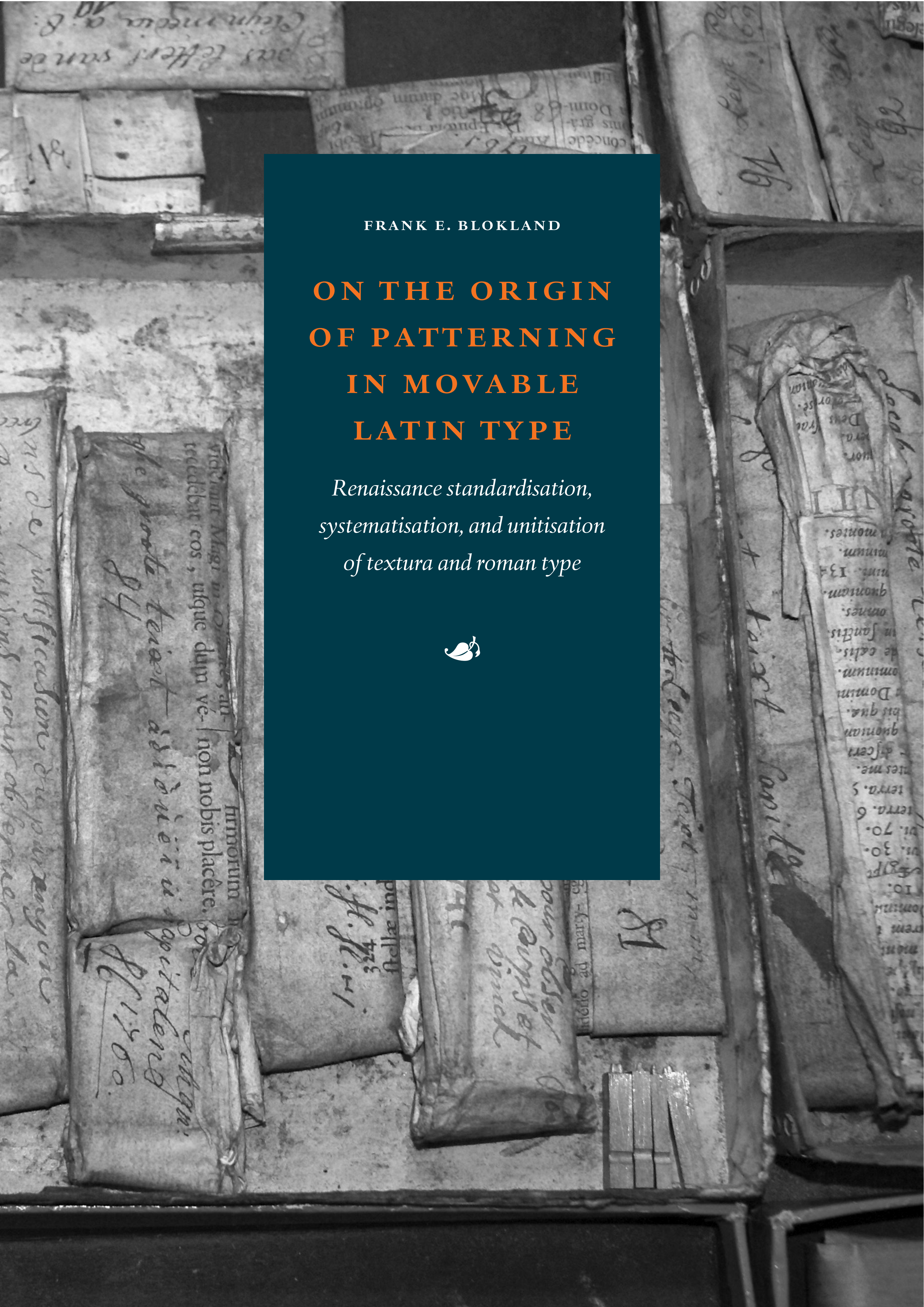
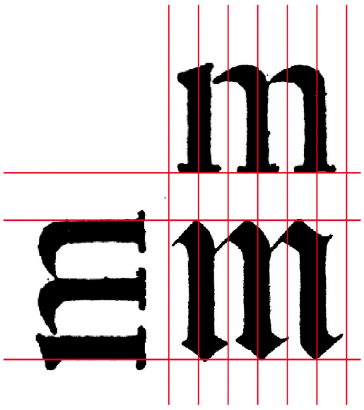
Author: Blokland, F.E.
Title: On the origin of patterning in movable Latin type : Renaissance standardisation, systematisation, and unitisation of textura and roman type
Issue Date: 2016-10-11



FRANK E. BLOKLAND

ON THE ORIGIN OF PATTERNING IN MOVABLE LATIN TYPE

Renaissance standardisation, systematisation, and unitisation of textura and roman type



ON THE ORIGIN OF PATTERNING IN MOVABLE LATIN TYPE

Renaissance standardisation, systematisation, and unitisation of textura and roman type

Proefschrift

Ter verkrijging van de graad van Doctor
aan de Universiteit Leiden
op gezag van Rector Magnificus
Prof.mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
ter verdediging op 11 oktober 2016
klokke 11:15 uur
door

Frank Eduard Blokland
geboren te Leiden in 1959

Promotores

Prof.dr. Adriaan van der Weel

Prof. Frans de Ruiter

Promotiecommissie

Prof.dr. Yra van Dijk

Prof.dr. Paul Hoftijzer

Dr. Roy Millington
University of Sheffield

Prof.dr. Bert Willems
Universiteit Hasselt

This dissertation is typeset in DTL Haarlemmer and DTL Haarlemmer Sans.

The serifed type was designed by the author –based on drawings by Jan van Krimpen– in 1995.

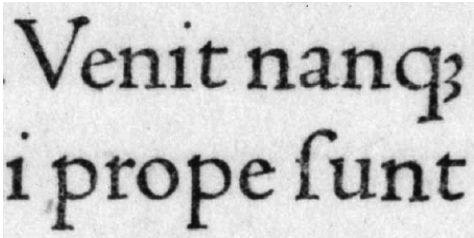
The sans-serif version was added by him a couple of years later.

TABLE OF CONTENTS

I. GLOSSARY OF TERMS

The reader may not be familiar with all historic and technical terms mentioned in this dissertation. In the following glossary, a number of these terms are explained.

Archetypal model (for roman type)



The type Nicolas Jenson applied in 1470 for the tractate *De Præparatione Evangelica* is generally considered the first roman type of high quality. It was not the first roman type: it was predated by the type Sweynheym and Pannartz used for Cicero's *De Oratore* in 1465 (although even this one may have been anticipated by a roman type applied in Strassburg a few months earlier).[1] Nevertheless, Jenson's roman type formed the basis for Francesco Griffo's roman types from 1495 and 1499, which in turn formed the basis for the French Renaissance roman types by Claude Garamont, Robert Granjon, and Hendrik van den Keere (these punchcutters are briefly introduced in the next glossary). The types of Garamont in particular have been of great influence on the works of his successors since the sixteenth century and continue to form the basis for the conditioning of typographers today.

Although Stanley Morison considered it to be a matter of taste whether Griffo's roman types were an improvement upon those of his illustrious predecessor,[2] I will argue in this dissertation that Griffo made direct use of Jenson's standardisation of character widths. Because Griffo's French-Renaissance successors also used the same proportions, Jenson's roman type is called archetypal.

---

[1] Stanley Morison and Kenneth Day, *The Typographic Book 1450–1935* (London: Ernest Benn Ltd., 1963), p.26.

[2] Stanley Morison, *Four Centuries of Fine Printing* (London: Ernest Benn Ltd., 1949), p.25.

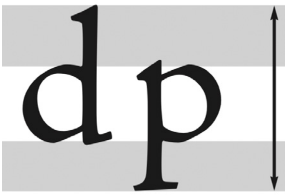
Ascender

Parts of the lowercase letters that stick out above the top of the x-height, such as the ascenders of the b, d, h, k, and l, and the terminal of the f.

Baseline

The line on which the upper- and lowercase letters and all other characters stand.

Body (size)



The body size or body of a typeface is the distance from the top ascenders to the bottom of the descenders. Whether the f, or any other letter with an ascender, or the g, or any other letter with a descender, is taken for measurement differs per punchcutter or type designer. Moxon writes in *Mechanick Exercises* that ‘By Body is meant, in Letter-Cutters, Founders and Printers Language, the Side of the Space contained between the Top and Bottom Line of a Long Letter.’ An example of such a long letter is the capital J.[3]

The body size does not by definition equal the body of movable type, which is the vertical dimension of the rectangle on which the letters are cast. The height of the cast type can be identical to the body size, but foundry type was usually cast on a slightly larger rectangle.

---

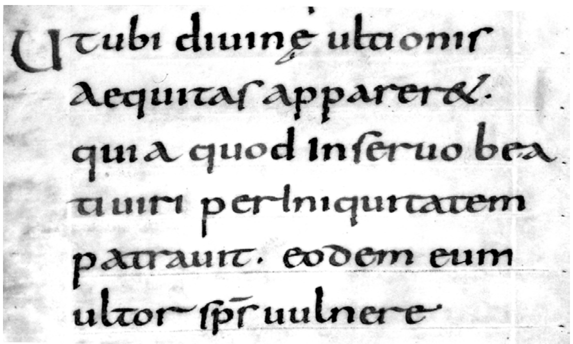
[3] Joseph Moxon, *Mechanick Exercises on the Whole Art of Printing (1683–4)*, ed. Herbert Davis and Harry Carter (New York: Dover Publications, 1978), p.102.

Moxon's definition is annotated by Davis and Carter as being 'Not a good definition because letters are often cast on a body larger than it need be. It is the dimension of type determined by the body of the mould in which it was cast (from the punchcutter's point of view: "is intended to be cast").'[4] The reason for casting letters on a larger body was to incorporate some extra distance between lines. In later times letters were cast on lower bodies and strips of metal were used for this separation, which is called 'leading'.

Cadence units

These units are part of a unit arrangement system that was developed as a result of this research on standardisation of the Renaissance type production. These cadence units are the result of a division of the stem interval of the lowercase letter n, indicated with 'A' in the image above. The distance from a side bearing to the centre of the counter equals the stem interval. The resulting character width (twice as large as the stem interval) can be divided into smaller units by either bisecting the aforementioned distance or by dividing it into an arbitrary number of units. The cadence unit arrangement system makes it possible to artificially fit type.

Carolingian minuscule (Caroline minuscule)



The Carolingian minuscule is the formal book hand from around 800: '[…] under the rule of Alcuin of York, who was abbot of St. Martin's from 796 to 804, was specially developed the exact hand which has received the name of the Carolingian

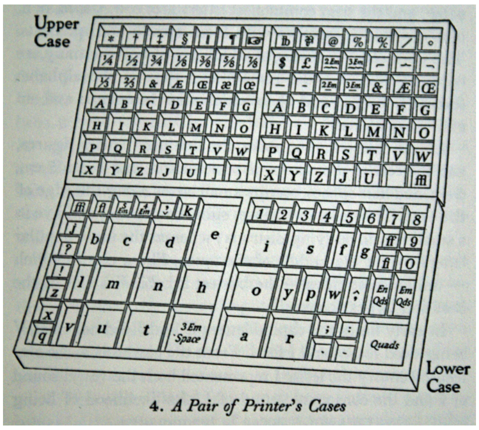
---

[4] Moxon, *Mechanick Exercises*, p.102.

Minuscule.'[5] Carolingian refers to Charlemagne: 'The term Carolingian, or Caroline, rests on the belief that the script sprang full-grown from the brain of Charlemagne, with Alcuin standing by as midwife.'[6]

The Carolingian minuscule formed the direct basis for the Humanist minuscule in the fifteenth century. The most generally accepted theory is that the Carolingian minuscule was mistakenly attributed to the ancient Romans by the Renaissance humanists. The reason for this was that when the humanists handled the manuscript books that were copied in Carolingian minuscule hands from the eleventh and twelve centuries, they thought they were looking at hands from Roman scribes.[7]

Case (upper/lower)



A case is a wooden tray that is divided into compartments for the storage of foundry type.[8] From this case the typesetter picks the characters that he needs. The case is vertically divided into two segments: the upper case and the lower case. Both segments are divided into small compartments. The compartments in the upper case contain the capitals plus some additional characters. In the lower case the 'small' letters, also plus some additional characters, are stored. Upper- and lowercase are typical typographic terms. After all, written letters are not stored in cases. The calligraphic counterpart of lowercase letters is formed by minuscules.

---

5 Edward Maunde Thompson, *An Introduction to Greek and Latin Palaeography* (Oxford: The Clarendon Press, 1912), p.367.

6 Berthold Louis Ullman, *Ancient Writing and its Influence* (New York: Cooper Square Publishers, 1963), p.105.

7 Elizabeth Lewisohn Eisenstein, *The Printing Revolution in Early Modern Europe* (Cambridge: Cambridge University Press, 2005), pp.134,135.

8 Daniel Berkeley Updike, *Printing Types: Their History, Forms and Use* (Cambridge, MA: Harvard University Press, 1937), Volume 1, pp.20,21.

Casting (foundry type)

For the production of foundry type the matrix, which contains a hollowed (readable) image of a letter and which is mounted onto a mould, is filled with typefounders' lead. The latter hardens as soon as it has been poured into the shaft of the mould, and the caster has to make an abrupt vertical move, a strong shake, to get the lead into all details of the letter.[9] The caster has to be careful, because shaking the mould too hard may spill the lead over what Moxon describes as the mouth of the upper half of the mould. According to Lawson, between 2,000 and 4,000 casts were made by a caster every day that he worked.[10]

Character

This term is often used as a synonym for letter, or even to indicate any grapheme in a font, including signs and symbols. However, a letter is a unit from the alphabet and there are only 26 letters in the English alphabet and the Greek alphabet contains even fewer: 24 letters (Cyrillic: 32, Hebrew: 22, Arabic: 28, et cetera).[11] There are more graphemes required to represent the Latin, Greek, Cyrillic, Hebrew, and Arabic scripts. Frederic Goudy described the alphabet as 'a system and series of symbols representing collectively the elements of written

---

[9] Moxon, *Mechanick Exercises*, p.169.

[10] Alexander Lawson, *Anatomy of a Typeface* (London: Hamish Hamilton, 1990), p.389.

[11] Peter T. Daniels and William Bright (eds.), *The World's Writing Systems* (New York/Oxford: Oxford University Press, 1996), p.883.

language'.[12] I would like to narrow Goudy's description of the alphabet somewhat to 'the basic set of graphemes of a written language'. Alphabet-derived graphemes are generally composed of multiple elements and can therefore be referred to as 'characters'. As a result of this somewhat proprietary nomenclature, in the image above the lowercase e is a letter and the ê (a letter with a diacritic), a character.

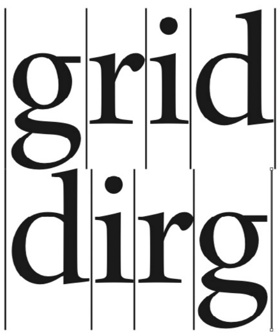
Character width

To make movable type, handwritten letters were adapted and moulded into rectangles. This system remains unchanged today, and digital characters are also placed on a (virtual) rectangle. Each character on such a rectangle has –as much as possible– an equal amount of space on either side. The total width of the rectangle (letter plus space) is called character width.

Descender

Parts of the lowercase letters that stick out below the baseline.

Fitting



---

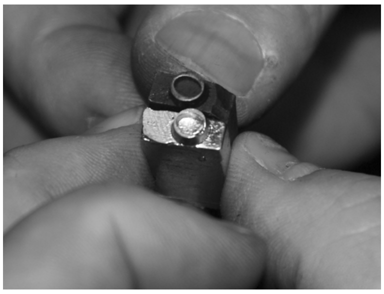
[12] Frederic William Goudy, *Typologia; Studies in Type Design and Type Making* (Berkeley: University of California Press, 1977), p.124.

This is the process of spacing movable-type characters in such a way that, irrespective of the sequence in which the letters are placed, there is always equilibrium of white space. Traditionally, spacing is done by eye, but in this dissertation a systematised alternative based on standardisations distilled from archetypal model is discussed.

Font

This is a set of related glyphs. This can be letters, characters, ornaments, symbols, or a collection of these. Normally they match in dimensions, weight (for example, light, regular, medium, and bold) and style (roman and italic). The number of glyphs in a set depends on the system. A digital single-byte font can contain up to 256 glyphs (2^8) and a double-byte font up to 65536 glyphs (2^16). In the times of foundry type, a font contained a collection of glyphs that were cast on the same body. Moxon uses the word 'fount' in his description. According to Davis and Carter the form 'font' is older and comes from the French 'fonte', which was in use by 1523.[13] The pronunciation of font and fount is identical.[14]

Foundry type



This is movable type cast for manual typesetting. Until the end of the nineteenth century the casting of foundry type was done manually with a typefounder's hand mould. In later times foundry type was also occasionally cast with the 'hot metal' Monotype casters. These machines were actually meant to cast lines of movable-type text. After printing with the lines, the letters were melted again and new letters were cast; the applied alloy was therefore softer than the ones used for 'real' foundry type.

---

13 Moxon, *Mechanick Exercises*, p.19.

14 Robert Bringhurst, *The Elements of Typographic Style* (Vancouver: Hartley & Marks Publishers, 1996), p.233.

Glyph

This is a formalised and fixed (as synonym for incised, engraved, photographed, or digitally stored) language(s)-specific graphical unit (grapheme) that represents a letter or character. The fixed image of a glyph is meant for repetitive use. However, glyphs used to represent a certain character can very much differ. For example, the lowercase letter a can be represented by many different glyphs (see image above).

Gothic type (blackletter)

This is a container term for type that is related to the gothic art in the High Middle Ages (ca.1000–1300) and the Late Middle Ages (ca.1300–1500). It comprises the textura and the rotunda models, which are discussed in this dissertation, but also models that are related to our present-day cursives: schwabacher and fraktur. An alternative name for gothic type is 'blackletter'.

Gothic type was not obsolete immediately after the introduction of roman type; the nature of the publications (classical, ecclesiastical, historical, etcetera) determined the sort of type that was applied. Although Jenson became famous because of his roman type, he cut and applied more gothic type.[15] In 1474 Jenson produced his first two editions in gothic type and from that time on Jenson applied his roman type only occasionally.[16] Clearly roman type did not immediately replace gothic type in the South of Europe and this delay was even more pronounced in North-West Europe. A century later, when Christoffel Plantin published his *Index Characterum*, gothic type was still in use, although 'Plantin had come a long way toward naturalising roman as the plain printing type of his gothic region.'[17]

Grapheme

Graphemes are the units that make up a writing system. In general, they are the graphical equivalents of phonemes, which are the basic units of spoken language.

---

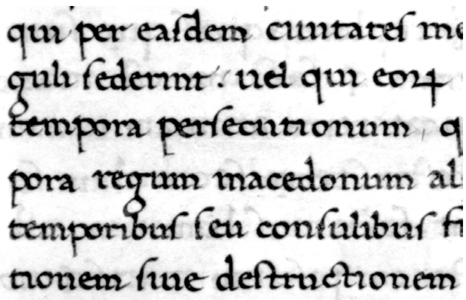
[15] Martin Davies, *Aldus Manutius, Printer and Publisher of Renaissance Venice* (London: The British Library, 1995), p.8, and Stanley Morison, *Type Designs of the Past and Present* (London: The Fleuron, 1926), p.15.

[16] Martin Lowry, *Venetian Printing: Nicolas Jenson and the Rise of the Roman Letterform* (Herning: Paul Kristensen, 1989), p.23.

[17] Christopher Plantin, *Calligraphy & Printing in the Sixteenth Century*, ed. Ray Nash (Antwerp: Plantin-Moretus Museum, 1964), p.56.

Graphemes comprise letters, syllables, characters, numerals, punctuation marks (of which there are no equivalents in speech), ornaments, et cetera. One can consider this collection as a huge container with all variants of all informal and formal grapheme variants used or in use in a writing system, such as for instance capital, uncial, textura, rotunda, Humanistic minuscule, roman type, italic type, fraktur, et cetera. More information on graphemes and the system they are a part of can be found in Appendix 9: *Systems and models in type*.

Humanistic minuscule


qui per eaſdem ciuitateſ me
guli ſederunt. uel qui eorum
tempora perſecutionum q
pora regum macedonum al
temporibuſ ſeu conſulibuſ fi
tionem ſiue deſtructionem

This is a formalised variant of the Carolingian minuscule dating from the fifteenth century. The Humanistic minuscule formed the basis for roman type. It is attributed to Gian Francesco Poggio Bracciolini (1380–1459): 'It is not only one of the earliest approximately datable examples of humanistic script, […], but actually the very first.'[18] The uninterrupted construction of the Carolingian minuscule was emphasised in the Humanistic cursive: 'It was the generation of chancery clerks after Poggio, i.e. of the period after the middle of the fifteenth century, who discarded the intricate gothic cursive in favour of a rational humanistic cursive.'[19] The Humanistic cursive is generally attributed to Niccolò Niccoli (1364–1437).[20] The Humanistic cursive formed the basis for italic type: 'It is in fact the kind of hand that led to the italic type fonts, just as the script of his friend Poggio was the prototype of the roman type fonts.'[21]

Incunable (incunabula)

Printed material, such as books and pamphlets, dating from the early years of printing with movable type until 1501.

---

[18] Berthold Louis Ullman, *The Origin and Development of Humanistic Script* (Roma: Edizioni di Storia e letteratura, 1960), pp.21,22.

[19] Stanley Morison, *Letter Forms: Typographic and Scriptorial* (New York: The Typophiles, 1968), p.142.

[20] Ullman, *The Origin and Development of Humanistic Script*, p.59.

[21] Ibid., p.60.

Italic (type)

This is generally used as a collective term for slanted letters, irrespective of their construction. It is also used as synonym for 'cursive'. The three variants of the lowercase a above show from, left to right, two cursive forms with an interrupted and uninterrupted construction respectively, and a sloped roman.

The first a finds its origin in the sixteenth-century chancery writing hands of the papal court in Rome. This was a formally written cursive, which means that its construction was interrupted to make the pattern more rigid. The a in the centre shows that the thin stroke goes all the way up to the top. A calligrapher could write this letter in one movement, hence its construction is uninterrupted. Gerrit Noordzij considers the left a to be a hybridised variant, an italic, of the cursive centre one.[22]

Justification (matrix, line)

Once a punch is struck in a copper matrix ('raw strike'), the matrix has to be adjusted and refined before it can be used for casting. This process is called justification. The term is also used for the alignment of text at the right margin to prevent fraying. This is achieved by evenly distributing the remaining space at the end of a line after the application of standard word spaces. The size of word spaces can also be evenly reduced to let a (part of a) word fit on a line.

Kerning

This is the overlapping by letter parts of the character width of the adjacent letter, like the terminal of the long s in the image above. Kerning is typical for

[22] Gerrit Noordzij, *The Stroke of the Pen: Fundamental Aspects of Western Writing* (The Hague: Koninklijke Academie van Beeldende Kunsten, 1982), p.33.

typography; the calligrapher never has to define the beginning and end of the width of the character, and letter forms freely enter each other's space. If necessary, their forms will be adapted spontaneously.

In the case of foundry type, kerning may result in collisions with parts of other letters. One way to circumvent this is with the use of ligatures. Another solution is to provide variants for certain combinations, like an f or a long s with a short terminal. In present-day digital technology, the term kerning is used to indicate corrections to the spacing of letter pairs. These corrections can either be positive or negative, i.e., the space between two characters can be enlarged or reduced. In most cases the correction will be negative and hence will result in an overlap of the character width of the adjacent letter. In digital fonts the corrections are defined in tables containing kerning pairs.

Lead (typefounding)

This is an alloy that is primarily made of lead, which is mixed with tin, antimony, and copper. At Plantin's printing office in about 1580 an alloy was used that contained 82% lead, 9% tin, 6% antimony, and for the rest copper. In the twentieth century a different alloy was used for foundry type: 60% lead, 15% tin, 25% antimony, and a trace of copper.[23] Sometimes iron was added.[24] Plantin's alloy was not of the highest quality and Leon Voet explains that Plantin started to make his own metal after all his possessions were sold in April 1562, because it was quicker, or cheaper, or both.[25]

Ligatures

These are combinations of letters that together form one character. In foundry type a number of ligatures were required to prevent technical problems, such as the f-i and the f-l combinations. As a result of kerning, the terminal of the f would

[23] Lawson, *Anatomy of a Typeface*, p.389.

[24] Cornelis and Jacob Ploos van Amstel, *Beschrijving der letter-gieterij.* (Amsterdam: De Wed. van K. van Tongerlo en Zoon, 1768), first part, p.4.

[25] Leon Voet, *The Golden Compasses* (Amsterdam: VanGendt & Co, 1969–1972), Volume 2, p.106.

inevitably collide with either the dot on the i or the top of the l, and subsequently it would break off.

Other ligatures, such as the c-t one in the image above, were meant to control the spacing. The lowercase c contains quite a lot of trailing space because of its open counter, and sometimes it is preferable to force the c into the space of the next letter. Some of these combinations can also be found in the calligraphic precursors of roman type.

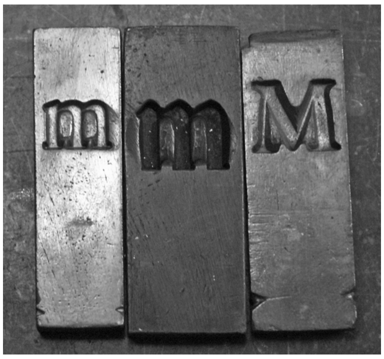
In the case of textura (type), ligatures can easily be formed for many letter combinations because most letters are made out of vertical strokes. Calligraphers used these to control the lengths of lines, and Gutenberg used a large number of such ligatures for controlling the justification of lines.

Today ligatures such as fi and fl are above all used for æsthetical reasons. If in a digitally typeset text the terminal of the f collides with the dot on the i nothing will break off, but it will probably not look nice. Throughout the years, ligatures have become a sign of well-made typography.

Letter model

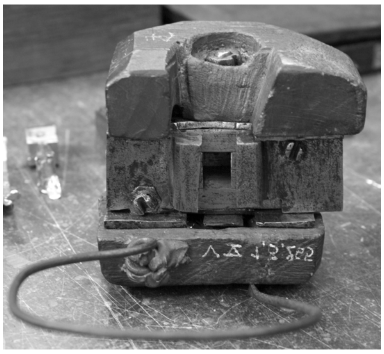
This is a geometric model, developed by the present dissertation's author, that captures the construction of textura and Humanistic minuscule, with the exception of those that contain diagonals and find their origin in the shapes of capital letters: k, s, v, w, x, y, z. The model maps the strokes which are repeatedly used by the calligrapher and also supports the idea that handwritten letters have a built-in standardisation, which was especially emphasised when calligraphic letter forms were transformed into movable type.

Matrix



This is a piece of copper (or very occasionally lead) into which a punch was struck.[26] Usually this was done with a hammer, but Carter mentions the later use of 'a striking', 'in which the punch is held firmly and upright whilst a screw, acting upon the top, presses it gradually into the copper. A vernier scale shows the depth to which the punch has been driven. This puts less strain on the punch than a hammer.'[27] After being justified the matrix was put in a mould for the casting of foundry type. Matrices were justified in such a way that after placing them in the mould the cast type had 'all the accuracy and finish required for printing.'[28]

Mould (typefounding)



This is a hand-held device for the casting of foundry type. The Dutch term 'gietfles', which literally translated means 'pouring bottle' exactly describes what it is. A typefounder's mould consists of two parts that are kept together by the caster's hand. The halves can be slid in one direction to control the width of the shank, of which the aperture can be seen in the centre of the mould in the image above. At the end of the shank the matrix is fixed with a large and easy to remove

---

[26] Voet, *The Golden Compasses*, Vol.2, p.63.
[27] Harry Carter, *Fournier on Typefounding* (New York: Burt Franklin, 1973), p.84.
[28] Ibid., p.89.

metal spring. Molten lead (actually an alloy) is poured into the shank and fills the image of the letter in the matrix.

In most cases each body size requires a different mould, although there are Renaissance moulds that allow the adjustment of the body. More information on moulds can be found in Chapter 6. The hand mould was used for production until well into the twentieth century, but from the middle of the nineteenth century the casting process became increasingly mechanised.[29]

Movable type

This term comprises the forms of type that find their origin in the system Gutenberg developed for typesetting and printing with separated letters. Gutenberg placed letters onto rectangles and, irrespective of their sequence, the spacing of these letters was uniform.

The Renaissance typesetters applied foundry type, and manual typesetting continued to be professionally practised into the twentieth century. Around the end of the nineteenth century the hot metal Monotype casting machine became an alternative for manual typesetting. Letters were cast and placed in line automatically, but were still movable. The typesetter could make corrections to the lines of cast text if necessary. This in contrast to line-casting machines, such as Linotype and Intertype, which produced solid lines of text.

Point size

The size of the body translates into typographic points, which are units for calculating dimensions of type and line spacing. Before the first point systems were developed in eighteenth-century France by Pierre Simon Fournier and

---

[29] Allen Hutt, *Fournier, the Compleat Typographer* (London: Frederick Muller, 1972), p.xi.

François Ambroise Didot,[30] body sizes were not indicated with points. In Dutch, body sizes had names such as 'Ascendonica', 'Parangon', 'Augustijn', 'Brevier', and 'Nonpareil'. In French the Parangon was called 'Petit Parangon' and Ascendonica was called 'Ascendonica Romain'. Some names were (almost) identical: the Dutch 'Nonpareil' was called 'Nonpareille' in French. In English the Dutch Parangon was called 'Paragon' and Ascendonica was called 'Double Pica'.[31]

The naming of the sizes was based on their use, the appreciation of the type (beauty), the region of origin, or something else. In Plantin's dialogue on calligraphy and printing one can read about the relationship between the application and naming: '[...] as in the composition of missals they called some missal types canon and petit canon de messel, glose de messel; letter de Cicéro, letter de S. Augustin, because they had been used to printing such authors with these types.'[32] And on beauty: 'Because of their great beauty some are called mignonne, nonpareille and paragon.'[33] And then he writes: 'Others have taken their names elsewhere, such as gros and petit canon, texte, two line tourné letters, gros trait, grand and petit bourgeois, letter batarde, letter de somme or modern, and letter de parchemin.'[34]

The naming of type could vary per region and, as Leon Voet noted In *The Golden Compasses*, which describes the history of the house of Plantin-Moretus, it is even possible that the names varied from one printing office to another.[35] The practice of naming the various sizes of type may have been a usage that was new in Plantin's early years: 'Different names were sometimes given to the same fount and two different founts might be referred to by the same term.'[36]

---

30 Updike, *Printing Types*, Vol.1, pp.26,31.

31 Hendrik Désiré Louis Vervliet, *Sixteenth-Century Printing Types of the Low Countries* (Amsterdam: Menno Herzberger & Co, 1968), p.16.

32 Plantin, *Calligraphy & Printing in the Sixteenth Century*, p.49.

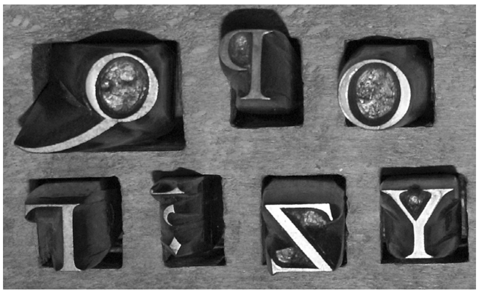
33 Ibid., p.53.

34 Ibid., p.53.

35 Voet, *The Golden Compasses*, Vol.2, p.55.

36 Ibid. p.55.

Punch



The oldest known publication on printing (type) was written by the Frenchman Loys Le Roi and dates from 1576. In 1594 it was translated by Robert Ashley and published in London. Le Roi's description is very brief and so is the part on the production of punches:

> To make Characters for imprinting, it is requisite to haue ponchions of steel, softned by the fire, on which they graue with counter-ponchions hardned, or grauing yrons steeled, the white which is within the letters: perfecting and smoothing the bodies of them with fyles, where they are eminent, or vneuen; not at the right ends, but at the contrarie: after they wet these ponchions in water to harden them, and then polish them, and do strike them into little peeces of fine copper [...].[37]

Christoffel Plantin's description of the punch in his dialogue on calligraphy and printing is concise too: 'This is a long piece of steel, on the end of which is engraved the desired character. [...] When it is done it is struck into copper and a matrix is made, which is nothing but the impression of the character struck, exactly as when a seal is impressed in wax.'[38] The way the shanks of the punches were cut could differ. Van den Keere made slight changes in his manner of shaping twice in his career.[39]

For cutting, the steel had to be relatively soft, but for striking into the copper matrix it had to be hard. In an annotation to Moxon's *Mechanick Exercises* it is mentioned that 'The best steel for punchcutting is one whose hard and soft tempers differ as much as possible and is least liable to cracking or distortion in passing from one to another.'[40] For cutting, the steel was softened by annealing the bars in a very hot fire and leaving them to cool slowly inside.[41] For hardening it, the end of the punch containing the letter was brought to a red heat and then cooled in

---

37 Loys le Roi, *On Printing* (Loughborough: The Plough Press, 1974), p.6.
38 Plantin, op.cit., p.41.
39 Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.31.
40 Moxon, *Mechanick Exercises*, p.106.
41 Carter, *Fournier on Typefounding*, pp.30,31.

cold water. Fournier's description of the hardening process makes it clear that this was far from easy:

> It is this struggle between hot and cold that closes up and compresses the pores of the steel and hardens it, and it is the right degree of heat in the punch and cold in the water that gives the right degree of hardness to the steel.[42]

The counterpunch was used for striking counters of letters into punches. Instead of engraving parts, such as the insides (counters) of the lowercase b, n, and o, these were cut on separate punches. The counter of the b could then also be used for the d, p, and q.[43] The strike with the counterpunch, if properly impressed, provided a quicker and neater result than could be achieved by cutting.[44] There were even counter counterpunches used occasionally. For striking steel into steel the receiving part had to be even softer than for engraving. Fournier provides a recipe for that too.[45] If counterpunches were used, the side of the punch on which the letter was cut (the 'Face') was larger than if all parts of the letter were cut. This prevented cracking when the counterpunch was struck, which required force.[46]

Punchcutting

As the name of the profession reveals, the punchcutter cut punches. In the period from 1450 until 1500, the complete typefounding process, which included the cutting of punches, the striking and justification of matrices, and the casting of type, was the work of a single person. In later times these activities were also split

---

42 Ibid., p.78.
43 Ibid., p.29.
44 Theodore Low De Vinne, *The Practice of Typography* (New York: The Century Co., 1900), p.16.
45 Carter, *Fournier on Typefounding*, p.31.
46 Moxon, *Mechanick Exercises*, p.101.

depending on the needs of the market.[47] Letters, for example, were cast from third-party matrices.

Cutting punches manually was practised in a manner that remained unchanged between the Renaissance until late into the twentieth century, although after the release of Linn Boyd Benton's matrix-engraving pantograph in 1884, punchcutting was no longer a prerequisite for producing matrices.[48] A famous twentieth-century punchcutter was Paul Helmuth Rädisch, who worked closely with Jan van Krimpen. Rädisch combined the old punchcutting technique with a more modern photographic one, as described in Appendix 5.2.

Fournier describes 'the art of the punchcutter' as follows: 'to know the best possible shape that can be given to letters, and their proper relation to one another, and to be able to reproduce them upon steel so that they may be struck into copper to make the matrices by means of which the letters can ever after be cast in any numbers.'[49]

Raw strikes (matrix)

These are matrices that have been struck with a punch and are unjustified, which means that they have not been further prepared for the production of type. Due to the force required to obtain a proper impression of the image of the letter on top of the punch into the piece of copper, the latter is distorted. Matrices were traded both raw and justified.

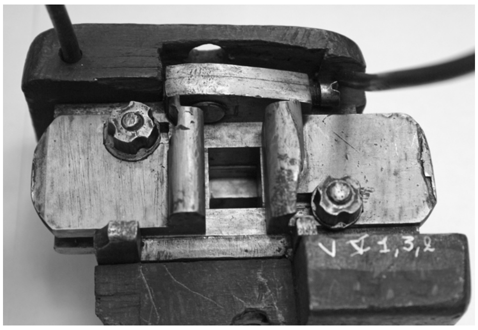
---

[47] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.12.

[48] Lawson, *Anatomy of a Typeface*, p.390.

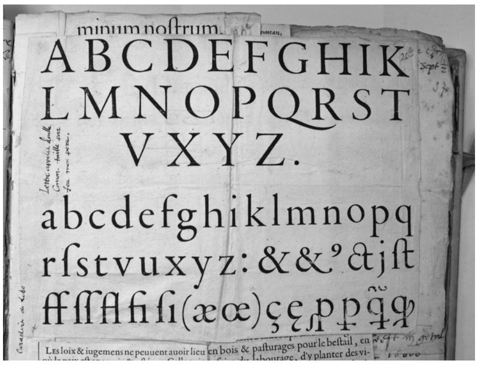
[49] Carter, *Fournier on Typefounding*, p.21.

Registers (moulds)



These were sliders at the bottom of the typefounder's mould for positioning the matrix in relation to the mould's shank. The offset of the matrix was determined with the mould's registers and hence so too was the position of the letter within its character width. Offset was required because otherwise the molten lead would leak out of the mould. The position of the mould's registers was fixed with nuts. In case the matrices were justified for fixed registers, the positions of the latter could remain the same for all letters from the same set. More information about these registers can be found in Chapter 6.

Roman type

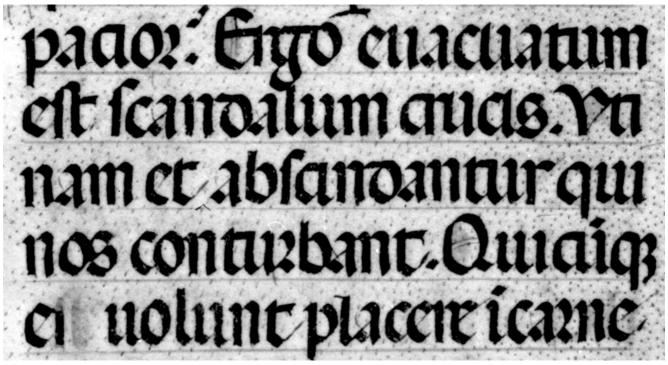


A collective term for type that finds its origin in the formalisation and standardisation of the Humanistic minuscule. Although there were a number of hybrid types combining gothic and Humanistic details, developed in Italy in the 1460s, the first roman is attributed to Johann and Wendelin da Spira (they migrated from Speier in the Rhineland to Venice, hence their surname) and was applied by them in 1469.[50] The archetypal model by Nicolas Jenson from 1470 was much more refined and thus became the basis and point of reference for later roman type. The Italian calligrapher Giovanni Battista Palatino (ca.1515–ca.1575)

50 Morison, *Type Designs of the Past and Present*, p.15.

was the first to use the term 'LettereRomane', instead of 'antique' or 'antiqua', or 'antiche' as employed by Pacioli and other writers.[51]

Rotunda


paciorꝰ: Ergo euacuatum
est scandalum crucis. Vti
nam et abscindantur qui
nos conturbant. Quicumq;
ci volunt placere i carne

A late gothic hand from Italy dating from around the beginning of the fourteenth century.[52] Although morphologically directly related to the textura, it combines the vertical stressing of strokes of the latter with a number of round letters. Another name for Rotunda is round gothic. As a type it was also applied North of the Alps –for instance by Christophe Plantin.[53]

Set patterns

These were collections of pre-cast type that were delivered together with matrices in case the matrices were not justified for casting with fixed registers. The caster could use these by putting a pre-cast letter into the related matrix and then enclosing it with the mould's registers. Consequently the caster did not have to check the spacing/fitting.

---

[51] Stanley Morison, *Pacioli's Classic Roman Alphabet* (New York: Dover Publications, 1994), p.81.

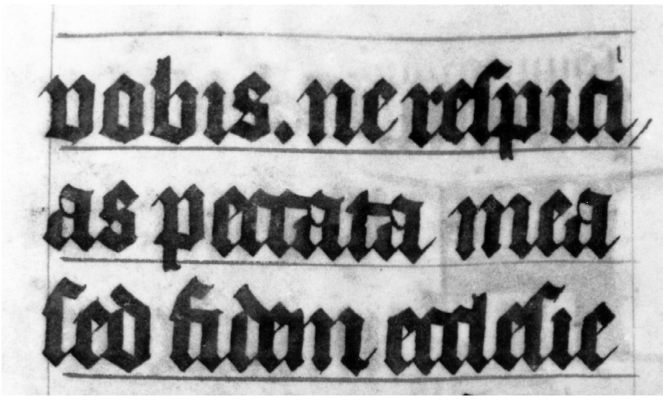
[52] Albert Kapr, *The Art of Lettering: The History, Anatomy, and Æsthetics of the Roman Letter Forms* (München: K.G. Saur, 1983), p.61.

[53] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.178.

Side bearing

These are the vertical boundaries that mark the character widths. In contrast with digital type, side bearings in movable type are physically present as the edges of the metal rectangles on which the letters are placed.

Textura



This is a collective term for variants of the Carolingian minuscule, in which the curvature is suppressed. The most formalised one, which was translated into type in the fifteenth century, is the 'textura quadrata'. A less formal variant that is less angular is known as 'textura rotunda'.[54]

Typefounding

This is a general term for the manufacturing of metal type. Typefounding was originally practised by the producers of foundry type, which was used for typesetting by hand. From the end of the eighteenth century the term also became applicable for type produced by casting machines, like the Monotype and Linotype hot metal typesetters.

---

[54] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.37.

Typesetting

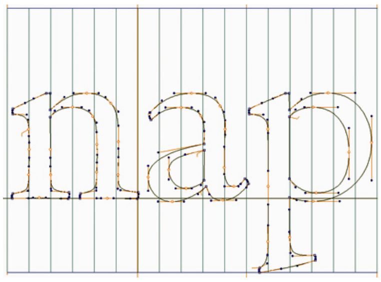
This is the process of composing lines with type. This can be done manually with foundry type, but can also be done using a keyboard for hot metal composing, photo typesetting, and digital typesetting. Until the rise of desktop publishing, typesetting was a separate profession that required special skills. Nowadays the graphic designer directly shapes digitally submitted texts.

Typography

In general, this is considered a formalised reproduction of handwriting, although some consider it to be more closely related to lettering. In the case of the latter, every letter is drawn or painted separately, for instance on a shop window. In *An Essay on Typography* Eric Gill describes typography as the reproduction of lettering via movable type.[55] The fact that Gill relates typography to lettering can be explained by the fact that he was a sculptor and letter carver. In his definition, the more handwriting-oriented Gerrit Noordzij put the emphasis on calligraphy by describing typography as writing with prefabricated letters.[56] Typographer and poet Robert Bringhurst describes typography as 'idealised writing'.[57]

With the invention of movable type came typography. The typographer restores the patterns from the type designer (punchcutter) and optimises the conditions in which the type has to function. Just like the calligrapher, the type designer creates patterns. However the type designer splits up the patterns into a collection of movable rectangles for distribution.

Unitisation (of type)



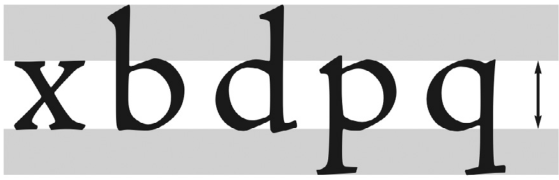
This is the translation of the proportions and widths of characters and word spaces into common denominators. This results in a unit-arrangement system.

---

[55] Eric Gill, *An Essay on Typography* (London: Lund Humphries, 1988), p.66.
[56] Gerrit Noordzij, *The Stroke: Theory of Writing* (London: Hyphen Press, 2005), p.49.
[57] Bringhurst, *The Elements of Typographic Style*, p.19.

Such a system can either be applied exclusively horizontally –for example to control the justification of lines– or it can also be used in a vertical direction to standardise the body size. In 1883 Linn Boyd Benton took out a patent for types made to units both in body and width. This was called 'self-spacing' type.[58]

x-height



This is the height of the lowercase letter x. In general the term is used to indicate the height of all (parts of) letters that equal or come close to the height of the x. Round letters, such as o, usually have, for optical reasons, some overshoot above and below the x-height; otherwise they would look smaller. Although less often used, the term X-height indicates the height of the uppercase letter X.

[58] Updike, *Printing Types*, Vol.1, pp.34.

II. GLOSSARY OF PUNCHCUTTERS

In this dissertation a small handful of punchcutters are placed into the spotlight, but there were many more. If one looks at punchcutters from the Renaissance Low Countries and France alone, one finds names such as Cornelis Henricszoon Lettersnijder, Jan Dinghelsche, Jan Thibault, Maarten de Keyser, Joos Lambrecht, François Guyot, Ameet Tavernier, Antoine Augereau, Pierre Haultin, Jacob Sabon, Jean Vatel, François Gryphius, Michel Du Boys, Charles Chiffin, Julien Du Clos, and many others. Today they are perhaps not as famous as the punchcutters mentioned in this glossary because their role in the history of printing type was limited, but nevertheless quite a lot of them produced great type.

Fournier, Pierre Simon (1712–1768)

French punchcutter, typefounder, and author of *Manuel Typographique, Utile aux Gens de Lettres, & à Ceux Qui Exercent les Differentes Parties de l'Art de l'Imprimerie* from 1764–66. This book contains directions for producing foundry type. Fournier criticised the Romain du Roi and is well known for his adage that the eye should rule.[59] Harry Carter writes about Fournier:

> His grasp of typography was so complete and so firm that he could venture into every corner of it, its literature, its history, its relation to greater things, writing, architecture, music. He was as much an artist as a mechanic, and to a less extent a man of letters.

[59] Carter, *Fournier on Typefounding*, p.9.

Garamont, Claude (ca.1510–1561)

Not much is known about Garamont's activities as punchcutter until 1540. Probably he entered the trade in 1535.[60] Still, according to Beatrice Warde (pseudonym: Paul Beaujon) one might say that too much is known about the cutter for a critical study of his work.[61] He was an apprentice to the punchcutter Antoine Augereau and was married to Guillemette Gaultier, a printer's daughter. His enterprise was not very commercially successful. However, for the development of roman type he was of great importance, because he fixed the model that found its origin in Jenson's archetypal one. In 1531 a series of roman types based on Griffo's type for *De Aetna* from 1495 was introduced by the French printers Simon de Colines and Robert Estienne and these types are attributed to Garamont.[62] The Garamont model is still preferred 'today as the most natural and invisible of typefaces,' as Hendrik Vervliet wrote in his article 'The Garamond Types of Christopher Plantin' from 1965.[63]

Garamont's name is often written as 'Garamond'. Vervliet writes in a footnote to his article that he makes a distinction between Garamont the punchcutter and the 'Garamond' types. Garamont's types are already indicated as such in specimens dating from the end of the sixteenth century.[64] Although I could not find any sources for this assumption, I once heard in the Museum Plantin-

---

60 Hendrik Désiré Louis Vervliet, *French Renaissance Printing Types* (New Castle: Oak Knoll Press, 2010), p.39.

61 Paul Beaujon, 'The 'Garamond' Types: xvi & xvii Century Sources Considered', *Fleuron Anthology* (London: Ernest Benn Limited, 1973), pp.181–213 (p.181).

62 Martin Lowry, *Nicolas Jenson and the Rise of Venetian Publishing in Renaissance Europe* (Oxford: Basil Blackwell, 1991), p.221.

63 Hendrik Désiré Louis Vervliet, 'The Garamond Types of Christopher Plantin', *Journal of the Printing Historical Society*, Number 1, (London, 1965), pp. 14–20 (p.14).

64 Leon Voet (et al.), *Inventory of the Plantin-Moretus Museum –Punches and Matrices* (Antwerp: Museum Plantin-Moretus, 1960), p.13.

Moretus that 'Garamond' was the result of stripping 'ius' from the latinised version of Garamont's name: Garamondius.

Granjon, Robert (1513–ca.1590)

French master punchcutter and printer who rivals Garamont when it comes to refinement and quality. He cut new type for Plantin, and he also adapted type by Garamont, making ascenders and descenders shorter for the Antwerp printer for the purpose of economising.[65] Granjon was a prolific punchcutter, producing on average two typefaces per year.[66] Vervliet calls Granjon 'a multinational avant la lettre' because he sold matrices to the whole of Europe.[67]

The italics of the digital revivals (a revival is an adaptation to the current technology of a historic typeface) Adobe Garamond and Garamond Premier are based on models by Granjon, although there are actually eight italics attributed to Garamont himself.

Griffo, Francesco (1450–1518)

Francesco Raibolini of Bologna, better known as Griffo, cut the punches for the roman type applied by Aldus Manutius in *De Aetna* (1495) and *Hypnerotomachia Poliphili* (1499). The punches of the two roman types were most probably cut directly on Jenson's model. Manutius's father-in-law Andrea de Torresani of Asola owned type from Jenson, so he had direct access to the model.[68] Griffo's roman type model dominated the trade from the end of the fifteenth to the middle of the seventeenth century.[69] Nowadays the roman from 1495 in particular is commonly in use, and still under the name '(Monotype) Bembo'.

---

65 Hendrik Désiré Louis Vervliet, *The Palaeotypography of the French Renaissance* (Leiden: Brill, 2008), p.216.

66 Vervliet, *French Renaissance Printing Types*, p.44.

67 Ibid., p.44.

68 Horatio Forbes Brown, *The Venetian Printing Press* (New York: G.P. Putnam's Sons, 1891), p.46.

69 Stanley Morison, *A Tally of Types: Cut for Machine Composition and Introduced at the University Press, Cambridge 1922–1932* (Cambridge: Cambridge University Press, 1953), p.32.

Gutenberg, Johann(es) Gensfleisch zum (ca.1398–1468)

German goldsmith to whom is attributed the invention of producing, and printing from movable Latin type. Gutenberg belonged to the family of Gensfleisch, a patrician clan from Mainz. This city was well reputed for the number and skills of its workers in precious metal. Johann's father was associated with the archiepiscopal print.[70]

Gutenberg's enterprise was complex and required huge investments.[71] The role of his invention for the distribution of information can hardly be overestimated. It is considered one of the most crucial developments in the history of civilisation,[72] and Gutenberg was therefore elected 'Man of the Millennium' in a poll by *The Sunday Times* at the end of 1999.

Jenson, Nicola(u)s (ca.1404–1480)

French engraver and master of the Royal mint at Tours, who became type founder and printer. Jenson is considered to have been the most competent technician in the typographic métier during his time. After studying printing and type founding

---

[70] Victor Scholderer, *Johann Gutenberg: The Inventor of Printing* (London: The Trustees of the British Museum, 1970), p.9.

[71] John Man, *Gutenberg, How One Man Remade the World with Words* (New York: John Wiley and Sons, 2002), p.149.

[72] Adriaan van der Weel, *Changing our Textual Minds* (Manchester: Manchester University Press, 2011), p.10.

in Mainz, he established a highly esteemed printing firm in Venice around the end of the 1460s. The possibility cannot be dismissed that he learned type founding directly from Gutenberg.[73] It is not certain that Jenson cut the gothic and roman types he applied himself; it is possible that he hired a punchcutter for the execution. In 1475 Pope Sixtus IV made Jenson a Count Paladine, which proves his status as type founder and printer in his time.[74] Jenson influenced the development of human communication not only during his life but also after his death, because of his reputation among his successors.[75]

Keere, Hendrik van den (ca.1540–1580)

Hendrik van den Keere the Younger of Ghent is considered the greatest Flemish punchcutter of the sixteenth century.[76] Voet writes in *The Golden Compasses*:

> Although his roman alphabets never quite equalled the elegance of his French models, they were nevertheless strongly designed, easily legible, and at the same time economical, because of their smaller ascenders and descenders. His speciality, however, was the 'flamande': his black letter alphabets were among the most beautiful ever designed. On 7th January 1568 he supplied Plantin with 21 matrices for fleurons and on 16th June 1569 he contracted to deliver strikes of a nonpareil gothic within five to six weeks. Orders did not become really frequent until after Granjon's departure, but from 1570 until his death in the summer of 1580, Van den Keere supplied Plantin with punches and matrices with unrelenting regularity, and supplemented or modified existing sets, greatly extending the Plantinian typographical collection. Altogether the Ghent craftsman delivered 44 sets of punches and matrices (14 roman, 14 Gothic, 1 cursive italic, 1 civilité, 2 Greek, and 12 music types), and also a number of fleurons and various signs.[77]

Van den Keere's Parangon Romain, which is considered by Vervliet to be 'one of the truly outstanding designs originating in the Low Countries,'[78] was adapted and enhanced for digital use by the author of this dissertation. The digital font family was released under the name DTL VandenKeere. Because Van den Keere never cut any italic type, work by his comtemporary François Guyot (d.1570) formed the basis for the accompanying italics.

---

73 Based on my investigations of Gutenberg's textura type and Jenson's roman type and the similarities of proportions between both types I consider this plausible.

74 Morison and Day, *The Typographic Book 1450–1935*, pp.27,28.

75 Lowry, *Nicolas Jenson and the Rise of Venetian Publishing in Renaissance Europe*, p.174.

76 Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.30.

77 Voet, *The Golden Compasses*, Vol.2, pp.73,74.

78 Vervliet, op. cit., p.252.

Moxon, Joseph (1627–1691)

Besides being a hydrographer, Joseph Moxon was also an instrument maker, a lexicographer, and a printer, a punchcutter, and a typefounder. His account of the typefounders' practice and printing, titled *Mechanick Exercises on the Whole Art of Printing,* from 1683–84 has become especially famous and is often cited, including in this dissertation. *Mechanick Exercises* is the oldest detailed source of information about the typefounders' practice. The only other source is Fournier's *Manuel Typographique, utile Aux Gens de Lettres* from 1764–1765. Because no information is known from the times of Gutenberg and Jenson, Moxon's and Fournier's descriptions are often projected on the Renaissance typefounders' practice. In this dissertation this projection is questioned.

The first evidence of Moxon's activities as punchcutter and typefounder dates from 1667. He printed a type specimen sheet in 1669.[79] Moxon was not trained as punchcutter or caster: 'He himself said that he had never been properly taught the art of type-founding, but had taken it up solely through his interest in the subject – as was the case with many celebrated type-cutters before and since.'[80] Moxon's types are not highly regarded, but *Mechanick Exercises* is an impressive account of the seventeenth-century typefounder's practice.

79 Moxon, *Mechanick Exercises*, pp.xxxv,xxxvi.

80 Updike, *Printing Types*, Vol.1, p.9.

minium noſtrum. euneau,

A B C D E F G

L M N O P Q

V X Y Z

Lettre appellee double
Canon. taille par
feu mon pere.

a b c d e f g h i k l m

r ſ s t v u x y z : &

ff ſſ ſt fi ſi (æ œ) ç

LEs loix & iugemens ne peuuent auoir lieu
où la paix eſt aneantie & oſtée. Celle paix
doit eſtre refuſée laquelle cache ſouz ſoy la

en bois & paſturage
n faire du labourag
, cela eſt bien difficil

III. INTRODUCTION

Yet any attempt to dissuade 'experts' away from this entrenched thinking about letters, serifs etc., by the usual means, would undeniably be difficult.[81]
Edward M. Catich

Over the past twenty-nine years as Lecturer and Senior Lecturer in the fields of writing and type design at the Royal Academy of Art in The Hague (KABK), I developed an educational program initially targeted at the first-year students of the Graphic Design department, and later expanded to the requirements of the second- and third-year students. The program especially focuses on the origin of letterforms and how they harmonically and rhythmically form patterns (words). This requires a detailed description of the harmonics, patterns, and dynamics in writing, lettering, type design, and typography. The students are guided during their investigation and exploration of the underlying structures of type and typography with the help of theoretical models and related software, which I created in the course of time.

In line with my predecessor and tutor at the KABK, the Dutch type designer, calligrapher, and author on typography Gerrit Noordzij (1931), and his illustrious precursor, the British calligrapher and author on calligraphy Edward Johnston (1872–1944), I consider writing with broad nib, flat brush, and flexible-pointed pen a good starting point for exploring matters like construction, contrast, contrast sort, and contrast flow. Chirographic practice has proven to be a solid basis for designing type and for gaining insight into the basics of typography. Particularly for the development of a refined and sophisticated 'hand', writing remains an important factor today. Famous type designers *and* calligraphers like Jan van Krimpen (1892–1958), Hermann Zapf (1918–2015), and Noordzij have convincingly provided evidence for this with their typefaces. The American typographer and type designer Bruce Rogers (1870–1957) underlined the importance of writing when he noted in a letter to Van Krimpen that the italic of Lutetia could hardly have been produced by any other than an accomplished calligrapher.[82] However, I do not think that writing is a prerequisite for designing type, nor for a thorough understanding of the basics of typography.

---

[81] Edward M. Catich, *The Origin of the Serif: Brush Writing & Roman Letters* (Davenport: Catich Gallery, 1991), p.5.

[82] Bruce Rogers, *Pi: a Hodge-Podge of Letters, Papers, Addresses Written During a Period of 60 Years* (Cleveland: World Publishing Co., 1953), p.49.

Translating handwriting into type is not very straightforward. My experience is that, despite the fact that one can emphatically train students to purely work directly from their own writings, they often start to define grids with rulers before drawing letters. Many have the tendency to look at existing typefaces to find the 'correct' proportions, irrespective of the fact that they were supposed to find these proportions via writing. Meticulous patterning is a requirement for designing type; it is therefore difficult to distil these patterns from handwriting, especially if one is not an experienced calligrapher.

If type and patterning are inextricably connected, however, could it be possible that type also finds its origin in a form of patterning that does not find its direct origin in handwriting, and that such patterning even influenced and standardised the hands that postdate the invention of movable type? If so, would it also be possible to distil the origins of this supposed patterning from early Renaissance movable type? These questions alone were enough for me to start – more than nine years ago– research on possible standardisation, systematisation, and unitisation of textura and roman type.

Note on perception and interpretation

In *Early Typefounders' Moulds at the Plantin-Moretus Museum* Mike Parker notes that little is known of very early typefounders' moulds.[83] In fact, there is no documentation on the production of type dating from the early days of typography at all. Everything written on Renaissance type production so far is a projection of seventeenth- and eighteenth-century descriptions of type-foundry practices. These sources put a lot of emphasis on the role of the eye. Is it perhaps possible that later punchcutters could mostly rely on the eye because for them optical judgment took for granted the underlying patterns, almost unconciously? Was it simply the framework in which things were done?

In comparison to punchcutters, present-day digital type designers have the almost unlimited freedom to define the proportions and widths of characters. This also makes it possible to emphasise optical matters. As I aim to prove, this freedom was not available in the early days of typography and should therefore not be used to explain the proportions of typographic letterforms that have been an

[83] Mike Parker, 'Early Typefounders' Moulds at the Plantin-Moretus Museum', *The Library*, Fifth Series, Volume xxix, No.1, (Oxford: Oxford University Press, 1974), pp.93–102 (p.93).

intrinsic and salient characteristic of typography since the second half of the fifteenth century.

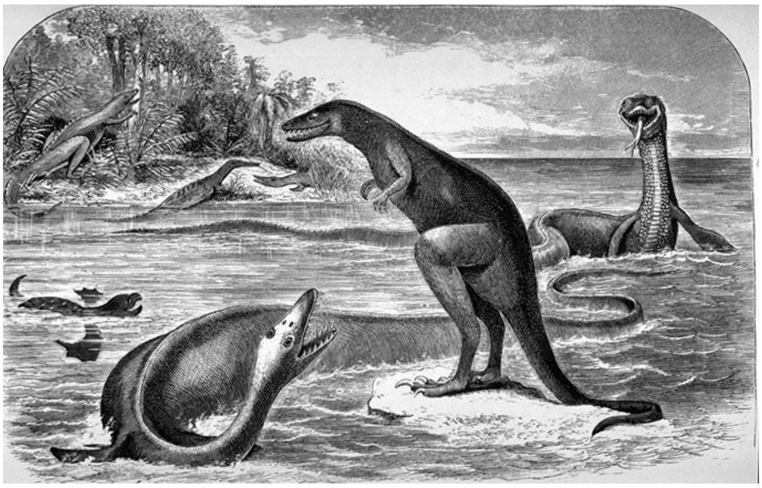


Figure III.2 Nineteenth-century engraving showing the Elasmosaurus (left) with the head on the tail.

What does the present-day type designer actually see? I like to metaphorically illustrate the perceptual aspect of type patterns with the image of the Elasmosaurus in Figure III.2 (bottom left). In the nineteenth century the palaeontologist Edward Drinker Cope reconstructed the skeleton of an Elasmosaurus platyurus, and he erroneously mounted the head on the tail. Roughly two decades later a colleague discovered the mistake: the tail turned out to be shorter than the neck. Obviously for Cope this was an unexpected proportional relationship between the two body parts. Cope (inadvertently?) manipulated the drawing of Figure III.3 by not including the back paddles, which were actually front paddles that simply did not support his theory.[84]

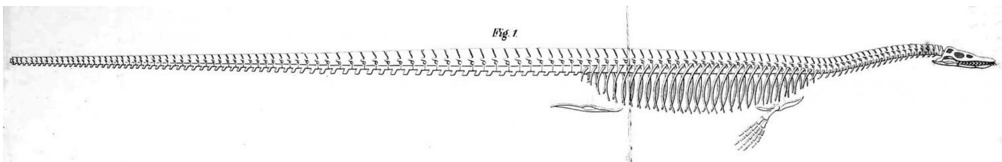


Figure III.3 Part of the 'head-on-the-wrong-end' Elasmosaurus platyurus.[85]

The story of Cope's mistake illustrates the fact that the power of the human eye is purely relative to the anatomy of the things perceived. In *Art and Illusion* art historian Ernst Gombrich, in a passage about this phenomenon, notes that the

[84] <http://en.wikipedia.org/wiki/Elasmosaurus>

[85] <http://www.archive.org/download/synopsisofextincoocope/page/n112_w742>

stimulus patterns on the retina are not alone in determining our picture of the visual world, and that its messages are modified by what we know about the 'real' shape of objects.[86] Letter carver and type designer David Kindersley defined the matter more simply as: 'It is a commonplace that we see only what we know […].'[87]

Figure III.4 Han van Meegeren in front of one of his 'Vermeers'.

Kinderley's statement was supported by the forgeries that were painted by Han van Meegeren (1889–1947) in the style of Johannes Vermeer during the first half of the twentieth century (Figure III.4). Van Meegeren cleverly took revenge on experts, who in his opinion did not take his œuvre seriously enough. According to these experts it was likely that in his younger years Vermeer had painted in Caravaggio's style. However, there was no proof to support this theory. Van Meegeren provided what experts wanted to see, in this way underlining their expertise and essentially dazzling them in such a way that they did not see through his forgeries.

If we look at Van Meegeren's forgeries nowadays, it is difficult to recognise Vermeer in them. What one sees is also influenced by the *zeitgeist*, and, of course, today we know more about Vermeer and his practice than the experts did roughly 100 years ago. One's perception is influenced by many factors. For example, if one looks at type applied in incunabula with the eye of a calligrapher it is possible that certain details, like the positioning of diacritics or the shape of serifs, can be

[86] Ernst Hans Josef Gombrich, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (Oxford: Phaidon, 1987), p.255.

[87] David Kindersley, *Optical Letter Spacing: for New Printing Systems* (London: The Wynkyn de Worde Society, 1976), p.35.

explained by the way in which a calligrapher would write driacritics and stroke endings. Such an explanation could differ from one that takes the technical aspects of Renaissance movable type into account. After all, one cannot see more than one knows. In the following chapter I provide some examples of this fact.

A factor that makes perception matters even more complex is the *willingness* to adapt one's viewpoint to new scientific insights. A famous case, although not related to type and typography, is Afred Wegener's 'supercontinent' Pangea, in which, like in the case of the Elasmosoraus, fossils also played a role. This German geologist and meteorologist claimed that about 300 million years ago the continents formed one mass of land.[88] One of Wegener's arguments was that fossils of specific prehistoric species were discovered in both Western Africa and South America.[89] Only the continents drifting apart could explain this (although some scientists proposed the existence of land bridges between the continents as alternative). In 1915 he described his theory in the book *On the Origin of Continents and Oceans*.

Wegener's theories were basically ridiculed by the established scientists. Colleagues even warned him that his heretical ideas would befog the minds of students. Wegener's radical viewpoint clearly threatened the authority of fellow scientists, and they just could not, or did not, want to believe that the foundation of their points of view was incorrect. The argumentation against Wegener's model was sometimes hilarious; for example, the geologist R. Thomas Chamberlain remarked: 'If we are to believe in Wegener's hypothesis we must forget everything which has been learned in the past 70 years and start all over again.'[90]

In the 1960s when the old generation of geologists had disappeared from the scene, Wegener's theories were proven to be right, and they are now commonly accepted. It was Wegener's intention to have his theories openly discussed. Inspired by this, I set up a blog dedicated to my research a couple of years ago.[91] I also started discussions on type-related forums like Typophile and TypeDrawers. Of course, the exchange of thoughts and opinions was not always on an academic level, but from time to time it helped me to sharpen my arguments.

---

[88] Greg Young, *Alfred Wegener: Pioneer of Plate Tectonics* (Mankato: Compass Point Books, 2009), p.16.

[89] <http://www.scientus.org/Wegener-Continental-Drift.html>

[90] Ibid.

[91] <http://www.lettermodel.org>

IV. THEORETICAL CONTEXT, HYPOTHESES, METHODOLOGY, AND DISSERTATION STRUCTURE

This chapter will first introduce the theoretical context in which my research is situated, and will then outline the problems in this context that led me to formulate my thesis. Next, my research hypotheses will be presented and will followed by my research methodology.

Theoretical context

In eighteenth-century France, during the reign of Louis XIV, a committee formed by the Académie des Sciences developed geometric patterns for the construction of a new series of types for the exclusive use by the Imprimerie Royale, known under the name 'Romain du Roi'. This attempt to rationalise, standardise, and unitise the design and the production of type with the use of geometry and grids is generally considered a deviation from the earlier development of type. The theory is that this new type broke away from a tradition evolved under the influence of punchcutters such as Nicolas Jenson (ca.1404–1480), Claude Garamont (ca.1510–1561), and Robert Granjon (1513–ca.1590).[92] According to the literature, until the creation of the Romain du Roi the production of type was merely a mechanised and disciplined form of calligraphy without any form of systematisation. [93] This puts the emphasis on the eye of the punchcutter and disregards the possibility that systematisation may be an intrinsic part of font production. However, this emphasis on æsthetics is not grounded in any historic evidence. In this dissertation I bring this belief into question by making use of historical artefacts; my hypotheses are the result of questioning commonly embraced assumptions such as this one about the origins of roman and italic type. The following section illustrates the problems with the generally accepted belief that roman type was largely influenced by æsthetic rather than technical considerations.

Putting the dot on the i

If a letter is presented as an image, isolated from other letters and also dissociated from the requirements for its production, the way we look at it is affected. I once read on Wikipedia that Jenson's 'carefully modified' serifs follow an 'artful logic of asymmetry.' The idea that the shapes of serifs are the result of 'artful logic' is

---

92 André Jammes, 'Académisme et Typographie, The Making of the Romain du Roi', *Journal of the Printing Historical Society*, Number 1, (London, 1965), pp. 71–95 (p.71).

93 Morison, *Letter Forms*, p.30.

perhaps obvious if one looks at these letters as isolated images. If one realises that letters are meant to form words, and measurably centres Jenson's lowercase n between side bearings, the weight, or 'blackness', on the left side of the letter has to be reduced and on the right side increased in order to optically balance the letter in its width (Figure IV.1).[94] This can be achieved by shortening the serifs on the left, and lengthening the ones on the right. Increasing the thickness of the right-hand serifs will also help to optically centre the n.

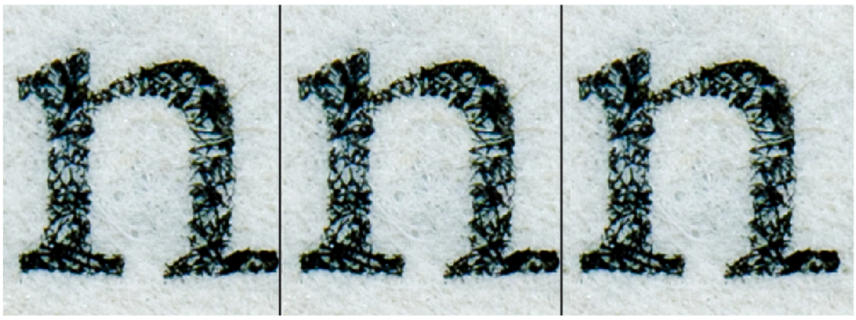


Figure IV.1 Jenson's original lowercase n centred between side bearings.

This approach is out of the scope of the work of present-day type designers, who mostly *optically* centre the letters *after* these have been designed. They adapt the space to the prefixed design instead of adapting the design to the prefixed width. Based on my research, I can only conclude that the latter was common practice during the Renaissance.

Figure IV.2 Jenson's lowercase n (left) and Griffo's lowercase n from *De Aetna*.

The 'artful logic of asymmetry' was not unique for Jenson's roman type. Also the Italian punchcutter Francesco Griffo (1450–1518) used the same structure in

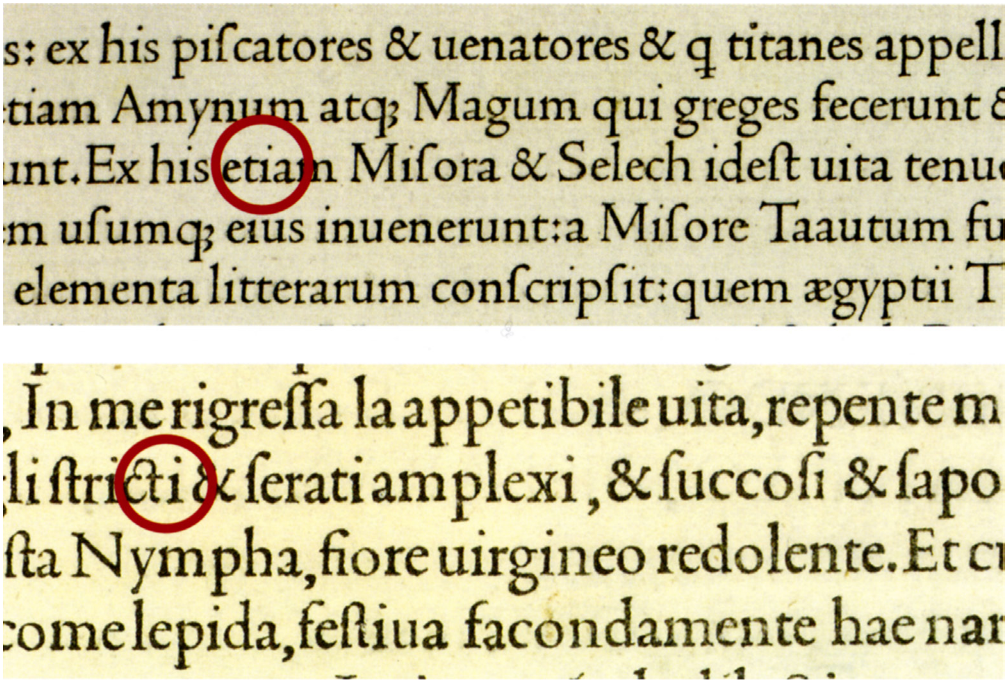
[94] Measurably in the meaning that the distances from both stems to the side bearings are identical. This is in contrast to centering optically, in which case the positioning of the letter is based on an even distribution of the black shape within its character width. See section 9.2 *Optical spacing*.

the typeface he cut for *De Aetna*, a book published by Aldus Manutius (1449–1515), the Renaissance printer who founded the famous Aldine Press at Venice, in 1495 (Figure IV.2). This structuring of the serifs was the result of a standardisation of the spacing process, which was directly related to the way Renaissance roman type was produced, as I will try to prove in this dissertation.

One cannot see more than one knows or wants to believe. The interpretation of prints from the Renaissance with the theory in mind that roman type is purely a direct translation of handwritten models could well differ from an interpretation that takes the technical aspects of the Renaissance type production more into account (without ignoring or denying the fact that there is a direct relationship between roman type and the predating handwritten models).

An example of how the interpretation of historic prints can be influenced by the adaptation of the theory that handwriting formed the direct basis for roman type can be found in the highly informative *Reading Letters, designing for legibility*. In this book, Danish type designer and author on typography Sofie Beier shows two details from Jenson's 'Eusebius' type from 1470 and Griffo's roman type used for the *Hypnerotomachia Poliphili* (1499), respectively (Figure IV.3). In the caption Beier states that the positioning to the right of the dot on the lowercase i was a common adaptation from the calligraphic hand.[95] The position of the dot on the i is apparently a minor detail, but extrapolated it can be of great importance to the way one looks at roman type.

[95] Sofie Beier, *Reading Letters, Designing for Legibility* (Amsterdam: BIS Publishers, 2012), p.53.


s: ex his piſcatores & uenatores & q titanes appell
tiam Amynum atq; Magum qui greges fecerunt &
unt. Ex his etiam Miſora & Selech ideſt uita tenu
m uſumq; eius inuenerunt: a Miſore Taautum fu
elementa litterarum conſcripſit: quem ægyptii T

In me rigreſſa la appetibile uita, repente m
li ſtricti & ſerati amplexi, & ſuccoſi & ſapo
ſta Nympha, fiore uirgineo redolente. Et c
come lepida, feſtiua facondamente hae nar

Figure IV.3 Positioning of the i's dot by Jenson (top) and Griffo.

If one isolates the i from the rest of the letters, like what is done with Jenson's lowercase n in Figure IV.3, then Beier's explanation is plausible. However, if one takes other surrounding letters into account, like the f and the long s, then the conclusion could differ. If one looks at the lengths of the terminals of the aforenamed letters from Jenson's and Griffo's roman types, then it is obvious that the offset of the i's dot is required to prevent collisions with the letters' terminals. These surpass the character widths, which is called 'kerning' (Figure IV.4), and they are hence highly vulnerable parts. If a terminal were to collide with the i's dot, it would rest on the latter and subsequently break off as soon as any pressure was put on it.

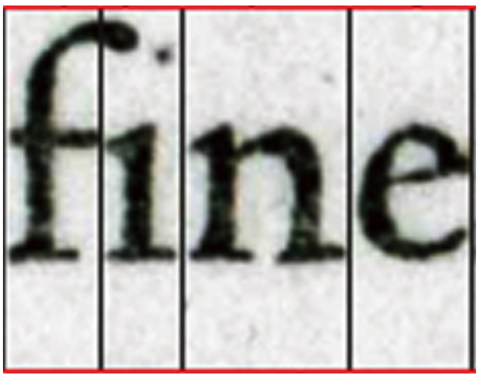


Figure IV.4 Part of the terminal of de f from Jenson's roman (left) is 'kerned'.

In Jenson’s roman type all diacritics are positioned relatively far above the top of the x-height and are in line with the i’s dot (Figure IV.5). Hence he also used the same offset for the diacritics to prevent collisions with the terminals of f and long s.

Figure IV.5 The positioning of diacritics in Jenson’s roman type from *De Evangelica Præparatione.*

In Griffo’s roman for the *Hypnerotomachia Poliphili* all diacritics, including the i’s dot, are lowered slightly. In addition, the dot is bolder. This is something the present-day typographer is accustomed to. Adobe Jenson shows that its i has obviously been adapted to this later standard. The terminal of the f has also clearly been shortened slightly (Figure IV.6).

Figure IV.6 The positioning of diacritics in Adobe Jenson.

The offset of the i’s dot in Griffo’s roman for the *Hypnerotomachia Poliphili* is much less to the right than in Jenson’s. Figure IV.7 shows that this is the case with all diacritics in Griffo’s type from 1499. Not surprisingly, the terminals of Griffo’s f and related long s are also much shorter than those of Jenson’s.

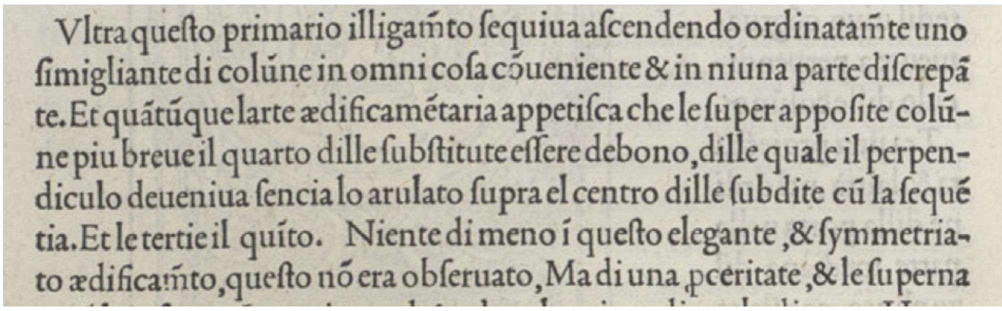


Figure IV.7 The positioning of diacritics in the *Hypnerotomachia Poliphili*.[96]

Both Jenson and Griffo treated the character widths of the f and long s identically, which resulted in a lot of space trailing the long s from Jenson's roman (Figure IV.8). One can think of several technical reasons for treating the f and long s identically. First, the offset of all diacritics works for both f and long s. Second, it makes the production of the long s and all related ligatures simpler because only the crossbar at the right of the stem of the f has to be removed to make a long s. A calligrapher never has to consider such technical issues.

Figure IV.8 A large space is trailing the long s in Jenson's roman.

It cannot be excluded that Jenson was inspired by calligraphic models when he extended the terminals of the f and long s. This could then have triggered the offset of the i's dot, but, in that case, the positioning of the dot was still required to prevent a technical problem.

The roman type that Sweynheym and Pannartz applied in *Opera* from 1469 (Figure IV.9), which predates the type from *De Evangelica Præparatione*, does not show much –if any– offset of the diacritics. The terminals of the f and long s from Sweynheym and Pannartz's type are so greatly extended that, as a result, they must inevitably have collided with the diacritics. After studying other prints by Sweynheym and Pannartz I tentatively conclude that alternate variants with shorter terminals of the f and long s were used if these letters were followed by

[96] <http://www.metmuseum.org/toah/works-of-art/23.73.1/>

accented characters.[97] This is in line with calligraphy because adapting letter shapes to contextual issues is exactly what a calligrapher can do so easily. As such, the absence of the offset of the i's dot in Sweynheym and Pannartz's type can also be put forward as proof for its calligraphic origin.

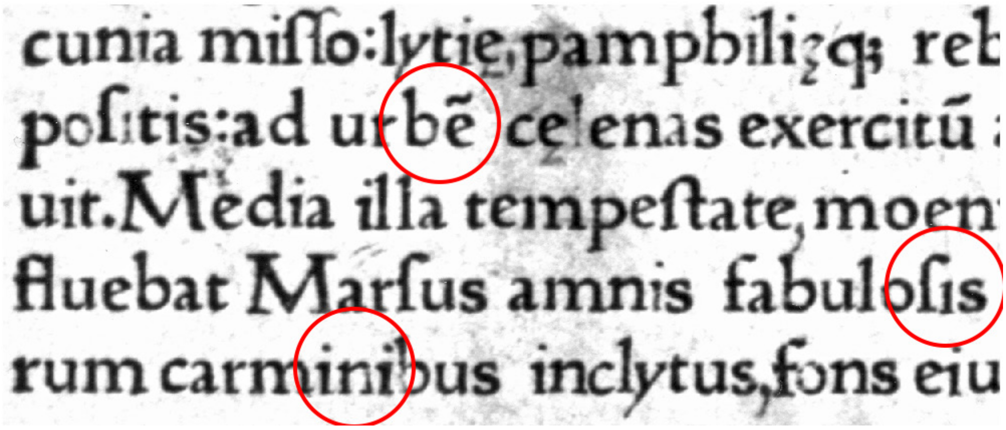


Figure IV.9 Sweynheym and Pannartz's type from *Opera* (1469).

Taking this into account, then, the conclusion that the offset of the i's dot is the result of a technical problem is at least equally plausible as the conclusion that it was an adaptation from the calligraphic hand. Although there was undeniably a direct relationship between roman type and its handwritten precursor –which is discussed in detail in Chapter 3– the Renaissance punchcutters had to deal with all kinds of technical aspects unknown to calligraphers.

This raises the question of whether certain details in roman type, other than the positioning of the i's dot, are the result of technical aspects rather than of the interpretation of calligraphic models. Taking the technical requirements for the Renaissance type production –*besides* the calligraphic aspect– into account when investigating the details of roman type, and by extension italic type, could provide more insight into the origins of the structure of roman and italic type, and especially their harmonics, patterns, and dynamics.

The analysis of a small detail such as the position of the dot on the i in Renaissance prints provides a good reason to investigate to what extent movable type finds its origin in calligraphy and to what extent technical requirements forced roman type to deviate from its handwritten origins. The extrapolation of the position of the i's dot could well lead to a completely different insight into the details of type and even into the basis of typographic conventions.

---

97 Contextual alternates are easy to implement in digital fonts nowadays. The replacement of the f with a shorter variant, for instance for combining it with a question mark, can be automatised. Hence this is done more and more by present-day type designers.

Hypotheses

Considering the differences between the handwritten models predating the invention of movable type, first textura and then roman type, is it possible that –at least to a certain extent– the proportions and details of roman type are the result of patterning? Later punchcutters could place a greater emphasis on the eye because for them, optical judgment took for granted the underlying patterns, almost without consciousness: it was simply the framework in which things were done. However, considering the fact that the Renaissance punchcutters were craftsmen who invented, organised and executed a complex and sophisticated production process, how likely is it that this was possible without an extensive structuring of handwritten letterforms? The question is: were the Renaissance archetypal models by Jenson, Griffo, and Garamont made with the use of patterns? And if this is the case, are harmonics and æsthetics in type, which are embedded in typographic conventions, not only the result of optical preferences predating the invention of movable type, but also of standardisation in the Renaissance type production? These questions lead to the main hypothesis of my dissertation:

– *The creation of roman type was influenced at least as much by technical as by æsthetic considerations.*

In order to support this hypothesis, I will investigate the following two sub-hypotheses:

– *Roman type is the result of the standardisation in the Renaissance of the Humanistic minuscule to the type production process. This is in analogy to the standardisation that took place when the already rather 'unitised' gothic hand was used as the basis for textura type.*

– *Æsthetic preferences in roman type continue to be conditioned by the early standardisation of roman type production.*

In support of the first sub-hypothesis, the first (and longest) part of this dissertation will closely examine the links between gothic and roman type, and between the latter and its handwritten origins. I will try to prove that the regularity of the written textura quadrata (gothic hand) made it relatively easy for the German printer and punchcutter Johann Gutenberg (ca.1398–1468) and consorts to standardise and systematise their movable gothic type, which was directly based on its written precursor. Once this was accomplished for textura type, it was natural to apply the same system to the new roman type (and decades later to italic type) due to the relationships between the gothic hand and the Humanistic minuscule, on which roman type was based. I will explore this relationship with the use of a geometric letter model, which I developed through the course of my research. I will then also use this model to illustrate the differences between the humanistic minuscule and roman type. Then, I will try to demonstrate evidence of standardised patterns in roman type and propose a framework in which this standardisation was done.

In an attempt to support the second sub-hypothesis, I will discuss the flaws in the generally accepted theory that roman type was largely the result of æsthetic considerations. I will argue that what we find optically appealing in Latin type is – at least partly– the result of the standardisation process. My aim is to prove that our present-day eyes are conditioned by the outcomes of this standardisation, and due to this we unconsciously use the roman and italic types from the early days of typography as points of reference.

The examinations and discussions in the context of these two sub-hypotheses should provide support for my main hypothesis that the creation of roman type was largely influenced by technical rather than æsthetic considerations.

Research methodology

There is unfortunately no known documentation about the production methods of the Renaissance punchcutters. One can only speculate about the reason for this. Perhaps there were no descriptions of the processes because these were deliberately kept secret from competitors? After all, the seventeenth-century Dutch punchcutter Dirk Voskens taught Hungarian Nicholas Kis for six months, but Kis later remarked that he would not instruct a countryman for one hundred thousand florins.[98] The lack of Renaissance documentation also automatically implies that what has been written on this subject so far is not based on original sources, but merely on the projection of seventeenth- and eighteenth-century descriptions of earlier times. And if there is no documentation, the best course of action is to distil information from Renaissance artefacts –not unlike archaeologists do– and to compare this with the information from later dates.

I measured punches, matrices, foundry type, prints, and in some cases also digital revivals. When taking such measurements one inevitably has to filter the distilled information. Details like the squash, which is the halo effect around the

---

[98] Lawson, *Anatomy of a Typeface*, p.386.

edge of printed areas in letterpress printing, and which may play a role when interpreting the image, do not have to influence the outcome of measurements as long as one does not measure mixed sources. In order to prevent mingling of distilled information, punches have to be compared with punches, matrices with matrices, foundry type with foundry type, and prints with prints (within the boundaries of a specific publication).

Figure IV.10 Granjon's *Ascendonica Cursive* as (left to right) punch, matrix, print, and digital.

Figure IV.10 shows enlargements of punch, matrix, and print of Granjon's Ascendonica Cursive and the derived italic of ITC Galliard, respectively. The digital interpretation by Matthew Carter is obviously freely based on Granjon's cursive and would not be suitable for researching the proportions in Renaissance type. For this reason I only used (photos of) historical prints and digital revivals that accurately resemble the original historical type. For illustrating some specific relationships only, like those between vertical and horizontal proportions in type, in some cases I used faithfully produced digital revivals, like Adobe Jenson or Adobe Garamond.

Due to the fact that much of the measured historical type was made for small point sizes, and the fact that letterpress results in the aforementioned squashes, there will always, to some extent, be tolerances when proportions are captured in models. These tolerances will also be part of a revival, such as Adobe Jenson and Adobe Garamond, because in general digital type designers distil the proportions from enlarged prints –if only because, in many cases, the punches and matrices have not been preserved over time. Nevertheless, in the measurements I make and present in this dissertation, the tolerances in the proportional relationships are remarkably small.

To illustrate the morphologic relationship between textura handwriting and the Humanistic minuscule I developed a geometric letter model. The model maps the construction of letters written with a broad nib and supports the idea that handwritten letters contain an intrinsic standardisation. I also use it to demonstrate the inherent differences between roman type and its handwritten origins. The geometric letter model formed the basis for software to digitally reproduce the standardisation of the handwritten textura and the Humanistic minuscule for type fitting. The patterning generated with this software can also be used as basis for present-day type design. In addition, to illustrate the similarities in widths in gothic and Renaissance prints I developed a horizontal grid system to measure width standardisation related to this patterning. The grid system formed the basis for software to distil, analyse, and reproduce the unitisation that is at the root of Renaissance type, as I aim to prove. This software can be used to automatically space digital typefaces and hence it directly connects the Renaissance archetypal standardisation and systematisation with today's type design practice.

Dissertation structure

Chapter 1 focuses on the importance placed on handwriting and calligraphy in teaching typography today; it aims in particular to illustrate the ways in which handwriting and type differ, and to question the general use of the Foundational hand model as evidence for the direct link between the Humanistic minuscule and roman type.

Chapter 2 focuses on the relationship between the Humanistic minuscule and textura handwriting, on which the first movable type was based, in order to examine the possibilities for the use of this relationship by the first Renaissance punchcutters in the roman type production process.

Chapter 3 examines the standardisation of the Humanistic minuscule in greater detail. The aim is to begin to answer the question of how handwritten models were standardised for roman type. It makes use of the software that I developed to digitally reproduce the standardisation of the Humanistic minuscule for type fitting.

Chapter 4 focuses on the standardisation of widths both in textura and roman type production. The chapter first describes the process of optically spacing type before discussing the advantages of using standardised widths instead. It then discusses the similarities in widths in gothic and Renaissance prints using a horizontal grid system that I developed to measure width standardisation. The aim is to draw further parallels between textura and roman type production.

Chapter 5 examines standardisation of character widths in greater detail. To this end, a unit-arrangement system is introduced and distilled from examples of both textura and roman type, in an attempt to provide further evidence that roman type, much like textura type, was the result of the standardisation of its handwritten origins to the type production process. The chapter then compares optical and grid fitting to illustrate the extent to which seemingly æsthetic preferences can be obtained systematically.

Chapter 6 describes technical details of the Renaissance type production, discussing first the general process and then focusing on the technical possibility for width standardisation of the matrices for simplified type casting.

Chapter 7 presents the distilled evidence of a unit-arrangement system from various Renaissance artefacts housed at the Museum Plantin-Moretus, thereby demonstrating that the early punchcutters standardised widths in the production of roman type.

Chapter 8 discusses the possible standardisation of vertical proportions in Renaissance type and investigates these in relation to the horizontal standardisation as the last piece of evidence to support my hypothesis that the Renaissance punchcutters made use of standardised handwriting in the production of roman type in a process analogous to the more obvious standardisation of textura handwriting for textura type. To this end, the chapter presents dynamic frameworks that may have been used in this process.

Chapter 9 aims to answer the question of why later roman type designs show a greater diversity in proportions and details than can be found in the archetypal models. It discusses the decline in the need for standardisation in the post-Renaissance type production process. Is it possible that this decline caused later punchcutters to place a greater emphasis on the eye? Finally, the chapter discusses the use of archetypal patterning in digital type production and demonstrates how this allows greater control of the harmonic and rythmic aspects in type design today.

It is evident that handwritten models formed the basis for movable type, the quintessential difference between the two forms being that in movable type characters need to be positioned on rectangles. Textura handwriting was characterised by a relentless regularity of the minims that made up each character. This regularity made it possible to translate the characters in a highly standardised manner onto the rectangles of textura type. In the case of Humanistic handwriting, however, such regularity was missing and translating the handwritten models into roman type would appear to require greater freedom on behalf of the punchcutters.

For this reason it might seem obvious to explain the differences that can be found between the handwritten models and roman type as being the result of punchcutters' optical preferences imposed during the act of translation. That the fifteenth-century punchcutters translated handwritten models to these rectangles by eye (visually), both in the case of textura and roman type, has indeed become the generally accepted view. If handwriting was directly translated into type, this means that the rectangles on which letters are placed in movable type were adapted to the letter proportions. But could the opposite be true? That –at least to a certain extent– the letter proportions were adapted to an existing standardised system of rectangles? After all, the by now well established production of textura type was based on such a standardised system of rectangles, and compositors had come to depend on it in their daily practice of setting type.

I hypothesise that roman type was in fact the result of the adaptation of the Humanistic minuscule to the existing type production process based on standardised rectangles. Because of the organic morphologic relationship between the handwritten origins of textura type and roman type, the production of the latter could be standardised in a similar manner as that of the former (this standardisation will be discussed in detail in the next chapter). This does not mean that I deny that manuscript models are at the basis of the production of roman type. What I will try to argue is that the influence of the handwritten models is a matter of formal principles (morphology), while the details and final proportions owe more to the exigencies of the translation process to standardised rectangles. To support my hypothesis, this chapter will first discuss the importance traditionally attributed to handwriting and the eye of the type designer in the production of roman type; it will then closely examine the flaws behind this line of thinking, highlighting the inherent differences between typography and calligraphy. This information will then be used in subsequent chapters to examine the standardisation of handwriting for the production of roman type.

1.1 The role of the pen

Education today reflects the general acknowledgment of the central role of the pen for the development of type, following the underlying belief that the first roman type set out to imitate handwriting. Writing takes a central place, for instance, at the Graphic Design department of the Royal Academy of Art in The Hague (KABK). This practice was initiated by Noordzij, who lectured at the KABK from 1960 until 1990.

Noordzij is convinced that although developing insight in type design via handwriting is not the easiest way, it is the best way to make complicated and subtle matters clear: 'Convention is no longer a restricting fence but a vast territory.'[99] What Noordzij implies is that writing explores the basic structure of type, on which the designer can develop his own specific idiom. The alternative method for gaining more insight is to study existing typefaces. However, this could severely restrict the designer because it will be difficult for him to imagine what is possible beyond the investigated models.

Noordzij is not the only one who preaches the development of insight via handwriting. For instance, the English typographer and type consultant Stanley Morison (1889–1967) preceded Noordzij's emphasis on writing when, back in 1926, he criticised contemporary type designs from France. In *Type Designs of the Past and Present* he mentions that the designers of these types ('*artists*') should have let the pen help them, and that the conventions for letters have grown out of the very nature of the pen stroke.[100] On the same page Morison concludes: 'To-day education is broadcast and nobody bothers to write with a pen.' In his turn, Morison was undoubtedly influenced by Johnston, who advertised penmanship as the basis for understanding letterforms for those involved in book production. In his collected notes presented in *Formal Penmanship*, Johnston states that even if one cannot write, one may profit from a study of the methods and principles of that penmanship on which one's art is founded.[101]

---

[99] Gerrit Noordzij, 'A Program for Teaching Letterforms', *Dossier A–Z 73: Association Typographique Internationale* (Belgium: Remy Magrermans, 1973), pp.80–88 (p.86).

[100] Morison, *Type Designs of the Past and Present*, p.62.

[101] Edward Johnston, ed. Heather Child, *Formal Penmanship and Other Papers*.

One can find numerous quotes on the fact that written letters formed the basis for the Renaissance invention of movable type in literature; I will cite just a few here. The alert reader will note that the wording does not always make it quite clear whether the comment refers to textura or roman type or both, but that is precisely the point. I agree that this was the case for textura type, but I don't think it was for roman type. Johnston: 'The first printers' types were naturally and inevitably the more formalised, or materialised, letter of the writer.'[102] Bringhurst: 'The original purpose of type was simply copying. The job of typographer was to imitate the scribal hand in a form that permitted exact and fast replication.'[103] Morison: 'Handwriting is, of course, the immediate forerunner of printing, and some knowledge of its history is essential to any sound understanding of typography.'[104] And finally Ullman: 'The early printers based their fonts on the writing that was current in books of their day.' According to Ullman they imitated writing as closely as possible, 'so that their product might not suffer by comparison.'[105]

However, if the goal was to imitate handwritten books, the early typographers did not completely succeed. The most famous printed books from the Renaissance were not always considered of a quality equal to handwritten ones. Morison notes that in spite of Jenson's almost divinely assisted craftsmanship, fine writing was nevertheless so highly esteemed elsewhere that even his printing failed to please many contemporary collectors of books. According to Morison the bibliophiles of Florence even insisted that printing was so inferior to the manuscripts as to be unworthy of their libraries.[106]

In *Printing Types* Updike mentions the negative effects on type of the imitation of handwritten letterforms. He discusses the first printers and how they, in his opinion, made certain errors in designing and cutting types that profoundly influenced typography; he attributes these errors to the fact that their types tried to imitate the text in written manuscripts. Because of this reproduction '[…] they had neither time, opportunity, nor desire to consider what types were, or to realise that they could never successfully reproduce in metal all forms derived from the

---

(London: Lund Humphries, 1971), p.29.

102 Ibid., p.43.

103 Bringhurst, *The Elements of Typographic Style*, p.18.

104 Morison, *Type Designs of the Past and Present*, p.1.

105 Ullman, *Ancient Writing and its Influence*, p.150.

106 Stanley Morison, *Four Centuries of Fine Printing* (London: Ernest Benn Ltd., 1949), p.19.

pen.'[107] Updike was perhaps closer to the truth than he suspected, except that the reason was perhaps not that the punchcutters did not succeed in reproducing 'all forms derived from the pen', but that they did not even try. Instead they were most concerned with standardising the details and proportions to the demands of the rectangles they needed to fit.

The invention of movable type did not make handwritten books obsolete. In his treatise *De Laude Scriptorum* Johannes Trithemius (1462–1516), a German abbot, explains why the invention of printing should not discourage his monks from copying books –if only to keep idle hands busy, and to encourage diligence, devotion, and knowledge of Scripture.[108] In return therefore, movable type also influenced handwritten letterforms. A large number of the manuscripts made during the late fifteenth century were copied from early printed books because, by then, so much printed text was circulating.[109] The sixteenth-century calligrapher Alejo Vanegas advised calligraphers to copy details from Aldine italic that was cut by Griffo.[110] For this reason too, we have to exert extreme caution in asserting that handwritten forms served as exemplars for type.

The citations adduced so far show that roman type is widely believed to have been the result of the Renaissance punchcutters' imitation of the Humanistic minuscule. The next section will bring this belief into question by illustrating the flaws in the Foundational hand model, which is used in education to prove that roman type is directly based on the patterns and structures of preceding written letters.

1.2 The Foundational hand model

Further emphasising the importance of handwriting in today's typographic studies is the use of Johnston's Foundational hand, which finds its origin in late-medieval models and is used in today's education of type designers and typographers to link roman type directly to Humanistic handwriting. For instance, Noordzij applied his own variant for his lessons at KABK, and I use mine there too (Figure 1.1). However, one has to realise that the Foundational hand and all related present-day models are interpretations of historical hands, which were defined by

[107] Updike, *Printing Types*, Vol.1, p.6.

[108] Eisenstein, *The Printing Revolution in Early Modern Europe*, p.11.

[109] Ibid., p.23.

[110] Arthur S. Osley, *Scribes and Sources: Handbook of the Chancery Hand in the Sixteenth Century* (Boston: David R. Godine, 1980), p.140.

Johnston and his followers long after the invention of movable type. The question is whether it is possible to distil such a model from manuscripts predating the invention of movable type, or whether it can in fact only be made with knowledge of (the standardised proportions of) movable type.

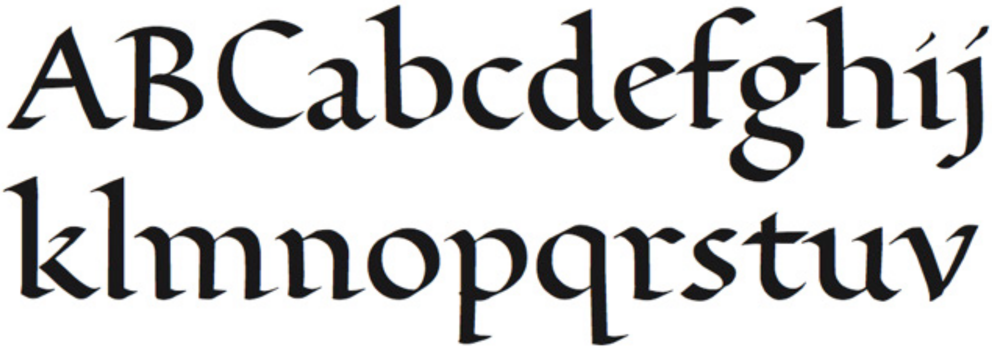


Figure 1.1 Formalised Humanistic minuscule (Foundational hand) with adapted capitals.

Johnston's model was also inevitably influenced by his knowledge of the historical development of writing and typography: he adapted the Foundational hand to Jenson's archetypal patterns. This raises the question of the extent to which the Foundational hand actually show standardisation that was the result of decisions already made during the production process of Renaissance movable type instead of being the inspiration for such decisions. In addition, Johnston's model is an enlargement of the original late medieval and Renaissance small-sized hands, and this results in a more detailed and standardised description. At a larger size it is much easier to make letters uniform and deviations become more visible than at smaller sizes. It seems highly likely that these models use circular logic.

Figure 1.2 From Poggio's model to Jenson's via Noordzij's Humanistic hand.

To illustrate this circular logic, Figure 1.2 shows two enlarged images of a Humanistic minuscule m. The left-hand m is from the Italian scholar and Humanist Gian Francesco Poggio Bracciolini (1380–1459), commonly known as Poggio, to whom the Humanistic minuscule is credited, and Noordzij's 'Humanistic script' variant, which is in fact a Foundational-hand m, is in the centre. The m from Jenson's roman type is on the right. Although all three m's share the same structure, there is a big difference between Poggio's handwriting and Jenson's type. Noordzij captured the structure of Poggio's model in his 'Humanistic script' illustration from *The Stroke of the Pen* (1982), but he made it more formal in order to make it resemble Jenson's m. Inevitably, Noordzij's m was influenced by the fact that he was familiar with Renaissance roman type, in addition to the fact that he wrote his m at a much larger size. Furthermore, Figure 1.3, with Poggio's hand on top and Jenson's type below, shows, in addition to the structure similarities, that Jenson rigidly standardised and systematised the structure of the Humanistic minuscule. Noordzij's 'Humanistic script' m was undoubtedly influenced by this standardisation, in line with Johnston's Foundational hand. The standardisation of the Humanistic minuscule for the production of roman type will be discussed in detail in the following chapters.

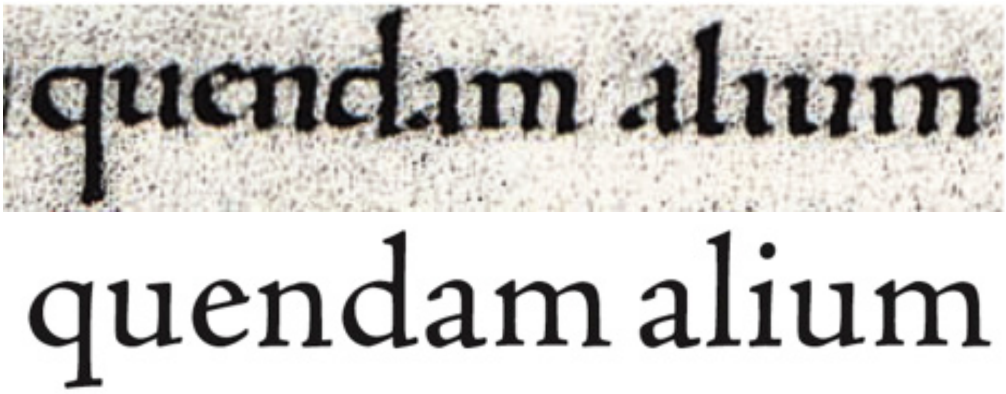


Figure 1.3 The differences between Poggio's model (top) and Jenson's type.

When it comes to details there is a clear difference between Humanistic handwriting and Jenson's archetypal model, which directed the further development of roman type. The generally embraced theory is that Jenson and consorts tried to mimic handwriting, but that view is contradicted by the details of roman type. Figure 1.3 shows that Poggio's model clearly differs from Jenson's. One does not need a trained eye to see that the underlying structure is identical, but that the elaboration of Jenson's letters differs. The British leading scholar in the printing history of Renaissance Venice, Martin Lowry (d.2002), links Jenson's type to the hand of 'a relatively obscure figure' named Battista Cingulano.[111] Also in this case one can see the same underlying structure in the written and printed letters but the differences are huge. If one starts looking for Humanistic

[111] Lowry, *Venetian Printing*, p.22.

handwriting predating movable type that resembles the density ('colour') and patterning of Jenson's roman type, one can find examples that in my opinion come closer, such as shown in Figure 1.4. This is a part of a handwritten edition of Cicero's *Epistolæ ad familiares* that was made in either Florence or Rome around 1450.[112] Still, it does not look as even and well-structered as Jenson's roman type.

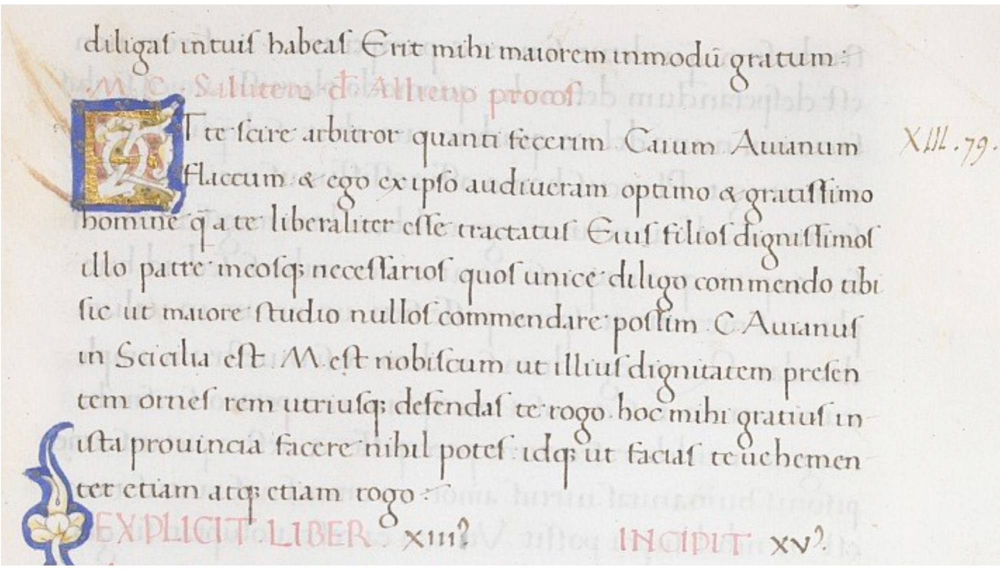

diligas in tuis habeas Erit mihi maiorem inmodu gratum
M. C. Salliceno d. Allieno procos
Te scire arbitror quanti fecerim Caium Auianum XIII.79.
flaccum & ego ex ipso audiueram optimo & gratissimo
homine q a te liberaliter esse tractatus Eius filios dignissimos
illo patre meosq necessarios quos unice diligo commendo tibi
sic ut maiore studio nullos commendare possim C Auianus
in Scicilia est M est nobiscum ut illius dignitatem presen
tem ornes rem utriusq defendas te rogo hoc mihi gratius in
ista prouincia facere nihil potes idq ut facias te uehemen
ter etiam atq etiam rogo
EXPLICIT LIBER XIII INCIPIT XV

Figure 1.4 Handwritten edition of Cicero's *Epistolæ ad Familiares* from ca.1450 (British Library col.).

The differences between the handwritten models and Jenson's roman type make it just as plausible that, instead of copying handwriting, Jenson did his very best to come up with a handwriting-related, but at the same time different model to set a new standard. His type certainly did not successfully imitate handwriting. And vice versa, the calligraphers of manuscripts from the late-fifteenth century who tried to imitate roman type did not succeed either. This resulted in little more than crude approximations of the printed type. Figure 1.5 shows a part of a book of hours (*Hours of Bonaparte Ghislieri*) made in Italy around 1500.[113] The structuring of the handwriting and also the stroke endings are clearly influenced by roman type and hence the patterning is stronger than the one shown in Figure 1.4.

112 <https://www.bl.uk/catalogues/illuminatedmanuscripts/TourBurnShape.asp>

113 <http://www.bl.uk/catalogues/illuminatedmanuscripts/record.asp?MSID=6432>

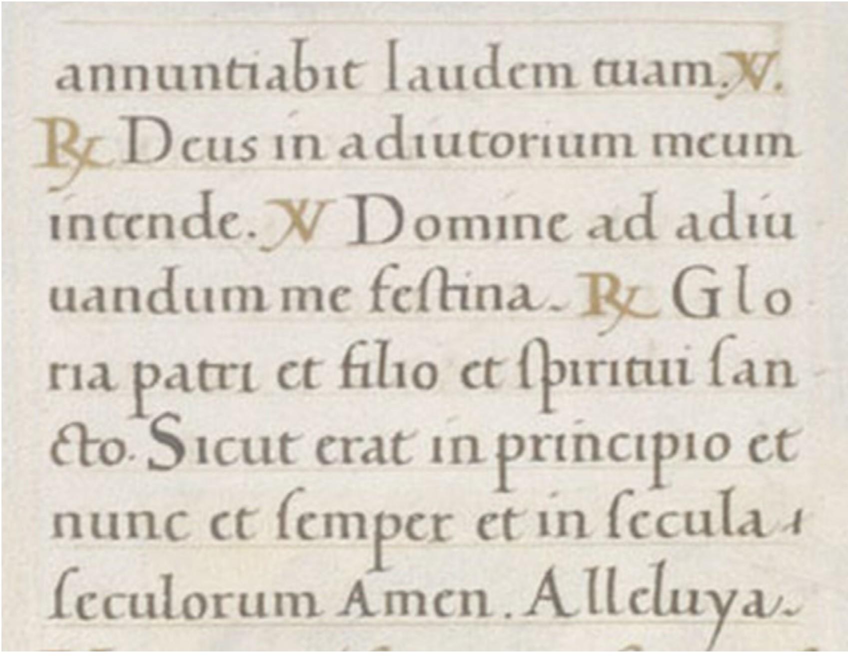

annuntiabit laudem tuam. ℣.
℟ Deus in adiutorium meum
intende. ℣ Domine ad adiu
uandum me feſtina. ℟ Glo
ria patri et filio et ſpiritui ſan
cto. Sicut erat in principio et
nunc et ſemper et in ſecula
ſeculorum Amen. Alleluya.

Figure 1.5 *Hours of Bonaparte Ghislieri* from ca.1500 (British Library col.).

In this book of hours the stroke endings, which are the result of a backward-forward movement with the broad nib like in the textura quadrata, simulate the serifs in roman type. However, the serifs in Jenson's roman type have a clearly different structure. The American type designer Georg Abrams, who used Jenson's roman as inspiration for his typeface named 'Abrams Venitian', concludes that Jenson combined acknowledgement of the broad-nib stroke with the chisel-based shapes of the Roman Imperial capitals.[114] The drawn capitals in the book of hours mimic printed type as much as possible.

1.3 Comparing handwriting and type

To compare calligraphy to type production too closely ignores the inherent differences between the two processes; the present section aims to make those differences clear. Without question one can find many similarities between Humanistic minuscule and Renaissance roman type. However, there are also many differences due to the fact that the structure of movable type, for which letters had to be placed on rectangles, has inherently different characteristics than writing.

---

[114] Lowry, *Venetian Printing*, p.55.

Figure 1.6 The quintessence of movable type is the positioning of letters on rectangles.

The structure of movable type is fairly simple: letters are placed on rectangles (Figure 1.6). This is done in such a way that, irrespective of the sequence of letters, the rhythmical pattern results in the best possible equilibrium of white space. Regardless of the adjoining characters always the same exact duplicates of characters are used. The repetition of precisely reproduced letterforms and a standardised distribution of space are characteristic aspects of typography. Even when varying glyphs of certain characters are stored in a font to approximate the versatility of handwriting, applying these randomly will still result in a degree of repetitiveness, owing to the finite number of variants. Written characters, by contrast, are never completely identical (and can never be, even if the hand of the writing master is an expert one). They will always to a degree be adjusted to their context: the letters on either side.

There is another major difference between written letters and type: the calligrapher divides the space with pen strokes while the type designer (punchcutter) has to divide the space between these strokes. The question of where the space belonging to a letter starts or ends does not exist for the calligrapher; he makes rhythmical patterns of black and white shapes and if necessary he can adapt the letterforms, by making them more condensed or wider, to adjust the pattern to for instance the length of a line. The type designer has to divide the space between the letters equally because this is essential for creating even patterns with movable type. He then stores the pattern as separate pieces and the pattern is only restored when the type is actually set for printing. The flexibility and freedom that the calligrapher has when it comes to controlling the space inside and surrounding the letters has to be approximated by the type designer; this is done by adding ligatures, contextual alternates, and corrections on the spacing for specific letter combinations.[115]

[115] These corrections for pairs of letters are named ‘kerning pairs’. For some letter combinations, such as ‘Ty’ or ‘Ve’ these are always required to get an even distribution of white space.

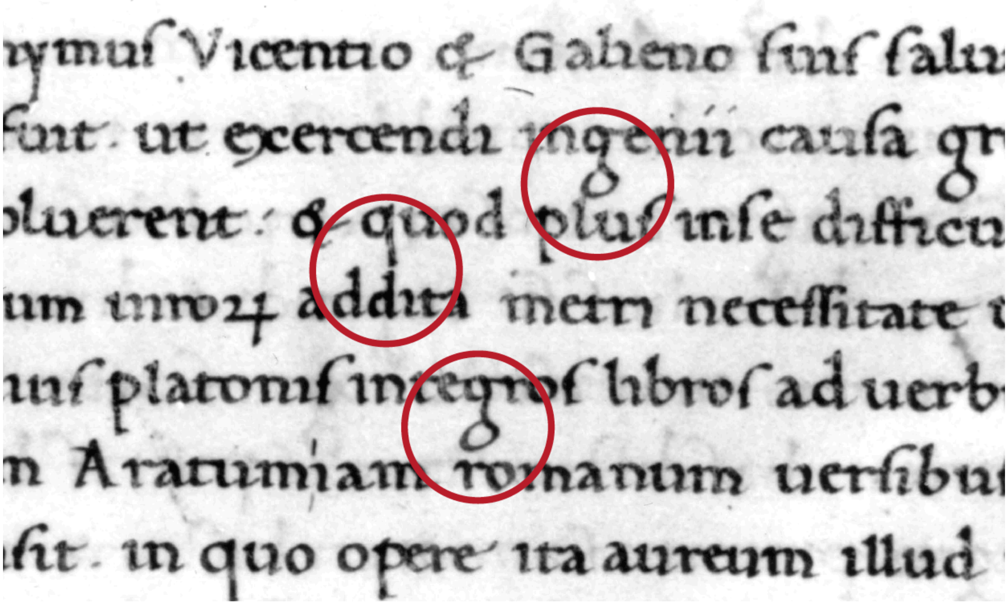


Figure 1.7 Humanistic minuscule with varying ascender and descender lengths (Italy, fifteenth century).

Another difference between typography and handwriting is that in the latter there are no strict vertical boundaries between lines. The lengths of the ascenders and descenders can vary, even when the distance between the lines will be kept constant. Particularly with small-sized Humanistic hands, it was obviously difficult to fully control the lengths of ascenders and descenders (Figure 1.7). Collisions between these elements ('clipping') were prevented as much as possible, which resulted in varying lengths of the ascenders and descenders. The x-height is the most constant factor in Humanistic writing; the lengths of the ascenders and descenders much less so.

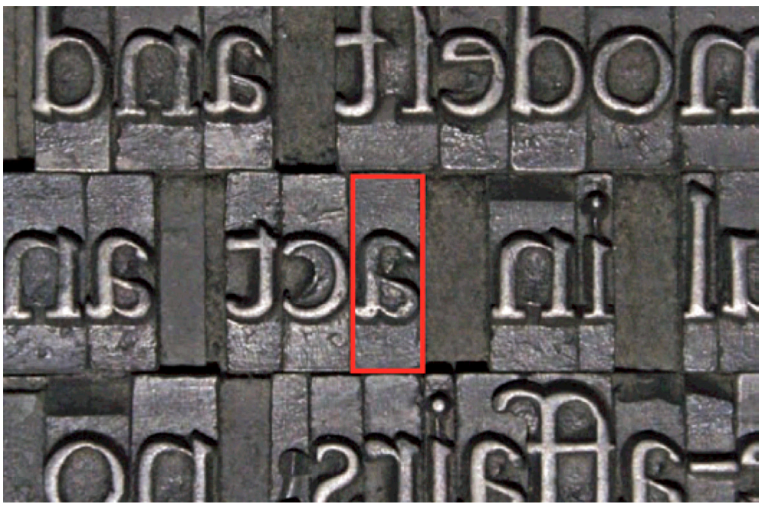


Figure 1.8 For movable type the letters and their surrounding space were captured in rectangles.

In movable type the vertical boundaries are as strictly defined as the horizontal borders (Figure 1.8). This results in fixed vertical proportions for the rectangles in which the letterforms plus surrounding space are captured. Here the structure of movable type, which is meant for the reuse of letters, is completely artificially placed on top of patterns that find their origin in handwriting.

In *Visible Language* the Jesuit Priest Walter J. Ong, who was professor of English literature and professor of Humanities in Psychiatry (and as such could be considered an outsider), makes a distinction between writing and typography by stating that, in the case of writing, words are made by creating marks on surfaces whereas with type words are made 'out of pre-existing things'.[116] This definition is clearly related to Noordzij's description of typography as writing with prefabricated letters, which it actually predates, but it emphasises that writing and typography are basically different things.[117] Ong compares typography to the building of houses by relating type to bricks, and subsequently describing typography as the equivalent to brickwork.

This chapter focused on the importance placed on handwriting and calligraphy in teaching typography today; it aimed in particular to illustrate the ways in which handwriting and type differ, and to question the general use of the Foundational hand model as evidence for the direct link between the Humanistic minuscule and roman type. The next chapter will focus on the relationship between the Humanistic minuscule and textura handwriting, on which the first movable type was based, to examine the possibilities for the use of this relationship by the first Renaissance punchcutters in the roman type production process.

---

[116] Walter Jackson Ong, 'Comment: Voice, Print, and Culture', *Visible Language*, Volume IV, Number I (Cleveland: the Journal, 1970), pp.77–83 (p.80).

[117] Noordzij, *The Stroke*, p.49.

CHAPTER 2

As was discussed in the previous chapter, it is generally accepted that the Renaissance punchcutters aimed to replicate handwriting as closely as possible in their production of roman type. The transition from textura type into roman type is mostly described in the literature as a matter of Italian Humanistic scholars' tastes and preferences.[118] The technical consequences of this transition for the punchcutters are underrepresented in the literature. I hypothesise that roman type was largely the result of technical rather than solely æsthetic considerations, and that the production process was based on that of Gutenberg's textura type.

This chapter will focus on the question of how and why the structures of textura type might have been translated into roman type. To do so, it will examine the links between textura handwriting, on which textura type was based, and the Humanistic minuscule, which formed the basis for roman type. The first section briefly presents the historical links between the production processes of textura and roman type. The transition from the Carolingian to the Humanistic minuscule is discussed next, followed by the morphologic relationship between textura and Humanistic minuscule. This discussion will draw parallels between these two hands, in this way supporting the hypothesis that roman type was the result of the standardisation of the Humanistic minuscule to the type production process, in analogy to the standardisation of the gothic hand for the production of Gutenberg's textura type.

2.1 Historical development

There is not much discussion possible about the fact that written letters were initially standardised and eventually formalised by the Renaissance punchcutters.[119] Early printers based their fonts on the writing that was current in books of their day. For example the Venetian printer Manutius, whose punchcutter was Griffo, was 'obsessed by the same dream as Gutenberg' and 'made a repeated claim that his letters were "as good, if not better, than any written with a pen".'[120]

---

[118] Morison, *Type Designs of the Past and Present*, p.14.

[119] Johnston, *Formal Penmanship and Other Papers*, p.43.

[120] Martin Lowry, *The World of Aldus Manutius: Business and Scholarship in Renaissance Venice* (Oxford: Basil Blackwell, 1979), p.131.

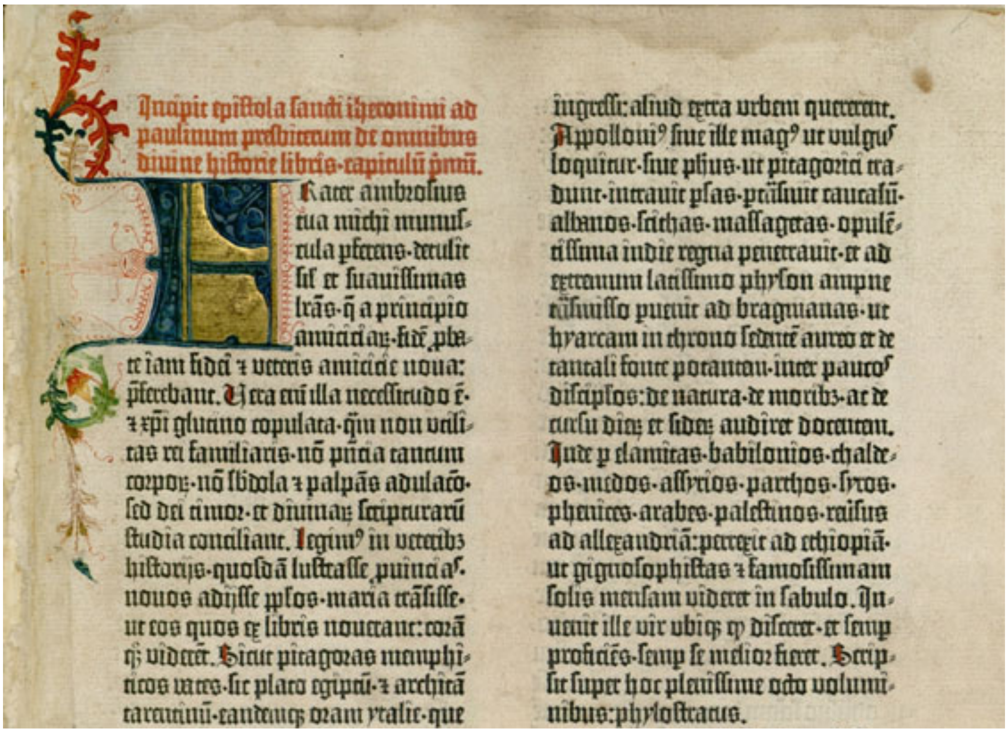


Figure 2.1 Detail from Gutenberg's 42-line bible (1452–1455) typeset in textura quadrata.

The mimicking of handwriting was certainly the case for books printed in textura type, such as applied by Gutenberg (Figure 2.1). The type in Gutenberg's 42-line bible (1452–1455) comes indeed very close to written textura quadrata in the *Giant Bible of Mainz* from 1452/3 (Figure 2.2).

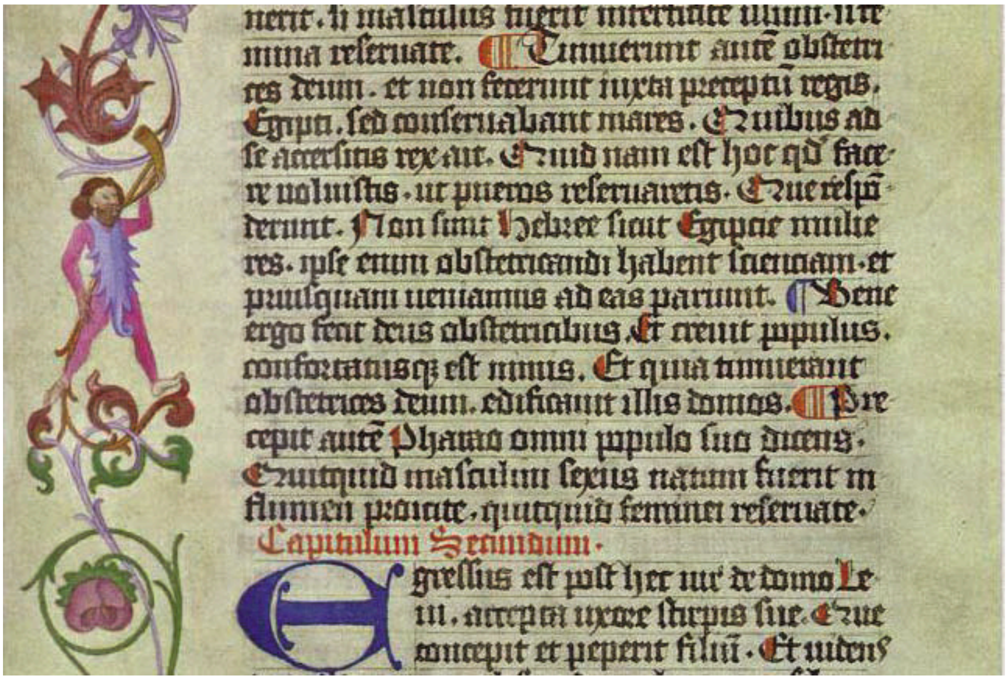


Figure 2.2 Detail from the *Giant Bible of Mainz* (1452/3) written in textura quadrata.

The written textura quadrata (Figure 2.2) was perfectly suited for justifying and casting, because it made the equal distribution of space between the letters – when placed on rectangles– quite simple. Furthermore the number of character widths can be easily limited, because this is an intrinsic element of the textura quadrata's morphology; it was almost as if the model was developed with the standardisation and systematisation of movable type in mind.

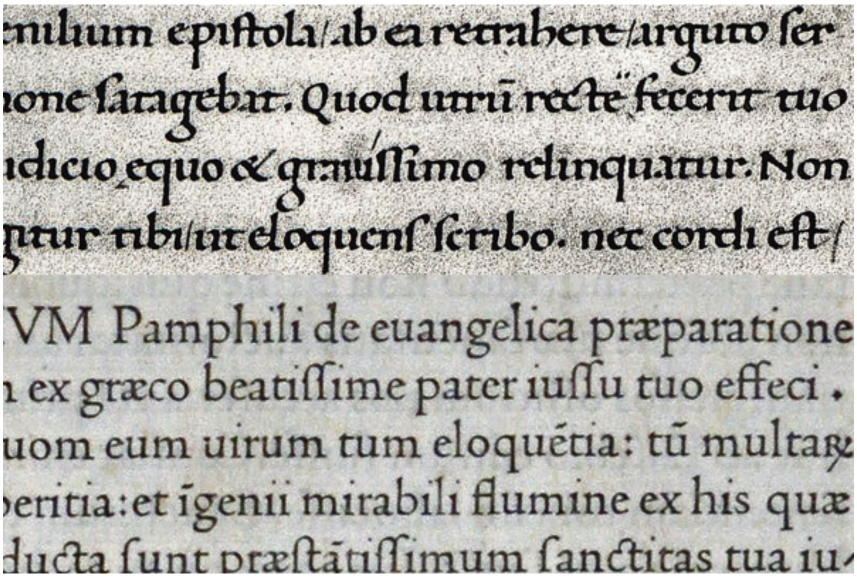

milium epiſtola/ab ea retrahere/arguto ſer
ione ſatagebat. Quod utrū recte fecerit tuo
idicio equo & grauiſſimo relinquatur. Non
ptur tibi/ut eloquens ſcribo. nec cordi eſt/
VM Pamphili de euangelica præparatione
ı ex græco beatiſſime pater iuſſu tuo effeci .
uom eum uirum tum eloquētia: tū multaꝝ
peritia:et īgenii mirabili flumine ex his quæ
ducta ſunt præſtātiſſimum ſanctitas tua iu

Figure 2.3 Poggio's Humanistic minuscule and Jenson's roman type (below).

The transition from the handwritten Humanistic minuscule to roman type, and later from Humanistic cursive to italic type was less straightforward than the transition from the written textura quadrata to the textura types as applied by Gutenberg. Figure 2.3 shows Humanistic handwriting by Poggio on top of roman type cut by Jenson. There are some similarities between Poggio's and Jenson's models, but there are definitely more differences. In fact, it is hard to trace an exact interpretation of Renaissance handwriting in early Renaissance roman type.

However, some standardisation in early roman type, like that of character widths in relation to the body size, is identical to that in textura type (Figure 2.4). They are the result of the reuse of textura patterns for the production of roman type. Creating roman type with the same scheme as used for casting the morphologically related textura type in mind, simplified design and production matters.

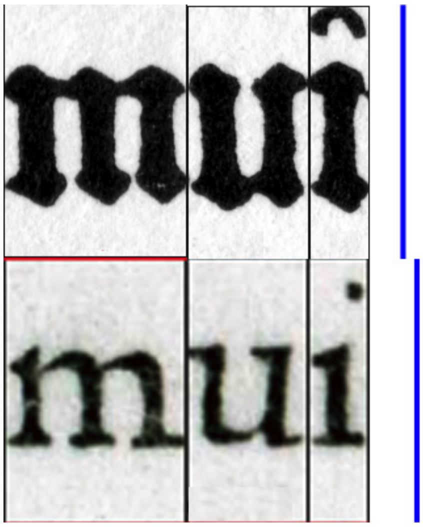


Figure 2.4 Gutenberg's textura type (top) and Jenson's roman scaled to the same body size.

In less than twenty years, Gutenberg's textura type from Mainz was flanked by fully evolved roman type in Venice. The type Jenson made in 1470 for the tractate *De Præparatione Evangelica* of the historian, exegete and polemicist Eusebius of Caesarea (ca.263–339) is generally considered the first highly refined roman type. It directed the development of the types by Griffo and Garamont and their successors. Griffo used Jenson's type as template for the roman type he cut for *De Aetna*, a book published by Manutius in 1495. Although Griffo altered details, the ground plan remained unchanged (Figure 2.5).[121] This was not the first time Griffo used Jenson's type as basis: in December 1475 Francesco da Bologna was commissioned to cut two gothic typefaces to be modelled after the ones used by Jenson. This resulted in Griffo's gothic type from 1477, which was based on a type from that was applied in Venice a year earlier.[122] It has to be noted here that Lowry considers it possible that the Francesco da Bologna in question was in fact Griffo; obviously he was not as sure about this as Mardersteig.[123] However, Lowry fully acknowledges the resemblance between Griffo's font for *De Aetna* and Jenson's roman.[124]

121 Typographers tend to look specifically at the details; one cannot see more than one knows, after all. An example that illustrates this is what Morison writes in *Four centuries of fine printing* on the Relation between Jenson's and Griffo's roman types: 'Whether or not the Aldine letters are an improvement upon those of his illustrious predecessor is a matter of taste, but it will at least be agreed that they differ in many important respects. To our eyes they may claim to posses much more "present day" feeling than is conveyed in the letters of the earlier master.' Obviously Morison never investigated the ground plan, which is almost identical for both Jenson's and Griffo's roman types.

122 Giovanni Mardersteig, *The Remarkable Story of a Book Made in Padua in 1477: Gentile da Foligno's 'Commentary on Avicenna' printed by Petrus Maufer* (London: Nattali & Maurice Ltd., 1967), pp.9,10.

123 Lowry, *Venetian Printing*, p.17.

124 Lowry, *Nicolas Jenson and the Rise of Venetian Publishing in Renaissance Europe*, p.208.

The way movable type could have been copied during the Renaissance and surely was in later times, is discussed in Section 3 of Appendix 5: *Tricks and trade secrets*. The relation of Jenson's roman type to that of his Renaissance colleagues and its influence on later type are discussed in more detail in Appendix 2, *The Jensonian gospel*.

Figure 2.5 Jenson's roman type from 1470 (top) and Griffo's roman type from 1495 compared.

The morphologic relationship between the textura quadrata and the Humanistic minuscule made the reuse of textura patterns for the production of roman type possible. However, differences between textura handwriting and Humanistic minuscule have important implications for their use as bases in type production: while textura handwriting could be used to produce type with little modification, the Humanistic minuscule required a greater degree of standardisation. This will be discussed in greater detail in the following sections.

2.2 From the Carolingian to the Humanistic minuscule

In order to prove that Roman type was the result of the standardisation of the Humanistic minuscule to the type production process, this section will examine first the transition from the Carolingian minuscule to textura handwriting, and then from textura handwriting to the Humanistic minuscule. This discussion will then serve as a basis from which to build a comparison of these hands with regard to their standardisation for type production.

Figure 2.6 Transformation from roman capital (left) to Humanistic minuscule.

Figure 2.6 shows the transformation from roman capital to Humanistic minuscule via uncial, Carolingian minuscule, textura, and rotunda. The diagram spans roughly 1400 years. The Humanistic minuscule was a formalised variant of the Carolingian minuscule: it was mostly the result of the removal of the upstrokes that can be found in the Carolingian minuscule (Figure 2.7). This resulted in an interrupted construction, which means that the pen has to be lifted for writing the different strokes that make up a letter. However, in Renaissance Italy also the original uninterrupted construction can be traced. The differences between the Carolingian and Humanistic minuscule are not always completely clear. This probably made George Abrams state that Jenson transposed the structure of the Carolingian script into a lowercase roman letter.[125]

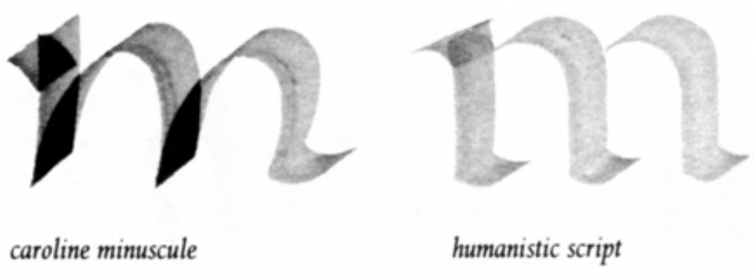


Figure 2.7 The relation between the Carolingian and Humanistic minuscule.[126]

The shift from gothic letter forms back to Carolingian-based ones in the Renaissance seems to have been triggered by the examination by the Humanists of ninth- and tenth-century copies of the classical Latin literature. Through this examination Italian Humanists became familiar with Carolingian handwriting, which predated the gothic hands. Clearly, they were willing to break with tradition.[127] Johnston's Foundational hand, which is often presented as

[125] Lowry, *Venetian Printing*, p.55.
[126] Noordzij, *The Stroke of the Pen*, p.27.
[127] Ullman, *Ancient Writing and its Influence*, pp.137,138.

Humanistic minuscule (as discussed in section 1.2), is based particularly on the Carolingian minuscule applied in the tenth-century *Ramsey Psalter* (Figure 2.8).[128]

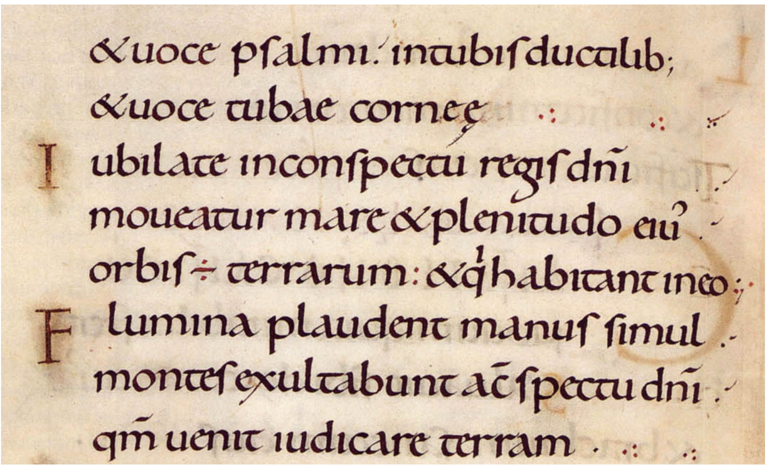

&uoce psalmi: intubis ductilib;
&uoce tubae cornee
Iubilate inconspectu regis dni
moueatur mare & plenitudo eius
orbis terrarum: & q habitant ineo;
Flumina plaudent manus simul
montes exultabunt ac̄ spectu dni
qm̄ uenit iudicare terram

Figure 2.8 Detail from the *Ramsey Psalter*.[129]

There are several differences between textura handwriting and Humanistic minuscule, and these differences are important in this discussion because both hands formed the basis for analogous type production processes. Textura handwriting was much darker than its Carolingian precursor; the space between the stems of its letters was smaller. This is because a calligrapher tries to distribute the space between strokes as evenly as possible, irrespective of whether this space is within or between the letters. The starting point is the stem interval, which is the distance between the stems of the n and related letters such as the m. If an n is wide, consequently there is a lot space in all letters and subsequently between the letters. The reduction of space in and around the letters as a result of compression in the later Middle Ages, which eventually resulted in the textura quadrata, was explained by Noordzij by what he names 'the consolidation of the word'. In his view the letters were not first compressed, which subsequently resulted in more compact words; on the contrary, he reverses the process by stating that the compressed letter forms resulted from placing the letters closer together, which required smaller counters: 'To keep the rhythm intact they make the interior shapes of the letters ever smaller.'[130]

[128] Johnston, *Formal Penmanship and Other Papers*, p.135.
[129] <http://www.snipview.com/q/Ramsey_Psalter>
[130] Noordzij, *The Stroke*, p.51.

Space and letterforms are indissolubly connected with each other. Figure 2.9 shows an increase of weight, which results in smaller counters. The x-height is identical in the three lines and the smaller counters are the result of an increased width of the broad nib. Because a larger pen nib will result in less space within the letters when the calligrapher makes the same movement, less space between the lines is required. This automatically results in a decrease of the length of the ascenders and descenders.

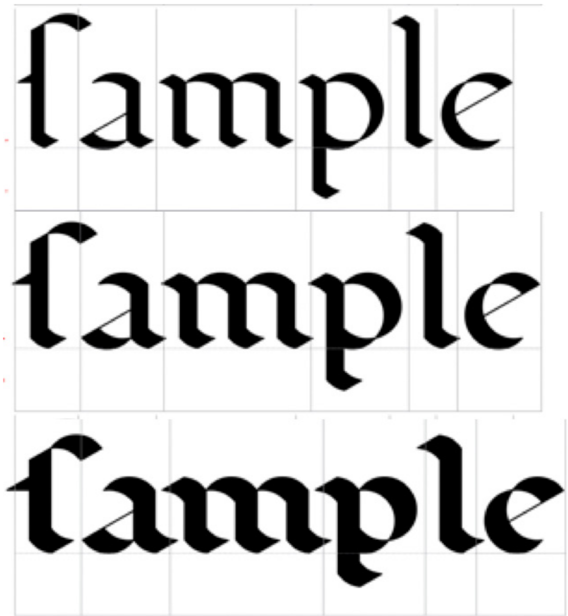


Figure 2.9 Increase of weight (as the result of larger pen nibs) results in smaller counters.

With the reduction of space in the counters of the textura, the space between the lines was reduced accordingly. This was the result of the hierarchical system in which the space between letters is determined by the space inside the letters; the space between the words by the space inside the words; the space between the lines by the space inside the lines; and the space around the text (the margins) by the space within the text. Smaller line spacing leaves less room for the ascenders and descenders. To avoid the clipping of the bottom of descenders with the top of ascenders from the next line, both have to be shortened. To retain a balanced relationship between the letter forms within the x-height and the ascenders and descenders, the lengths of the latter have to be reduced when compressing the letters anyway. This also implies vice versa, that if letters become more open, as they do in the Carolingian and Humanistic minuscule, the ascenders and descenders have to be made longer to retain visually attractive proportions.

In the course of time the written textura not only became darker but also the roundness of the shapes was suppressed, which eventually resulted in the complete removal of curves in the textura quadrata. A direct comparison of the squarish shapes of the textura quadrata and the round ones of the Humanistic minuscule could therefore give the impression that both models are intrinsically different. The following section further investigates the morphologic relationship between the Humanistic minuscule and textura handwriting.

2.3 Morphologic relationship

The aim of this discussion is to emphasise the fact that both the context in which the Renaissance punchcutters worked as well as the morphology of the handwriting used as a basis for roman type were conducive to the standardisation of that handwriting. The width of Gutenberg's movable type could be standardised with relative ease on the basis of textura handwriting; when it came to standardising the Humanistic minuscule for roman type production this standardisation process, while similar, was more difficult. For the production of textura type, the handwritten model could be transformed with hardly any adaptations. In comparison, there are many differences between roman type and the Humanistic minuscule. Producing roman type required a greater degree of standardisation of its handwritten origin. However, there is a clear morphologic relationship between Humanistic minuscule and textura. This made it possible for the Renaissance punchcutters to mould the Humanistic minuscule in a structure in origin as rigidly as that of textura, which was there all along, but that had never been revealed so clearly because handwriting did not require this.

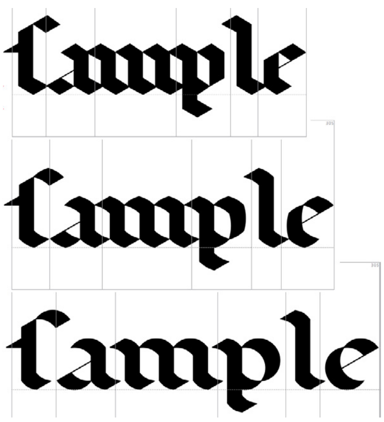


Figure 2.10 The transformation of textura into Humanistic minuscule. The letter is the result of curving the straight strokes of the textura.

At first sight, the letter forms of textura and Humanistic minuscule differ substantially. The compressed and bold gothic letter forms seem to have little in common with the generous open, round, and lighter shapes from the Italian Renaissance. However, the modulation from textura into Humanistic minuscule is no more than a matter of reversing the condensing and curve-flattening (in combination with an increase in weight), which took place in the second half of the Middle Ages and which transformed the Carolingian minuscule into the textura (Figure 2.10).[131] According to Ullman the new writing was not a reaction against the extreme Gothic forms –as is sometimes stated– but rather a gradual simplification of a relative plain Gothic, under Carolingian influence.[132]

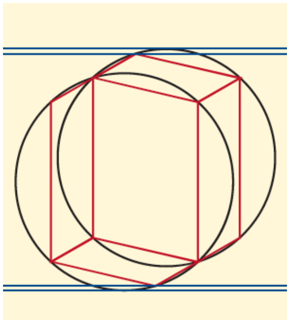


Figure 2.11 The construction of the textura o (red) inside the o of the Humanistic minuscule.

When it comes to the reason for the transformation of curves into straight strokes, which eventually culminated in the textura quadrata (Figure 2.11), the experts' opinions clearly differ. For instance the famous German calligrapher, typographer and author on typography Jan Tschichold (1902–1974) suggested that the curve flattening was partly the result of a desired acceleration of writing.[133]

Figure 2.12 Textura applied in a fourteenth-century *Missale Romanum*.

[131] Ullman, *The Origin and Development of Humanistic Script*, p.11.

[132] Ullman, *Ancient Writing and its Influence*, pp.137,138.

[133] Jan Tschichold, *Letterkennis* (Amsterdam: De Arbeiderspers, 1950), p.19.

This is hard to believe considering the many meticulously refined written medieval manuscripts, as shown in Figure 2.12, and Tsichold's remark on the increasing speed is in complete contrast with what Noordzij states in *The Stroke of the Pen*. Noordzij in fact considers the textura to be the result of formalisation that is achieved by a *reduction* of speed (Figure 2.13).[134] This formalisation is the result of a process that Noordzij calls 'articulation': the strokes become more even and the distribution of space more equal.

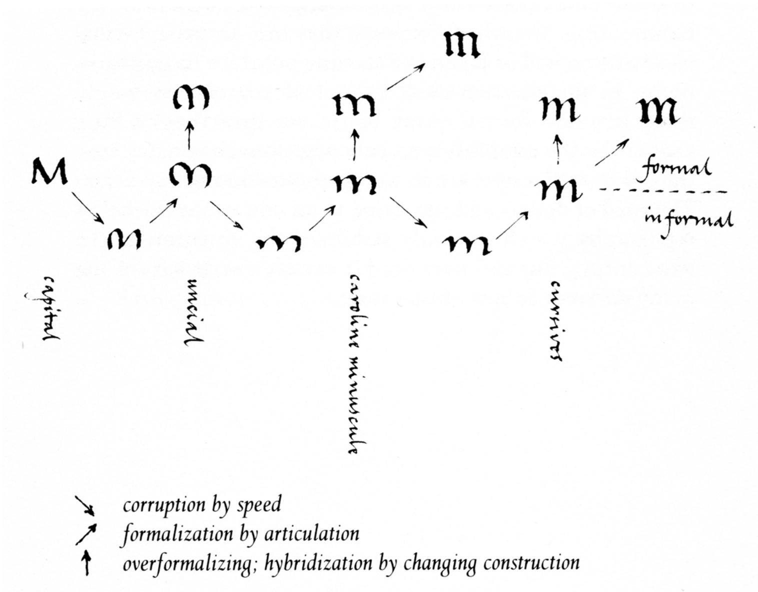


Figure 2.13 Textura (on top) as the result of formalisation by articulation.[135]

The American printer and author on typography Theodore Low De Vinne (1828–1914) was obviously not a fan of gothic letters, which he considered to be degenerate forms of the roman character. He explained the suppression of the curves as the result of a lack of skill.[136] However, as skilled calligrapher I concur with Noordzij's statement that the textura is not the result of an increased speed, nor do I consider it the result of a lack of skill. In contrast with the transformation from Humanistic minuscule to roman type, for which handwriting had to be adapted to technical requirements for the production of movable type, there was no technical reason for the removal of the curves, nor was there any gain in speed. It was above all a matter of taste, as it was also due to a matter of taste that it was replaced by the Humanistic minuscule in Renaissance Italy.

---

[134] Noordzij, *The Stroke of the Pen*, p.49.
[135] Ibid., p.49.
[136] De Vinne, *The Practice of Typography*, p.291.

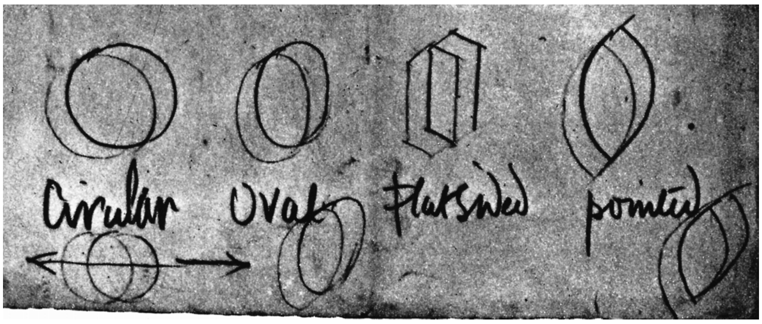


Figure 2.12 Notes by Johnston showing the different handling of strokes.

Johnston was well aware of the fact that gothic and Renaissance hands were variations on the same theme. He noted that, from the Foundational hand, various (more) roman forms and also italic forms could be derived, and that by using a broader nib, a more gothic variant could be developed.[137] Johnston used the letter o to illustrate the historical variants on the same theme: circular, oval, flattened, and pointed (Figure 2.12).[138]

Johnston supports my assertion that there is a closer morphological similarity between textura and humanistic minuscule than meets the eye, and that this similarity makes it not only possible but perhaps even stimulates the application to roman type of the same standardisation process that was applied to the gothic hand in the creation of textura type. This morphologic similarity lends support to my hypothesis that roman type is the result of standardisation of the Humanistic minuscule in the type production process, similar to the standardisation of textura handwriting to create Gutenberg's textura type.

This chapter focused on the similarities between the hands on which textura and roman type were based. It first discussed the transition from Carolingian to gothic to Renaissance hands, followed by the morphologic relationship between textura handwriting and the Humanistic minuscule. This was done in order to lend support to my hypothesis that the production of roman type was the result of the standardisation of handwriting, in a process analogous to the one that produced textura type. The following chapter will make use of both a model that I developed as well as my own software in order to provide concrete evidence of this standardisation.

[137] Johnston, *Formal Penmanship and Other Papers*, p.49.
[138] Ibid., p.98.

CHAPTER 3

The previous chapter discussed the intrinsic morphologic relationship between the written textura and the Humanistic minuscule because both models derived from the Carolingian minuscule. It is plausible that this relationship made it possible to reuse the standardised patterns of the textura type production for roman type. In order to find evidence for this hypothesis, the present chapter will examine the standardisation of the Humanistic minuscule in greater detail. The aim is to begin to answer the question of how handwritten models were standardised for roman type. To this end, I will first illustrate the ways in which roman type differs from its handwritten origins. This is necessary in order to understand what is shared by the calligraphic and typographic models, and where they deviate from each other. Without this knowledge it is difficult to understand how Humanistic handwriting may have been adapted to the technical requirements of the Renaissance font production. I will then introduce a software application that I developed, and I will make use of this software to reproduce the transformation of the Humanistic minuscule into roman type. This discussion will lend further support to my sub-hypothesis that the production of roman type made use of standardised handwriting, much like the production of textura type. In this way, this chapter aims to support the main hypothesis of this thesis: that the creation of roman type was largely influenced by technical rather than æsthetic considerations.

3.1 Roman type and Humanistic minuscule differences

In the late 1980s I developed a simple geometric letter model to capture the structures of the Humanistic minuscule and textura handwriting (and everything in between). I did this for the television course *Kalligraferen: de kunst van het schoonschrijven* ('Calligraphy, the art of beautiful handwriting') that I set up and for which I wrote the accompanying book. In the course I used the geometric letter model to explain how the strokes of the different letters relate to each other. This section will first introduce the model before using it to illustrate the ways in which roman type deviates from the Humanistic minuscule. This demonstration aims to highlight the differences between roman type and its handwritten origins. These differences suggest that, as I hypothesise, roman type was not exclusively modelled to exactly imitate handwriting; rather, it was also the result of technical considerations.

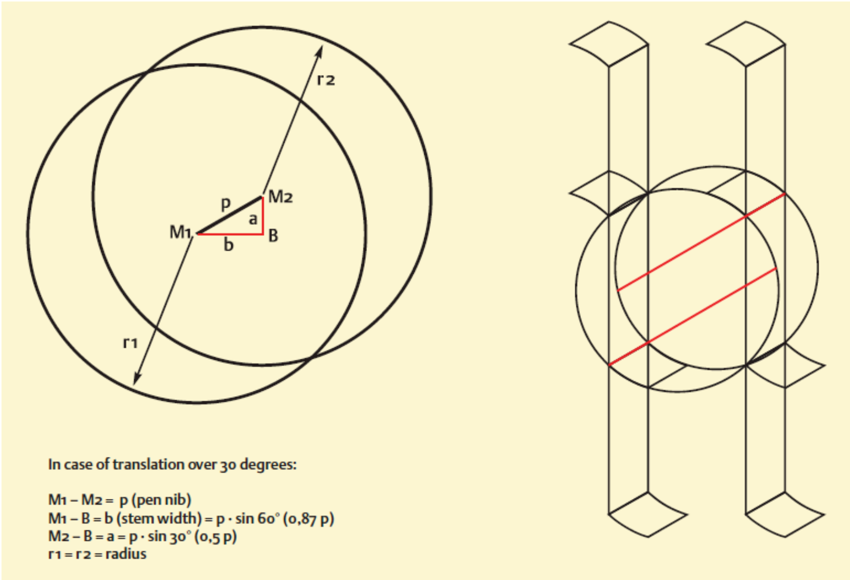


Figure 3.1 Geometric model for (the majority of letters of) the Humanistic minuscule.

If the Humanistic minuscule is reduced to its essence, i.e., stripped of details, the basic construction of the majority of the minuscules can be represented by my geometric letter model. This model reveals the relationship between the straight strokes and the overshoots of the curved ones. In Figure 3.1, the o of the Humanistic minuscule is made from two translated circles, using a vector angle of 30 degrees. The proportions of the n –and hence the h, m, and u– are the result of placing vertical lines through the intersecting points of the two circles, on which the same vector is subsequently used to determine the width of the stems.

Figure 3.2 All minuscules that do not contain diagonals can be formed using parts of the letter model.

The letters with diagonals –k, s, v–z– which find their origin in the Roman capitals, cannot be captured by this model. All other letters are made with this small set of strokes (Figure 3.2), because a calligrapher makes repetitive movements. The model does not have a specific top or bottom. After all, if one rotates the b one gets the q, if one does this with the d the result will be the p, and the n will become the u, etc.

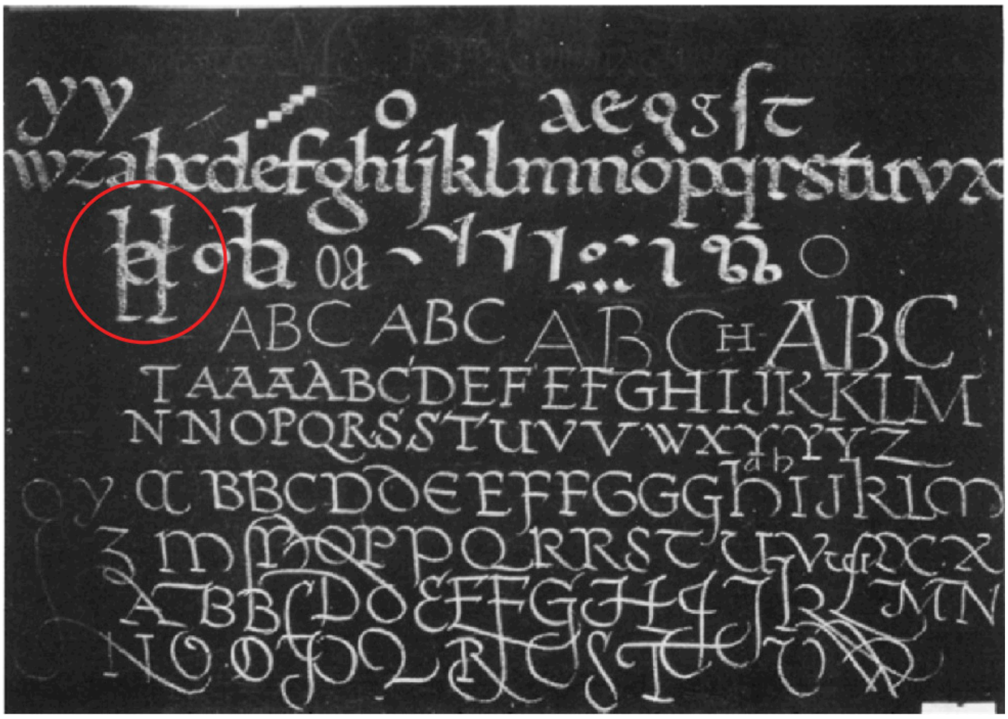


Figure 3.3 Johnston's model for the Foundational hand (beneath 'abc [...]') on a blackboard.

For the letter model I was inspired by pictures of blackboard demonstrations by Johnston (Figure 3.3), dating back to 1930 and 1931.[139] I translated Johnston's freely written diagram for the Foundational hand into a geometric construction. This serves two purposes: first, the model explains the structure of the handwritten pattern and, second, it transfers this pattern into a highly formalised one, which is required for the production of movable type, as I will argue in this chapter.

Using the geometric letter model, the creation of roman type from the Humanistic minuscule can be schematically reproduced in a small number of steps. Such a reproduction makes it easier to understand at which point roman type started to deviate from its handwritten origin. This deviation suggests that technical considerations were involved in the production of roman type, which is in line with my hypothesis and contrary to the general opinion that roman type production aimed to imitate handwriting. The starting point of this reproduction is handwriting, such as Poggio's *Littera Antiqua*, shown in Figure 3.4.

[139] Edward Johnston, ed. Heather Child and Justin Howes, *Lessons in Formal Writing* (London: Lund Humphries, 1986), pp.148,167.

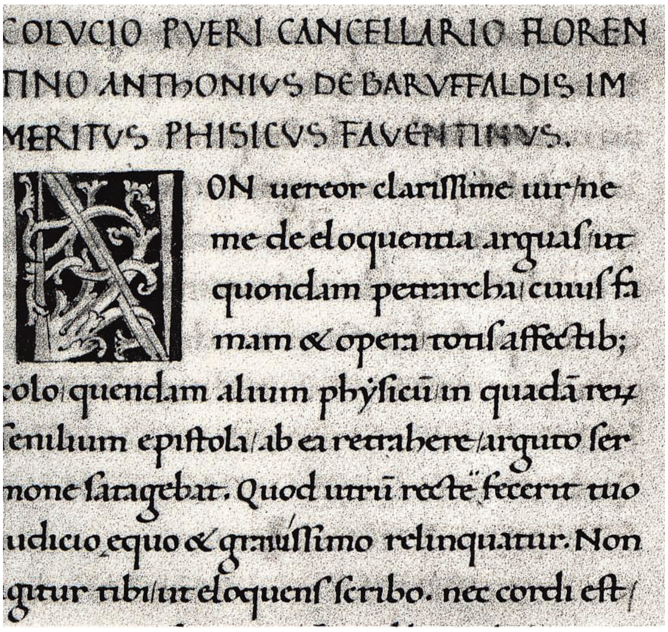

COLVCIO PVERI CANCELLARIO FLOREN
TINO ANTHONIVS DE BARVFFALDIS IM
MERITVS PHISICVS FAVENTINVS.
NON uereor clarissime uir/ne
me de eloquentia arguas/ut
quondam petrarcha/cuius fa
mam & opera totis affectib;
colo/quendam alium physicũ in quadã rex
senilium epistola/ab ea retrahere/arguto ser
none satagebat. Quod utrũ recte fecerit tuo
iudicio equo & grauissimo relinquatur. Non
igitur tibi/ut eloquens scribo. nec cordi est/

Figure 3.4 Poggio's *Littera Antiqua*.

Although meant in principle to look identical, and by definition sharing the same construction, handwritten letters inevitably deviate from each other. In Poggio's refined handwriting, for instance, no minuscule a is identical. By basically reducing the typographer's palette to one glyph for each uppercase character and one for each lowercase character, the text image is strongly standardised in the case of roman type. The following images show a stepwise transformation from the written Humanistic minuscule pattern to the roman typographic one.

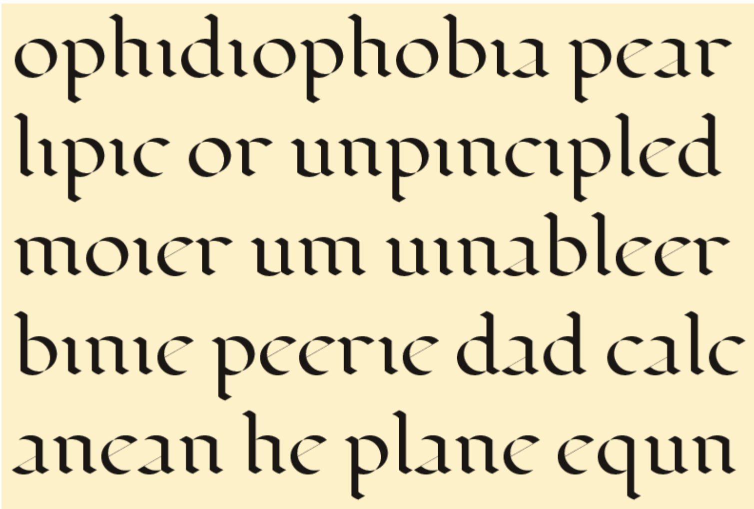


Figure 3.5 Humanistic minuscule geometrically reconstructed using the letter model.

Using letters constructed with the model one can form a text that geometrically represents the building of letters and words from strokes by the calligrapher

(Figure 3.5). The first formalisation is achieved by replacing the stroke endings by triangular serifs (Figure 3.6). The construction and weight of the serifs are directly related to the stroke endings that they replace. The serifs are identical at the top and bottom. This is something a calligrapher could simply do without changing the position of the broad nib.

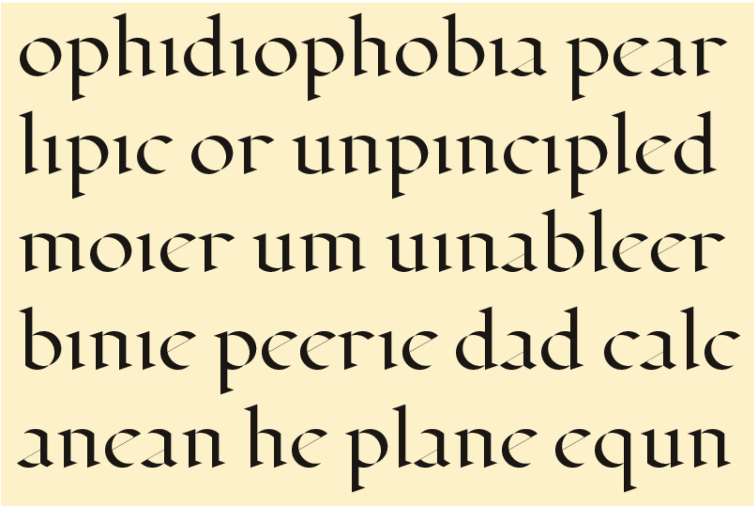


Figure 3.6 Replacement of the end strokes by triangular serifs.

As such the triangular top serif is not specific to type; it can also be found in more formally written variants of the Carolingian and Humanistic minuscule. The serifs at the bottom, on the other hand, were not treated this way by Renaissance calligraphers. However, this is the most consistent and therefore most logical replacement of stroke endings by serifs. Because it is not present in Renaissance roman type either, it is a purely theoretical addition.

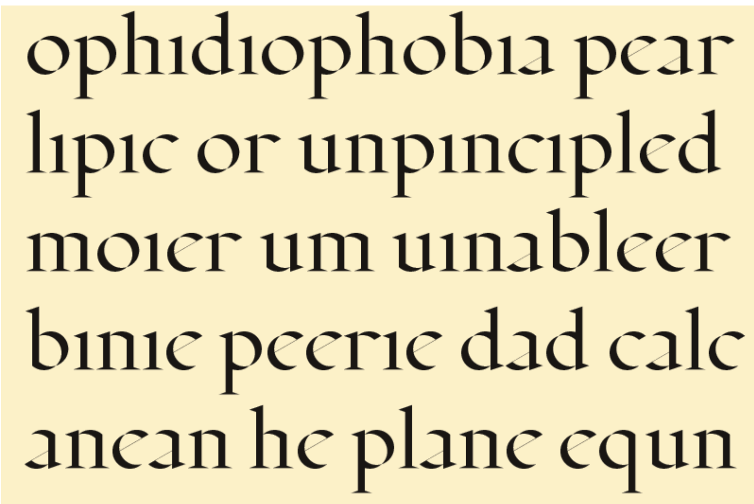


Figure 3.7 Triangular top serifs combined with ‘split’ bottom serifs.

In Figure 3.7 the bottom serifs are split variants of the triangular top serifs. This way the weight was distributed over both sides of the stems. At this point the letters clearly deviate from the handwritten model, because otherwise the calligrapher would have to rotate the pen nib and this would hamper the writing flow.

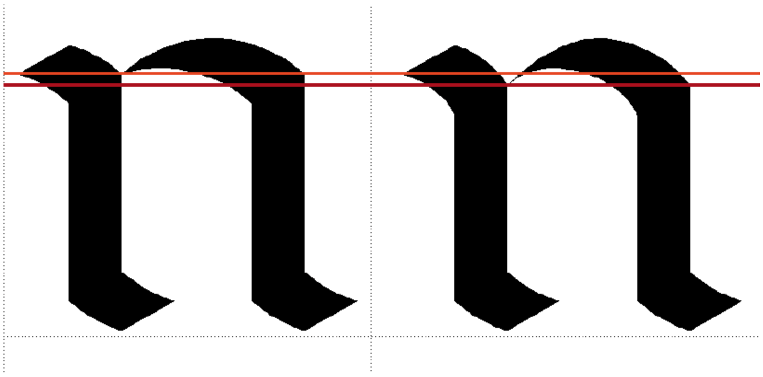


Figure 3.8 Curvature of the arches.

Written letters are usually smoother than the geometrical reconstructions with their hard connections between arches and stems. In Jenson's archetypal model this smoothing is even stronger, mainly because the arch is so bent that the counters of the h, m, n, and u almost resemble the shape of a Romanesque window. This is achieved by lowering the start point of the arch, which results in a movement of the curve's extreme towards the counter's centre (Figure 3.8).

The geometric model clearly shows that the Humanistic minuscule is mainly constructed of a limited number of strokes. This is a prerequisite for unity between the different letters. Consequently all details in roman type are related to one another. If the arch of an n is changed, then this will be also the case for the arches of the h, m, and u. It will also influence the shape of the bowls of the b, d, p, q, the terminals of the c and the f, etcetera. However, although the underlying structure of roman type can be represented by a relatively simple geometric model, this does not imply that the type designer is severely limited when it comes to applying details. The latter requires a thorough insight into the details of type design. These details are listed and discussed in Appendix 3, *Basic ingredients of Latin type*.

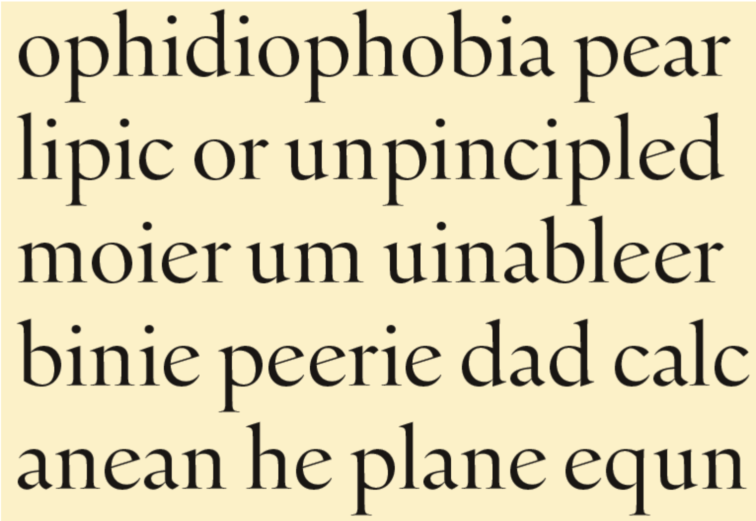


Figure 3.9 Further formalisation and polishing resulting in roman type.

In Figure 3.9 the letter forms of Figure 3.7 have been further refined by smoothing connections and further elaborating on details without changing the proportions of the previous models. This finally results in roman type. The o deviates the most from its broad-nib basis, because the two translated circles are transformed into a simplified and more vertically stressed shape.

The geometric letter model can also be used to construct other variations in roman type than the ones shown above. The following sections describe this process.

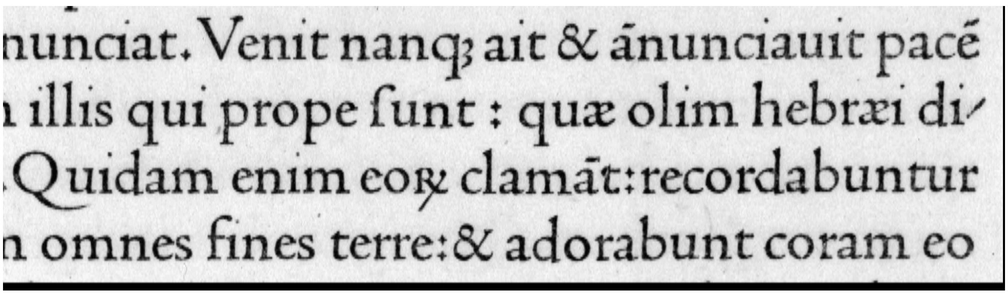


Figure 3.10 Jenson's roman type for *De Evangelica Præparatione* from 1470.

The contrast, which is the difference between the thick and thin parts of letters, in Jenson's type from 1470 (Figure 3.10) is considerably lower than in the type shown in Figure 3.9, although the two are related. A relatively low contrast is a prerequisite for small point sizes, because it prevents the (optical) disappearance of the thin parts of the letters. For smaller point sizes the letters need to be sturdier as well. A letter can be made bolder by simply drawing a line around a contour. This results in a reduction of the contrast, because the thin parts become relatively more emboldened than the thicker parts.

ophidiophobia pear
lipic or unpincipled
moier um uinableer
binie peerie dad calc
anean he plane equn

Figure 3.11 Rotation of the e-bar.

In comparison with Figure 3.10, in Figure 3.11 only the diagonal in the e has been replaced by a horizontal bar. Although this is a relatively minor change, the effect is quite extensive –if only because of the large percentage of e's that a text normally contains. This is one of the most notable changes Griffo made to Jenson's model.

ophidiophobia pear
lipic or unpincipled
moier um uinableer
binie peerie dad calc
anean he plane equn

Figure 3.12 Compression of the curved letters.

Figure 3.12 shows a compression of the curved letters with the exception of the o, which is only rotated to an upward position. The result is a more even image of the text. The more condensed lowercase e is a particular improvement over the one shown in Figure 3.11. Overall the relation between the stems and the bowls of the letters has clearly changed; the fact that the counter-axis has become steeper is the result of the compression of the curves (Figure 3.13). This effect can especially be found in roman types from the Baroque.

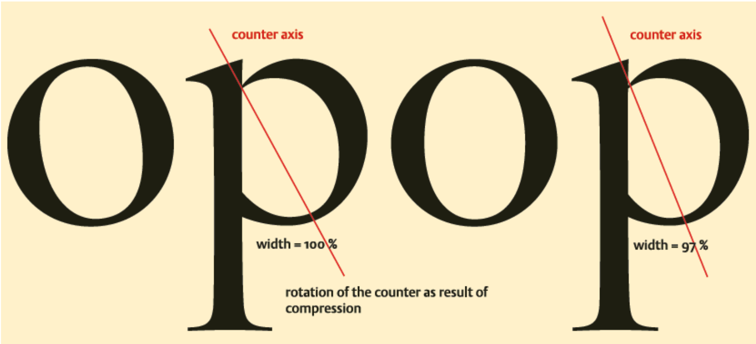


Figure 3.13 Compression of the curves and subsequent rotation of the o.

Because of the reduction of white space in the letters and consequently within the words and lines, the ascenders and descenders are shortened. If there is less white space within a line, less white space is required between the lines, as is described in Section 2 of this chapter. As mentioned, the length of the ascenders and descenders should also balance with the letter forms within the x-height. In Figure 3.13 the descender of the p on the right looks slightly longer than the one on the left because of the compressed counter.

Figure 3.14 Changed proportion of the e.

An enlargement of the x-height in relation to the ascenders and descenders is visible in the larger (display) point sizes of the French Renaissance and in text sizes of the Baroque. Many types from the Baroque show more horizontal compression of the curved letters in comparison to their Renaissance counterparts. This was done because of economical reasons in particular: compression made it possible to put more text on a page without changing the x-height. The e on the right in Figure 3.14 is an example of this.

ophidiophobia pear
lipic or unpincipled
moier um uinableer
binie peerie dad calc
anean he plane equn

Figure 3.15 Enlargement of the 'eyes' of the a and the e.

Finally, in Figure 3.15 the enclosed parts ('eyes') of the a and e have been enlarged. Since the Italian and French Renaissance, in general these relatively small counters have steadily become larger in type. Because of the repetition this also has a notable effect on the text image, of course.

The letters of the Humanistic minuscule are built using a limited number of strokes, as is illustrated by the letter model. Consequently, this is also the case for roman type. For a large part, what a type designer does when he designs roman type is to make variants within the structure of the letter model. As a result of the limited number of strokes, every detail that the type designer applies because of personal preferences is repeated numerous times. Zapf describes a typeface 'as a sum of a series of factors which must be fused into harmonious unity if a useful type is to result.'[140] These factors are discussed in Appendix 4: *Details of type*.

There are marked differences between roman type and its handwritten origins; these differences are captured in the geometric letter model. This demonstration lends further support to my hypothesis that roman type is the result of the standardisation of the Humanistic minuscule to the type production processes and that æsthetics were possibly not the only consideration in this process.

[140] Hermann Zapf, *About Alphabets* (Cambridge, Massachusetts: MIT Press, 1970), p.66.

3.2 LetterModeller application

As a part of my research, I developed the LetterModeller software application, or LeMo, which is built around the geometric letter model.[141] LeMo is meant to investigate movable Latin type patterns and to parameterise the design of digital type. A range of illustrations for this dissertation, such as Figure 3.16, were generated with this application.

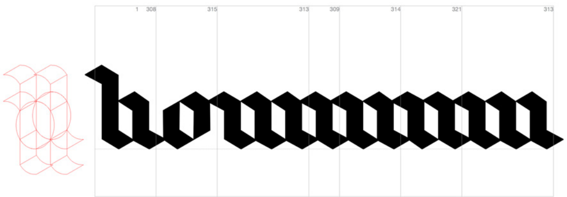


Figure 3.16 Textura pattern generated with LeMo.

The current version of LeMo supports Latin capital and Latin book hand minuscule, and is restricted to the contrast flow of the broad nib. It captures the morphology of the textura variants and the Humanistic minuscule because it was developed around the geometric letter model. The goal is that LeMo will eventually also support the contrast flow of flexible-pointed pen.

Figure 3.17 Writing parameters in LeMo.

With LeMo all aspects that affect writing with a broad nib can be parameterised (Figure 3.17). This includes the factors of pen width, pen thickness,

[141] LeMo is supported by macOS, Windows, and Linux. With LeMo CFF- and TTF-flavored OpenType fonts (the most current font format) as well as UFO files can be generated.

pen angle, x-height, ascender length, descender length, stretch factor, italic angle, and curve flattening. Sliders can be used to change each of these parameters.

The Humanistic minuscule is the result of writing with a broad nib. With the exception of the letters k, s, v–z, which find their origin in the capitals, these letters were not preceded by variants written with monolinear, or 'skeleton' strokes. In contrast with the Humanistic minuscule, capitals do find their origin in skeleton strokes. After all, the Romans adapted the monolinear Greek capitals by tracing the simple geometric structures with a flat brush.

Figure 3.18 Skeleton shapes for the capitals stored in LeMo.

Although the Humanistic minuscule finds its origin in writing with a broad nib, one actually can distil a skeleton line. The latter is the result of the applied broad nib, specifically of the pen (vector) angle. The relation between skeleton line and pen angle is described in Appendix 3: *Basic ingredients of Latin type*. The Humanistic minuscule was combined with adapted capitals, similarly to how in roman type the lowercase letters are combined with uppercase letters. LeMo combines the geometric letter model with skeleton forms for the capitals (Figure 3.18).

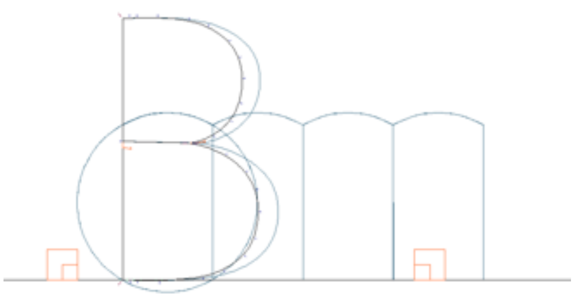


Figure 3.19 Capital widths are adapted to the width of the n.

The lowercase letters k, s, v–z can also be defined as skeleton lines. Effects applied on the letter model as the result of altered parameters are also applied on all skeleton forms. Figure 3.19 shows how the widths of the capitals can be adjusted to the skeleton lines distilled from the Humanistic minuscule: the width of the B is adapted to one and a half times the width of the n, which is used here to make a fence.

After parameterisation the characters can be stored in a glyph database for further processing (Figure 3.20). The parameter settings can be stored in a text file and hence reused.

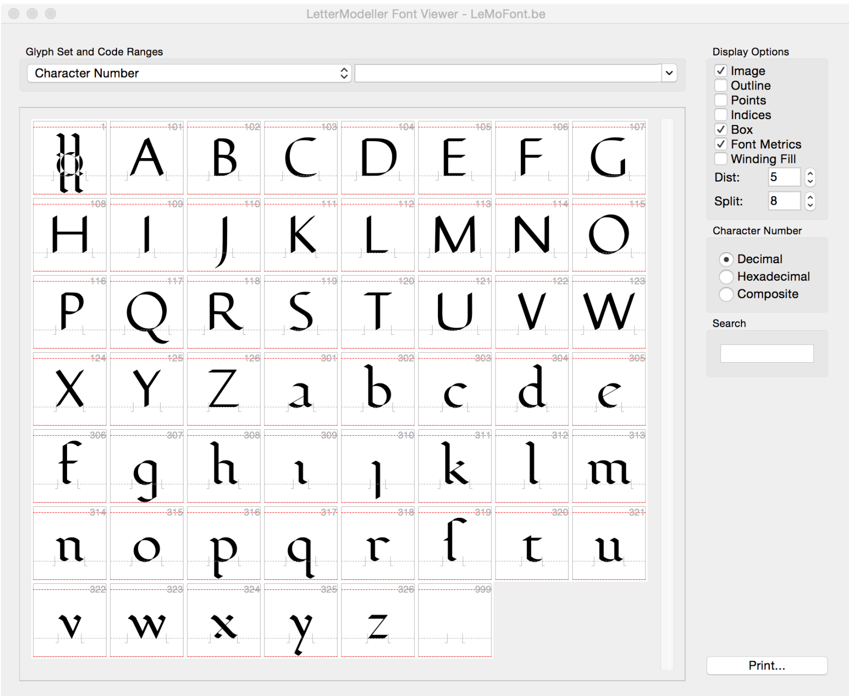


Figure 3.20 Parameterised characters can be stored in a glyph database.

LeMo contains an advanced glyph editor, in which the stored characters can be edited. Instead of writing on a template, which will be discussed in Section 3.3, the type designer can directly start to tweak the digital geometric model (Figure 3.21). The widths of the rectangles on which the geometric letterforms are placed, i.e., the character widths, are predefined in LeMo. These widths are marked by vertical boundaries: side bearings. The positioning of the side bearings is part of the patterning in LeMo and the letterforms can be enhanced within the predefined character widths.

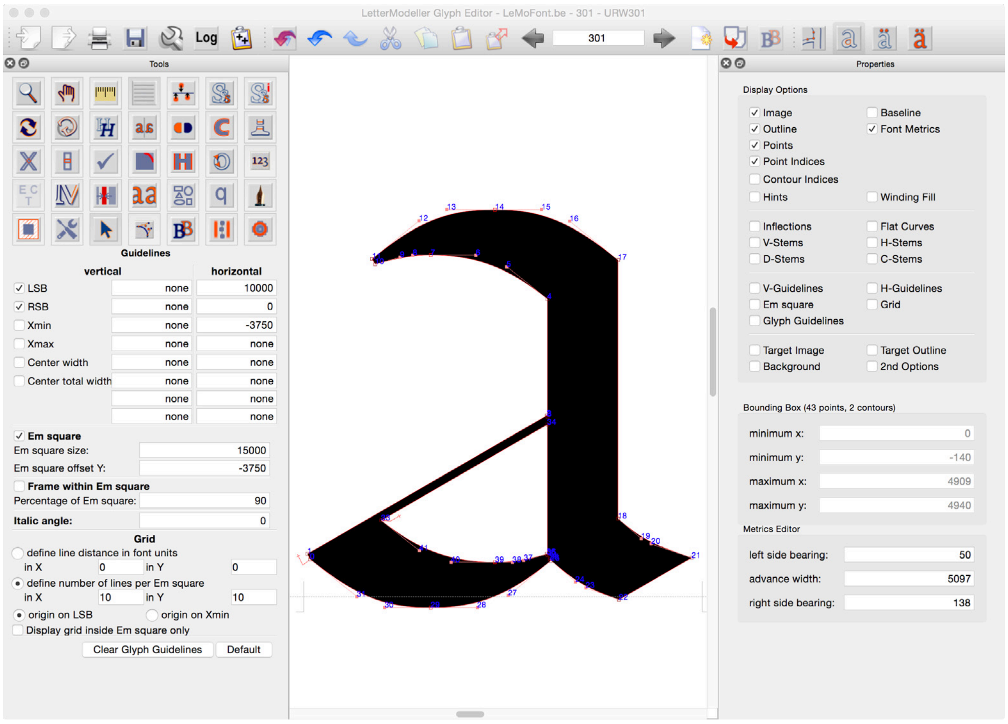


Figure 3.21 LeMo's glyph editor.

This makes it possible to quickly define a structure in which the rhythmical, weight, and contrast aspects are captured. Figure 3.22 shows the starting point for a roman type design.[142] Some refinements have already been applied on top of the pattern generated with LeMo: for example the curves and arches have been made smoother.

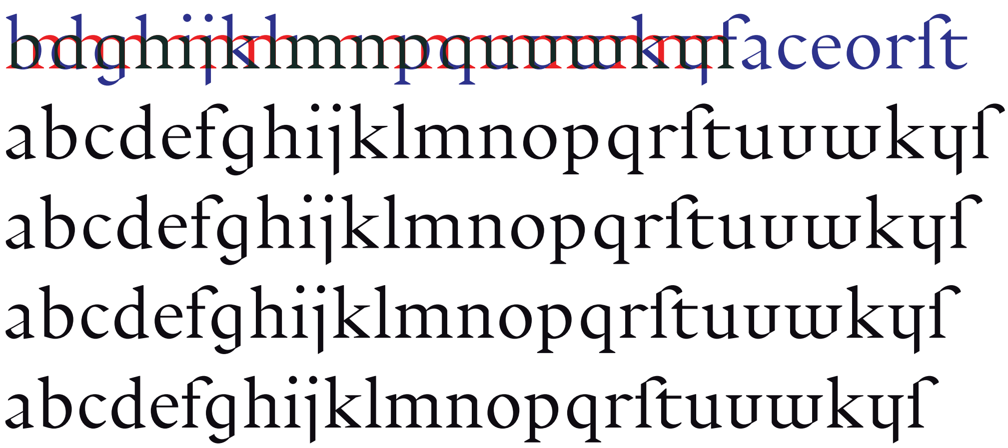


Figure 3.22 LeMo used for the patterning of a newly designed roman type.

---

142 This typeface was designed by Joost Dekker, who was a former student of mine of the Expert class Type design course of the Plantin Institute of Typography in Antwerp.

Overall the type shown in Figure 3.22 is very generic still but width, weight, contrast, and contrast flow are already fixed. This makes it possible to directly test the pattern in texts, as is shown in Figure 3.23, before details are worked out.

the quick brown fok jumpſ over the laſy dog univerſele verklaring van de rechten van de menſ preambule
overwegende dat erkenning van de inherente waardigheid en van de gelijke en onvervreemdbare rechten
van alle leden van de menſengemeenſchap grondſlag iſ voor de vrijheid gerechtigheid en vrede in de wereld
BN Model

the quick brown fok jumpſ over the laſy dog univerſele verklaring van de rechten van de menſ preambule
overwegende dat erkenning van de inherente waardigheid en van de gelijke en onvervreemdbare rechten
van alle leden van de menſengemeenſchap grondſlag iſ voor de vrijheid gerechtigheid en vrede in de wereld
BN Model minus 6

the quick brown fok jumpſ over the laſy dog univerſele verklaring van de rechten van de menſ preambule
overwegende dat erkenning van de inherente waardigheid en van de gelijke en onvervreemdbare rechten
van alle leden van de menſengemeenſchap grondſlag iſ voor de vrijheid gerechtigheid en vrede in de wereld
BN Model minus 12

the quick brown fok jumpſ over the laſy dog univerſele verklaring van de rechten van de menſ preambule
overwegende dat erkenning van de inherente waardigheid en van de gelijke en onvervreemdbare rechten
van alle leden van de menſengemeenſchap grondſlag iſ voor de vrijheid gerechtigheid en vrede in de wereld
BN Model minus 18

Figure 3.23 Different patterning of roman type tested in texts.

The next step in the design process is to refine the pattern. Figure 3.24 shows the details applied on the basic structure generated with LeMo. Clearly these details are not fully broad-nib based: the patterning does not restrict the creativity of the type designer. The typeface shows a contrast flow that is transitional, which means that it combines elements that find their origin in both writing with the broad nib and with the pointed pen, as can be found in eighteenth-century roman type.

abcdefghijklm
nopqrstuvwxyz
<fiflßæéêëïí>

Figure 3.24 Refinements on a predefined pattern.

Figure 3.25 shows the final result in a text. Despite the transitional contrast flow, the initial patterning with LeMo, which is in line with Jenson's standardisation, is visible still. It clearly provided the designer with a solid basis for the further development and refinement of the letterforms.

Overwegende, dat erkenning van de inherente waardigheid en van de gelijke en onvervreemdbare rechten van alle leden van de mensengemeenschap grondslag is voor de vrijheid, gerechtigheid en vrede in de wereld; ¶ Overwegende, dat terzijdestelling van en minachting voor de rechten van de mens geleid hebben tot barbaarse handelingen, die het geweten van de mensheid geweld hebben aangedaan en dat de komst van een wereld, waarin de mensen vrijheid van meningsuiting en geloof zullen genieten, en vrij zullen zijn van vrees en gebrek, is verkondigd als het hoogste ideaal van iedere mens; ¶ Overwegende, dat het van het grootste belang is, dat de rechten van de mens beschermd worden door de suprematie van het recht, opdat de mens niet gedwongen worde om in laatste instantie zijn toevlucht te nemen tot opstand tegen tyrannie en onderdrukking; ¶ Overwegende, dat het van het grootste belang is om de ontwikkeling van vriendschappelijke betrekkingen tussen de naties te bevorderen; ¶ Overwegende, dat de volkeren van de Verenigde

Figure 3.25 The final type design that started with patterning in LeMo.

Figure 3.26 shows another example of the application of LeMo for defining the pattern for a roman type design.[143] In this case a set of parameters that represent weight and proportions as used in Renaissance roman type by Jenson and his followers, formed the basis.

Figure 3.26 Customisation of the Renaissance preset in LeMo.

---

[143] This typeface, named FS Brabo, was made by my former Expert class Type design student Fernando Mello and released Autumn 2015. See also: <http://www.fontsmith.com/fonts/fs-brabo>. Mello has received several awards for FS Brabo: <http://www.tiposlatinos.com/2016/resultados.php> and <http://www.fontsmith.com/blog/2016/05/23/fs-brabo-wins-gold-at-the-european-design-awards>.

Proportions and dimensions were adjusted from there. After that a basic schematic font was exported from LeMo, it was imported into FontLab Studio, which is a commonly used font editor. Modifications in spacing and general dimensions of the font were made during the design process, but the core essence of the dimensions and the broad-nibbed pen scheme generated with LeMo remained. Figure 3.27 shows an example of the final version of the typeface.

Figure 3.27 The final type design.

3.3 Parameterisation of type design processes

The basic structure of roman type can be parameterised using LeMo, but to what extent is it possible to parameterise more detailed aspects of type design and to reduce the role of the eye? If something can be defined, it can be programmed but there are three big hurdles to face. First, it is necessary to have a detailed description of personal patterns and structures (idiom) in relation to the underlying generic letterforms. Second, the more refined these patterns and structures are, the more programming will be required and eventually this will result in a huge volume of data. Third, such a development requires a substantial amount of financial resources.

Eventually it should –at least theoretically– be possible to generate fonts in a certain idiom (for instance Van Krimpen’s or Zapf’s, a mixture of these, or one that is user-defined). It will take a significant amount of time and resources before this is possible, and until that time LeMo can be used to generate generic letterforms with control over the factors of pen width, pen thickness, pen angle, x-height, ascender length, descender length, stretch factor, italic angle, and curve flattening. As long as idiom cannot be parameterised, the type designer has to apply his own personalised patterns and structures in the glyph editor.

Many of the figures presented in this dissertation were created using LeMo. The following section will make use of this software to reproduce the moulding of the Humanistic minuscule into prefixed patterns for the creation of roman type.

3.4 Templates

In the following sections I describe a method in which the proportions and widths of the characters of roman type are first defined using geometrically based templates. The details of the letterforms are subsequently adapted to those widths. These templates may have been used in standardising the Humanistic minuscule for roman type production, thus making the production simpler and more reproducible, and hence to some extent minimising the role of the eye of the punchcutter.

The patterning in the Humanistic minuscule or any other hand is not something a starting calligrapher will easily control. In *Scribes and Sources* Arthur S. Osley presents an English translation of parts from *Libre nuovo d'imparare a scrivener* a writing manual by the Italian calligrapher Giovanni Battista Palatino (ca.1515–ca.1575) from 1540. Palatino's method for developing 'a fine, firm, and steady hand' underlines that patterning is the result of training:

> First, you must have a tablet of hard wood or copper, in which are cut, or rather hollowed out, all letters of the alphabet, made in their correct proportions with their basic elements, a little on the large side. Then take a stylus of tin, about the size of a small goose-quill, not hollow but completely solid as to give it weight and to leave your hand light and rapid when you stop using it. Cut this stylus to the 'ploughshare' shape as for a quill, though it is not necessary to slit the nib. Make your beginner move the end of the stylus repeatedly in the letters which have been hollowed out, starting each letter at the appropriate point, and continuing just as one does when writing with a pen. He should practice this way until he is certain that he can make the movements confidently without assistance. Then he begins to write on paper [...].[144]

In this way 'the beginner' not only becomes familiar with the movement, but also with the proportions of the letters. A consistent pattern of letters is only created when strokes and counters are repeated in a correct way. What is correct is

---

[144] Osley, *Scribes and Sources*, p.95.

relative; as history teaches us, hands can be compressed or wide, but all letters in a row should have related proportions. If a certain letter is relatively wide it will stand out in the pattern and will hence spoil it. A starting calligrapher needs guidance to create consistent patterns. There is clearly no pre-programming in the brain that results in a natural ability to create rhythmically strong 'fences' in textura quadrata or Humanistic minuscule. This patterning has to be obtained by practising.

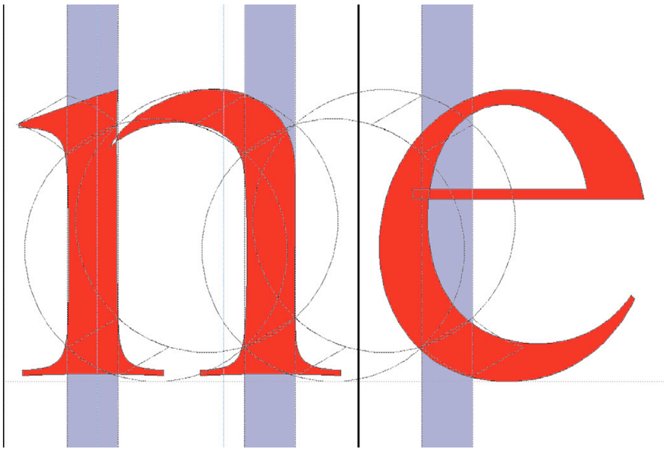


Figure 3.28 Positioning of side bearings in between the stems.

The structure of the Humanistic minuscule can be captured with the geometric letter model, and with the latter a pattern can be created that forms a template for writing (Figure 3.29). The positioning of the side bearings in the template directly comes forth from the intrinsic patterning in the handwritten model. As shown in Figure 3.28, the round strokes are overshoots of the stems and hence the character widths of the letters b, d, h, n, o, p, q, and u are identical. Because of their open counters, the a, c, and e require a smaller width, which is defined in the template by setting the side bearing tightly to the strokes that mark the counters. The width of aforementioned three letters is identical. The width of i and j are the same. The left side bearing of the f is identically placed as the left side bearing of the i because the shapes are corresponding. The right side bearing of the f is tightly placed to the horizontal bar because the f fits the pattern best this way.

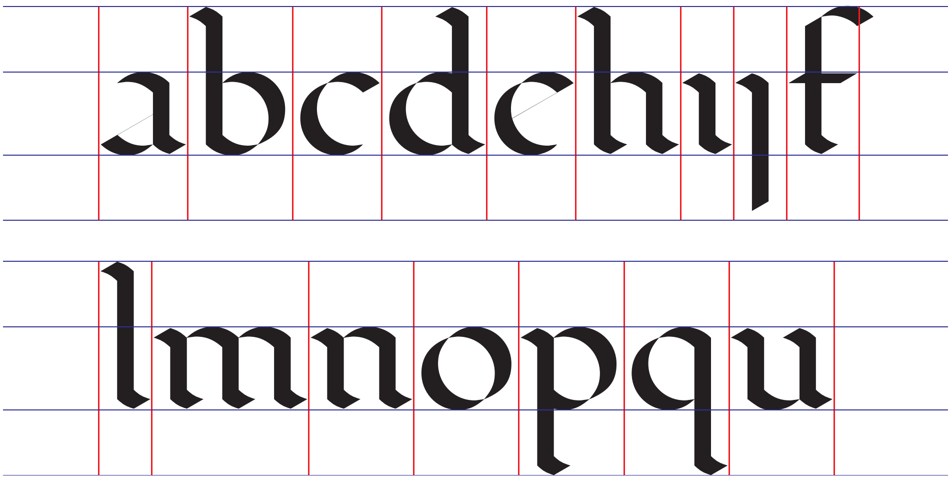


Figure 3.29 Pattern created with the geometric letter model.

The calligrapher can trace this template and in this way becomes acquainted with the archetypal proportions of roman type. Because the side bearings are part of the pattern, the fitting already exists and the written letters can easily be translated to (digital) type. To understand the quintessence of foundry type, the pattern in Figure 3.29 can be used to cut paper strips using the side bearings, and texts can subsequently be set with these strips. The pattern can also directly be used in LeMo for creating digital fonts.

Today it is common practice to design characters first and subsequently apply side bearings. It is plausible that during the early days of typography the proportions and widths of the characters were defined first and the details were then subsequently adapted to those widths. The possible use of templates in early font production is in line with my hypothesis that the Humanistic minuscule had to be standardised for roman type production, in a process analogous to the (more natural) standardisation of the textura hand for textura type production.

The following section describes stepwise the application of the template for the systematisation of writing and the subsequent transformation of the written letters into roman type, while retaining the side bearings and the positioning of the letters within the prefixed widths.

3.5 Systematised writing

When writing is used as basis for designing roman type, in line with Johnston's and Noordzij's theories, usually the proportions of the Humanistic minuscule will be investigated and practised via writing the Foundational hand model. Hence, when teaching type design, an instructor explains what these proportions are and how the pen has to be directed. But if these proportions can be captured in a geometric pattern, it makes sense to trace the pattern with a broad nib, in line with the method described by Palatino in his writing manual from 1540, as quoted in the previous section. Using LeMo, this section will demonstrate the possible steps involved in standardising the Humanistic minuscule for roman type production. It will then use the resulting patterns to digitally fit roman type.

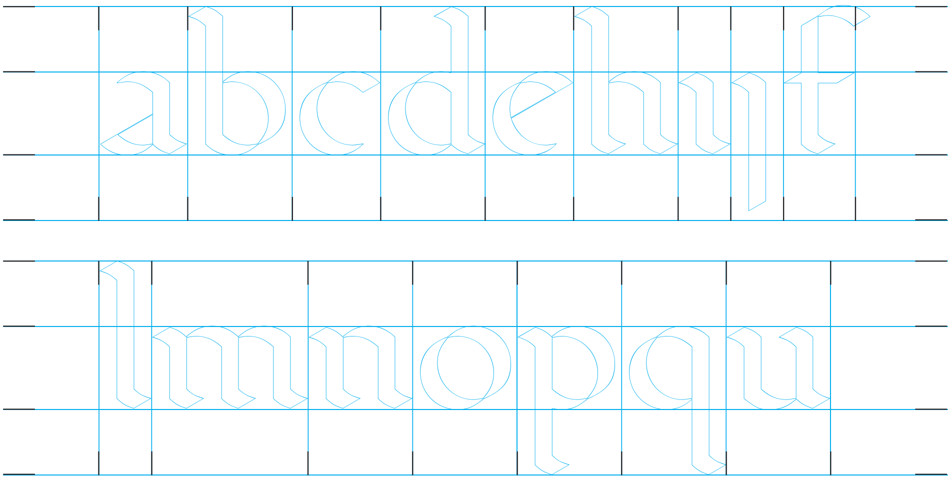


Figure 3.30 Template formed by the geometrically based pattern.

To be traceable, the pattern for standardisation should be created with outlines. One can use blue lines for the letter shapes and black lines for indicating the character widths and body, as shown in Figure 3.30. This makes the reproduction of the written letters on black and white photocopiers, or by line scanning, easier because the blue lines are not reproduced.

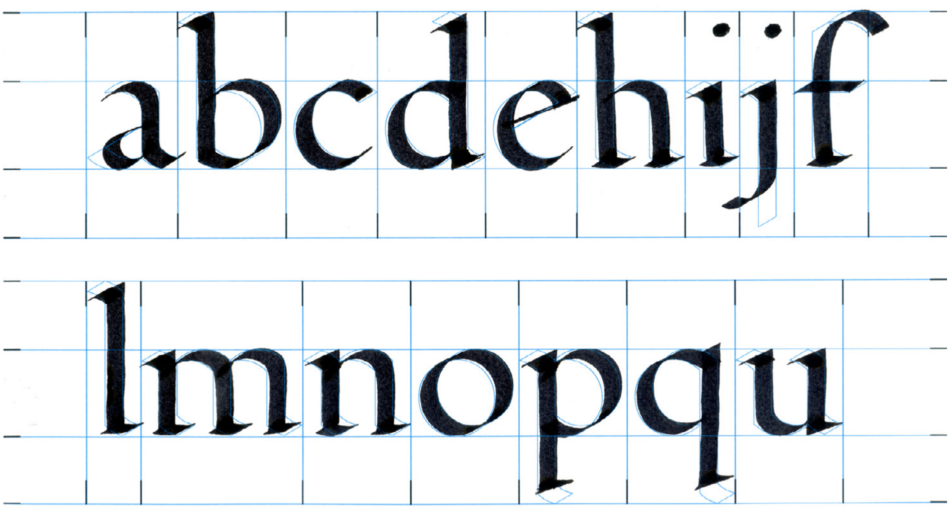


Figure 3.31 Pattern traced with a broad nib.

Next, the pattern can be traced with a broad nib. The width of the nib has to relate to the template, of course. In the case of a translation over 30 degrees, the stem thickness is pen-width · sin 60° = 0.87 pen-width. The x-height in Figure 3.31 is five times the stem thickness; approximating what I measured in Jenson's roman type. For the examples presented here, I traced the pattern using a Pilot Parallel Pen with a six-millimetre nib.

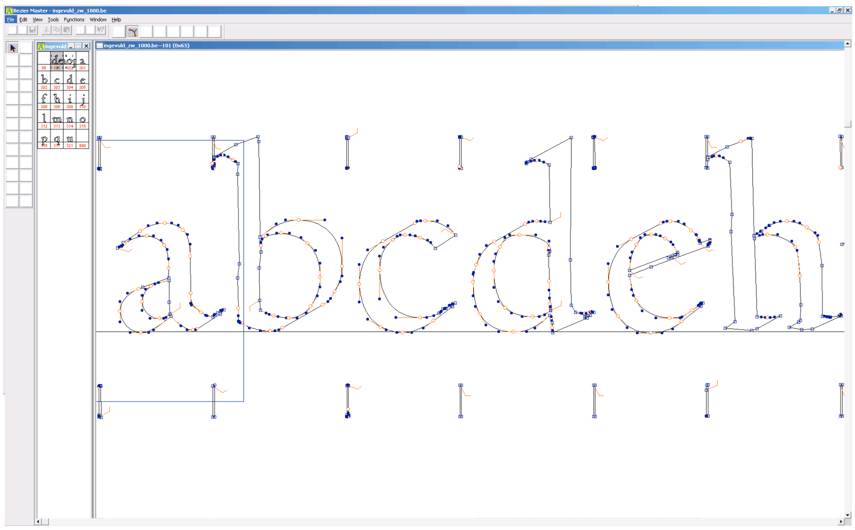


Figure 3.32 Auto-traced calligraphy.

The pattern standardises the proportions of the written letters. The standardisations required for the Renaissance font production suggest that, as I hypothesise, it is plausible that Humanistic handwriting was systematised this way before it was transferred to roman type. In line with the Renaissance punchcutter, the present-day type designer can use the written letters as a direct basis too, by converting them to digital contours using an auto-tracer (Figures 3.32 and 3.33).

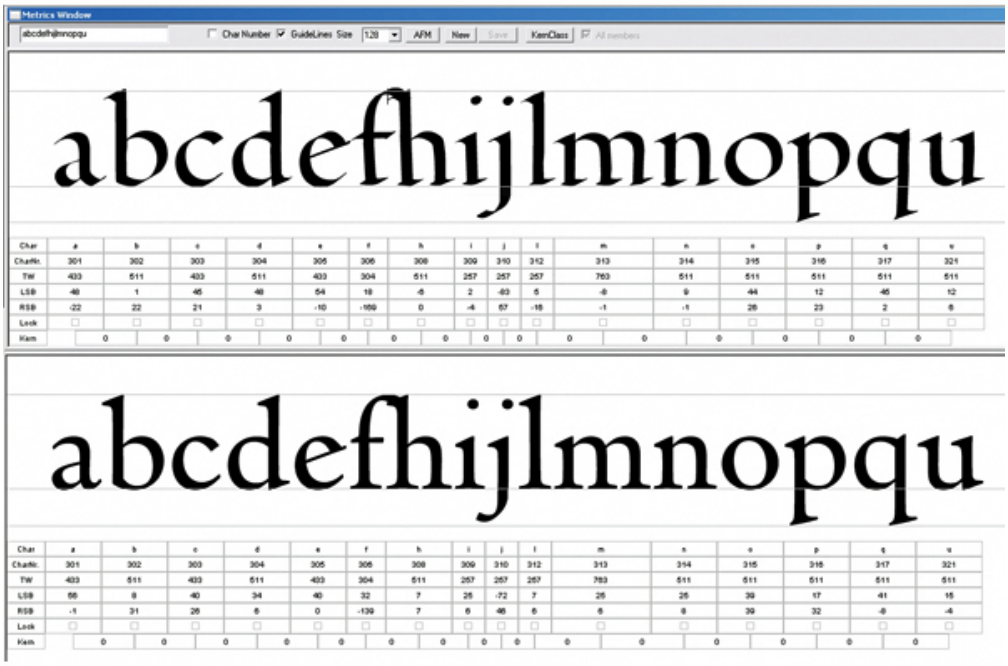
Figure 3.33 Auto-traced letters with filled contours.

The auto-traced letters can be separated and placed in slots in a digital font. The side bearings can be positioned using the small black indicators. Hence, the fitting process is purely a technicality; there is no optical processing required, thus minimising the role of the type designer's eye in the production process. Subsequently text can then be set with the font (Figure 3.34).

quill jumped and bounced
and one headline of penman
compiled a bad headache

Figure 3.34 Text typeset using the digitised written letters.

Jenson's roman type shows several deviations from the digitised written letters shown here: his letters are clearly more formalised and systematised and the serifs have chisel-based shapes. I adapted the written letters accordingly to create a digital roman (Figure 3.35).



Char	a	b	c	d	e	f	h	i	j	l	m	n	o	p	q	u
CharNr.	301	302	303	304	305	306	308	309	310	312	313	314	315	316	317	321
TW	433	511	433	511	433	304	511	257	257	257	763	511	511	511	511	511
LSB	48	1	46	48	54	18	-6	2	-83	6	-8	9	44	12	46	12
RSB	-22	22	21	3	-10	-169	0	-4	67	-18	-1	-1	26	23	2	6
Lock																
Kern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Char	a	b	c	d	e	f	h	i	j	l	m	n	o	p	q	u
CharNr.	301	302	303	304	305	306	308	309	310	312	313	314	315	316	317	321
TW	433	511	433	511	433	304	511	257	257	257	763	511	511	511	511	511
LSB	56	8	40	34	40	32	7	25	-72	7	25	25	39	17	41	15
RSB	-1	31	26	6	0	-139	7	6	48	6	6	8	39	32	-8	-4
Lock																
Kern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Figure 3.35 Written pattern transferred into digital roman type.

I maintained the stem interval and specifically manipulated the lengths of the serifs to obtain equilibrium of white space. The n, for example, is measurably centred on its width; this preserves the equal distances between all stems. It is plausible that it is for this reason that Jenson applied symmetrical serifs to the lowercase n (Figure 3.36). The o looks round, but is actually an ellipse and is still as wide as its handwritten origin.

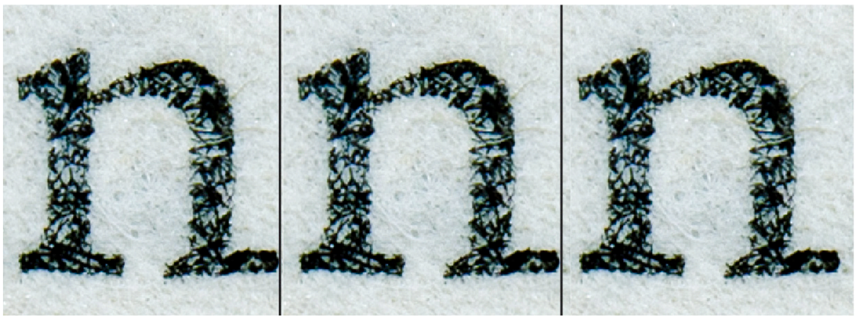


Figure 3.36 Jenson's lowercase n centred between side bearings.

The newly created roman type can be used for typesetting (Figure 3.37). The character widths are identical to the ones shown in Figure 3.31 still. The details of the letters are adjusted to the widths, in contrast with what is common practice nowadays –namely that widths are adjusted to the details of the letters.

quill jumped and bounced
and one headline of penman
compiled a bad headache

Figure 3.37 Text typeset with roman type that finds it origin in systematised writing.

In the text a few letters are missing: the g, k, s, t, and the v–z range. The g and the t can be made with the geometric model, although in the case of the g that is only true of the single-storey version: ɡ, and not for the double-storey version: g. The letters that find their origins in the capitals (k, s, v–z) have to be fit into the widths of the range that can be generated with the letter model; these letters dictate the rhythmic pattern. An example of how this was handled in French Renaissance roman type can be found in Section 2 of Chapter 7.

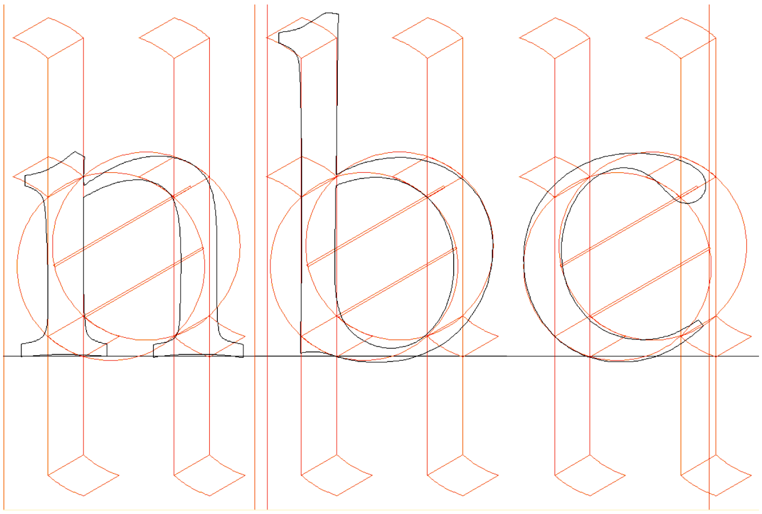


Figure 3.38 The n, b, and c from Van den Keere's Parangon Romain on the template.

This section demonstrated the way in which I used the LetterModeller application to create standardised patterns of Renaissance handwriting, and presented examples of digital reproductions of roman type fitting using those patterns. These reproductions suggest that Renaissance roman type could well be based on a systematised version of the Humanistic minuscule rather than trying to precisely imitate handwriting. Figure 3.38 shows a couple of letters from the roman of DTL VandenKeere positioned on the geometrically based template.

Figure 3.39 The roman and italic of DTL VandenKeere.

DTL VandenKeere (Figure 3.39) is a revival I produced more than twenty years ago based on the Parangon Romain that the Flemish punchcutter Van den Keere cut in 1575 (the italic I based on the Ascendonica Cursive that Guyot cut around 1557).

The eminent connoisseur of Renaissance type Hendrik D. L. Vervliet (1923) considers the Parangon Romain one of the truly outstanding designs originating in the Low Countries.[145] The similarities between the proportions of Garamont's Parangon Romain from 1564 and Van den Keere's Parangon Romain are evident. Just like Garamont's type, the roman of Van den Keere clearly follows the pattern that originated in Renaissance Italy and consequently it shows the same standardisation of widths that can be found in Jenson's archetypal roman.

This chapter illustrated differences between roman type and its handwritten origins, and then made use of LeMo to digitally reproduce the standardisation of the Humanistic minuscule for type fitting. Contrary to the generally accepted theory that roman type was based on the Renaissance punchcutters' visual preferences, this evidence supports my sub-hypothesis that it was in fact the result of standardising the Humanistic minuscule to the type production process.

[145] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.252.

CHAPTER 4

The translation of the handwritten textura quadrata to textura type was much more straightforward than that of the Humanistic minuscule to roman type. Because their round and open texture is more difficult to control at small sizes, the Humanistic minuscule and its Carolingian precursor were much more irregularly written than the textura quadrata. Therefore, translating the Humanistic model into roman type while relying solely on the eye would have been complex and time consuming. It is plausible that patterning of the Humanistic minuscule was required for the production of roman type. As was demonstrated using the LetterModeller application in the previous chapter, such structuring is possible because of the intrinsic patterning in the Humanistic minuscule.

The present chapter focuses on the standardisation of widths both in textura and roman type production. Due to the morphological relationship between textura handwriting and the Humanistic minuscule, the production of roman type was simplified by casting it on an adapted version of the scheme that was already in use for the production of textura type. The chapter will first describe the process of optically spacing type before discussing the advantages of using standardised widths instead. It will then discuss the similarities in widths in gothic and Renaissance prints, using a horizontal grid system that I developed to measure width standardisation. This grid system will be applied to textura and roman characters in order to further highlight the similarities in their character widths. The aim is to provide further evidence that, thanks to the underlying morphologic relationship between textura and Humanistic handwriting, the Renaissance punchcutters could make use of standardised handwriting in the production of roman type in a process analogous to that of the production of textura type.

4.1 Optical spacing

Before presenting any evidence of standardised widths in type, an understanding of type spacing, which results in the fitting, is needed. This section describes the process that is mostly used nowadays, which focuses on equilibrium of white space. In this process letter forms are designed first and then spacing is defined with the focus on an even distribution of the space between the letters. This method is widely accepted to have been used by the Renaissance punchcutters too.

Spacing type and defining side bearings are not, in theory, highly complex matters. The goal is that letters combined in words show an optimised pattern: 'Perfect spacing means that the letters in a word are bonded like bricks, and therefore maximum word pattern recognition is possible with no cause for the eye to be arrested in its scanning on account of spacing.'[146]

Only the space within the x-height of the lowercase letters is important for spacing roman type. The lengths of the ascenders and descenders do not have any influence on the spacing. Exceptions to this rule are formed by colliding parts of letters outside the x-height, such as the combination 'gj' in which, depending on its design, the terminal of the j may collide with the bottom part of the g (this combination is not unusual in Dutch). Most type designers start spacing by making a fence of n's or m's, and judge the spacing of other characters against the fence. In the case of Figure 4.1 the stem interval is the same within and between the n's. Because the shapes of the right and left stems of the n are identical, the side bearing can be centred exactly between the stems.

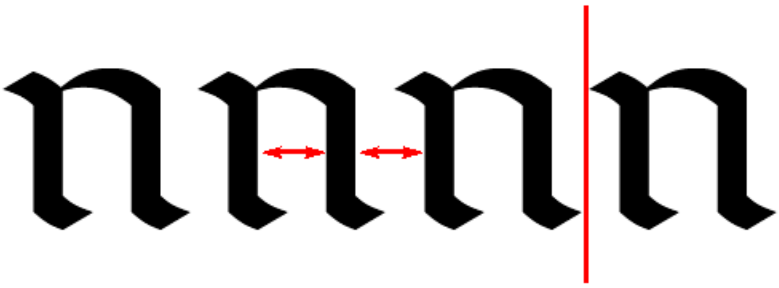


Figure 4.1 Dividing space between point symmetrical letterforms.

In roman type, not many shapes can be centred between side bearings. The o and the part of the l within the x-height normally form exceptions in archetypal and present-day roman type.[147] In case the two stems of the n are not identical, as shown in Figure 4.2, positioning the side bearings in such a way that the letter is optically centred requires an extra step. After defining the fence pattern, an arbitrary side bearing can be drawn in between the characters. This results in a distance between the right stem of the left n and the side bearing (indicated with '1'). By placing the side bearing at the same distance from the right stem of the right n, the character width is defined.

[146] Kindersley, *Optical Letter Spacing*, p.24.

[147] If the n is made with short serifs on the left and a long one on the right, like Jenson did, it can be centred between the side bearings too, but the o and l will usually be centred in any roman type design even if the n is not.

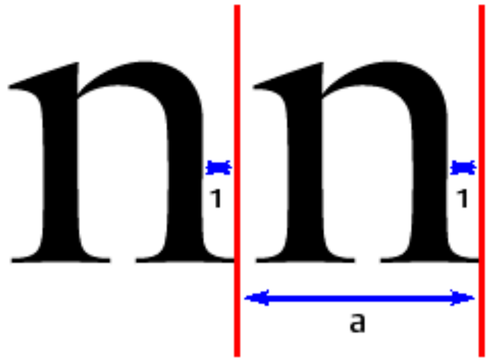


Figure 4.2 Defining the character width of the lowercase n.

Theoretically, this is enough information to space all other letters and characters, because these can be placed optically correctly between a number of n's. The side bearings of the n mark the side bearings of the spaced letters in between them. Letters that share (almost) the same forms, like the related bowls of the b, d, p and q with the o, can be spaced identically. Therefore it is not necessary to space every character separately; instead, groups of related letter forms can be made.

It has always been common practice to centre characters optically within their space. In theory, this is not necessary: if all letters within a font have the same deviation, that is to say the same offset, the spacing is identical to that of optically centred letters. However, matters become complex if different fonts, such as italics, are combined in lines: the other fonts must have the same deviation or the word spaces that combine the fonts become irregular. Therefore, it makes more sense to optically centre a character within its space. In Figure 4.3 the character space is marked by black strokes and the n is optically centred in between those strokes. As a result, the distance from the left side bearing to the left stem is larger than the distance from the right side bearing to the right stem.

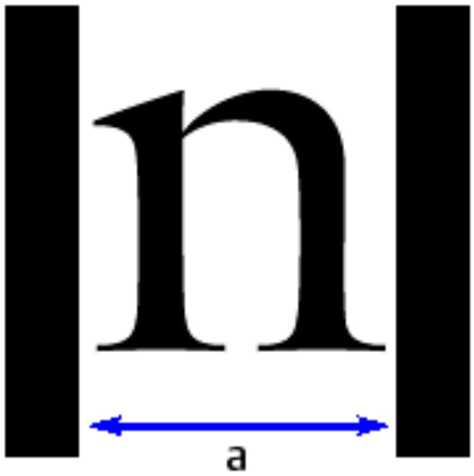


Figure 4.3 Optically positioning the n in the centre of the character width.

This positioning of the n obstructs the stem interval. When the n is optically centred, the distances from the left stem to the left side bearing and from the right stem to the right side bearing are not completely identical: 'The width between the uprights of n is measured, and a half of that amount is given to the left side of the letter and slightly less on the other side, because the arched corner seems to add to the space.'[148]

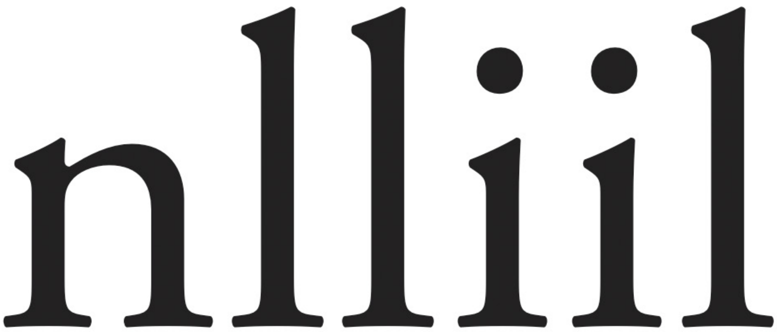


Figure 4.4 Adobe Garamond shows a slightly disrupted stem interval.

The different distances from the stems of the n to side bearings are the result of designing the letter forms before spacing them. In most cases the n will have symmetrical serifs instead of asymmetrical ones, as shown in Jenson's roman type (Figure 3.36). As a consequence the stem interval will not be completely even if equilibrium of white space has been achieved: in Figure 4.4 the distances between the stems are all different, with most space between the i's. Equilibrium of white space is especially visible when type is spaced at a relatively large size, like what is

[148] Walter Tracy, *Letters of Credit: A View of Type Design* (Boston: David R. Godine, 1986), p.74.

done on high-resolution computer screens today. Such a refinement was simply not possible to control for the early punchcutters considering the small size of their types.

Figure 4.5 Spacing the a in between two n's.

Placing the other characters in between the n's, as is shown in Figure 4.5, is not the only way to define their character widths. Another method is to place the next character twice in a row within the same rhythm by eye (Figure 4.6). Defining the right side bearing (indicated with 1) automatically results in the left side bearing of the following character. Measuring the distance from any arbitrary point of the following character (2) and using this information to define the same side bearing for the repeated character results in the right side bearing (3).

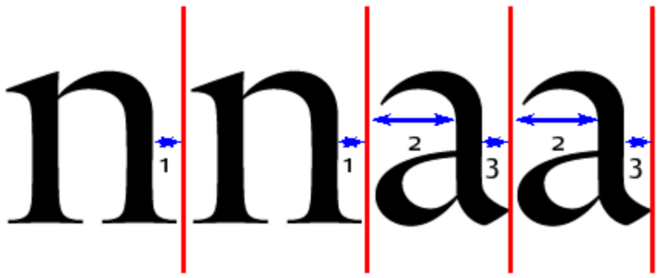


Figure 4.6 Defining side bearings by repetition.

Optical spacing is a back and forth process. If characters do not fit in the pattern, for instance because they are too wide or too condensed, they have to be revised. If the pattern is predefined, as discussed in the previous chapter, the proportions of the characters and their widths are inseparably connected. This makes spacing a more straightforward process. How the spacing and the casting of movable type were interconnected is discussed in Appendix 10, *Spacing and casting*.

4.2 Advantages of width standardisation

Before examining any evidence of width standardisation, it is important to understand the practical reasons for using such a system rather than optical spacing in Renaissance type production. By using the standardised construction that is an organic element of the patterns of both handwritten textura and Humanistic minuscule, the Renaissance punchcutters could reduce the number of widths on which characters were placed. In the production of movable type, the advantages of such an approach are twofold. First, one can predefine the widths of the characters, which serves to define and preserve the pattern before a punch is cut. This prevents an empirical process in which each punch has to be visually judged against others. Second, the number of widths of the copper bars required for striking matrices can be limited in this way, thereby also preventing loss of valuable material when justifying (finishing) the matrices.

4.3 Comparing widths in textura and roman type

If width standardisations were applied in the type production process, one should be able to distil proof of this from artefacts. Unfortunately there are neither matrices nor foundry type preserved from Gutenberg's and Jenson's time. This leaves only the measurement of Renaissance prints. To highlight the similarities in the widths of their characters, this section compares prints of textura and roman type.

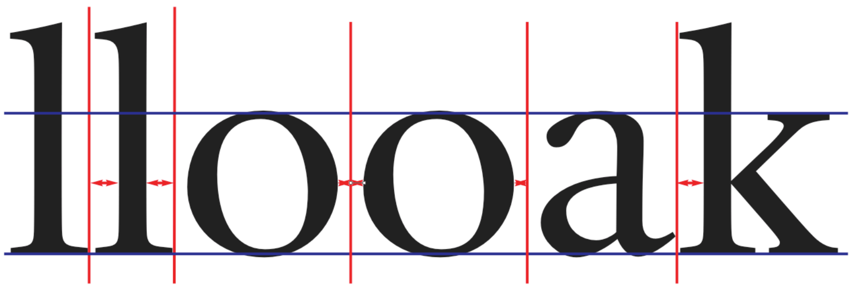


Figure 4.7 Distilling the positioning of the side bearings.

The method that I have developed during my research for distilling the widths from historical prints is as simple as it is effective (Figure 4.7). Irrespective of whether the spacing is done optically or on a predefined pattern, in roman type two letters will have an identical positioning of the left and right side bearings within the x-height: the l and the o because within the x-height these letters are symmetrical. When a text contains a sequence of either two l's or twice the o, the side bearing between the repeated letters will by definition be centred. As soon as the position of this side bearing has been set in a historical print, the text can be checked for other exemplars of the same letter and the side bearings of the adjacent letters can be determined in the same way as shown in Figure 4.6. Also there will be many shapes related to the l and o which will normally share the same positioning of the side bearings. For example the left side of the lowercase k will usually be identical to the left side of the l and hence will have the same positioning of the side bearing. The bowls of b, d, p, and q will most likely share the positioning of the side bearings of the o.

Figure 4.8 shows Gutenberg's textura type on a limited number of widths. The widths are numbered, starting from '1' for the smallest one (this is not a value of any kind, but simply an indication of relative width). Letters like b, p, and u share the same width (indicated with '4') just like the geometric letter model illustrates. The a has been placed on the same width. The m shares its width with the c-u ligature.

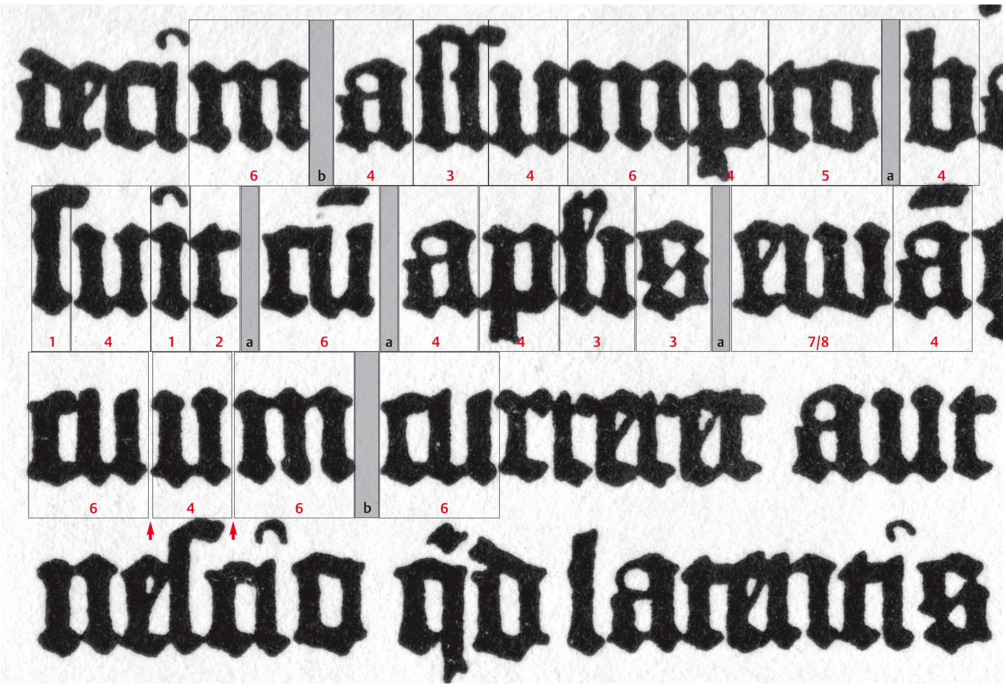


Figure 4.8 Gutenberg's textura type shows a limited number of widths.

In contrast, Figure 4.9 shows details from *De Evangelica Præparatione*, in which Jenson's roman type was used for the first time. As my hypothesis predicts, a limited number of widths, comparable with Gutenberg's textura type, can also be found here.

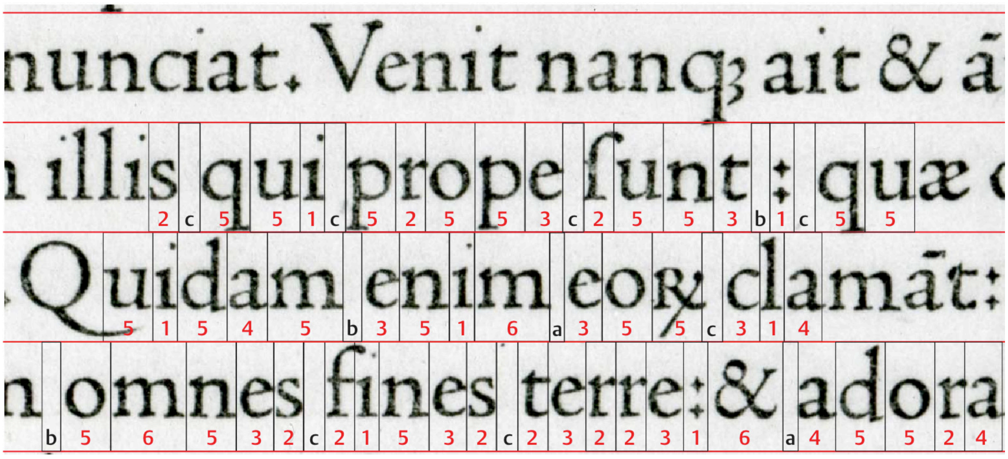


Figure 4.9 Jenson's roman as applied in *De Evangelica Præparatione* from 1470.

Even the rougher hybrid type from Sweynheym and Pannartz, applied in *Postillæ in Biblia* by the Franciscan teacher Nicolaus de Lyra (ca.1270–1349) in 1472 (Figure 4.10), shows standardised widths. In some cases the letters seem to be positioned on incorrect widths (indicated with blue) that belong to other ranges.

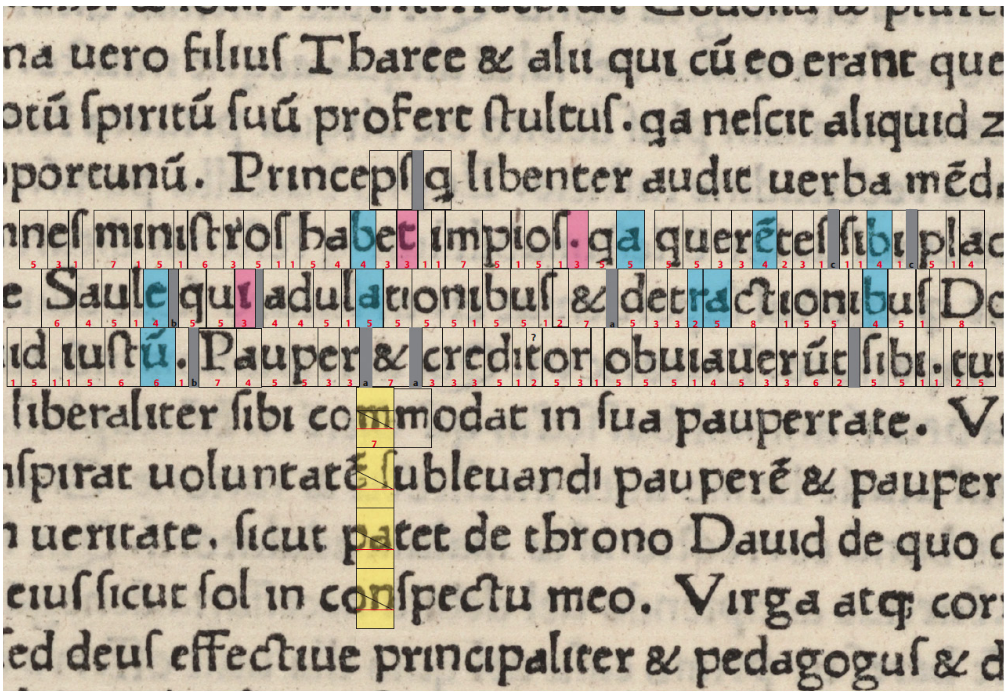


Figure 4.10 Sweynheym and Pannartz's roman type from 1472.[149]

This raises the question of whether the type was cast with fixed-width moulds, i.e., a different mould for every character width in contrast with an adjustable mould. Or were mistakes made when copper bars with consequently prefixed widths were

[149] <https://wikis.uit.tufts.edu/confluence/display/TischTech/23>

selected for the striking? In any case, the rhythmic pattern of the type is clearly inferior in comparison with that of Gutenberg and Jenson.

In this section textura and roman prints were compared to show that a limited number of widths can be found in both types. The following sections will present a framework that can be used to standardise the horizontal proportions of type, and will then use this framework to examine evidence suggesting that such a framework was not only used by Gutenberg, but by Jenson and other Renaissance punchcutters as well.

4.4 Comparing textura and roman type fitting

This section will demonstrate that a grid-based width system is clear in textura type. Then it will provide examples of the textura grid being applied to roman type. The aim is to show that the Renaissance punchcutters directly applied textura patterns to roman type, which is possible due to the morphologic relationship between the textura quadrata and the Humanistic minuscule.

The distinguished type designer and author on typography Adrian Frutiger (1928–2015), especially renowned for his sans-serif typeface Univers, considered it plausible that Jenson, like Gutenberg, adopted a grid system as framework for the rhythmic patterning of type. This is in support of my hypothesis that the standardisation of the Humanistic minuscule for roman type production was in analogy to the more natural standardisation of textura handwriting for the production of type. According to Frutiger, the framework resulted in counters and side bearings of equal weight. This created an even stem interval. Frutiger drew his own serifed roman typefaces accordingly (Figure 4.11).

Figure 4.11 Frutiger's even patterning of stem distances in his serifed roman type (top).

His former teacher, the Swiss type designer, calligrapher, and author Walter Käch (1901–1970), disagreed and had the opinion that the side bearings should be kept narrower.[150] Narrower spacing is inevitably the case with sans-serif typefaces, as can be seen in the second line of Figure 4.11. This is due to the lack of serifs, which form wedges between letters and help to preserve the stem interval.

Because of its vertical stressing as result of the lacking of curves, the fitting of textura quadrata is fairly simple: the vertical strokes can be placed at equal distances and hence the spaces between the strokes and the side bearings are generally also equal.

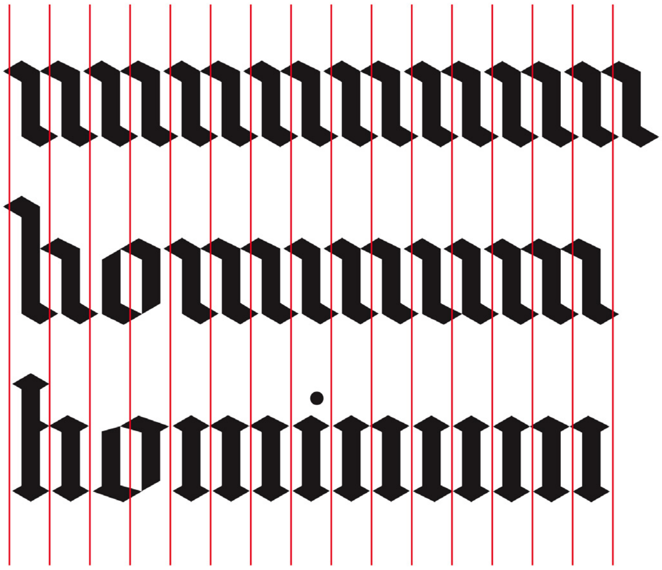


Figure 4.12 The fitting of textura type.

Figure 4.12 shows that textura type can be fitted by placing the side bearings exactly in between the stems; the 'fencing' is very strong here. The division by vertical lines automatically leads to a simple unit-arrangement system: one unit for the i, two for the n and the u, and three for the m. In the bottom row the stroke endings have been moved backwards. This not only optimises the position of the o within its fixed width, but also prevents that the difference between stroke endings and the arches becomes too small, which would make the letters difficult to differentiate from each other. Hence, textura is constructed with backwards-moved stroke endings.[151]

[150] Heidrun Osterer and Philipp Stamm, *Adrian Frutiger – Typefaces: The Complete Works* (Basel: Birkhäuser Architecture, 2008), p.18.

[151] Noordzij, *The Stroke*, p.54.

In the second row the space around the o is –both visually and measurably– too wide, but this can be corrected by extending the horizontally stressed strokes further. Doing so helps to keep the o on two units, like the n. Otherwise the width of the o has to be reduced and this would disrupt the pattern of the vertical strokes: the distances between the vertical strokes and the side bearings would differ from these of the other letters that contain vertical strokes. Also it would add an unnecessarily deviating character width.

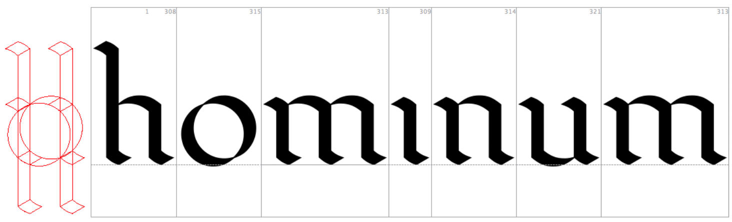


Figure 4.13 In the Humanistic minuscule some vertical strokes are replaced by curves.

In contrast with textura type, roman type combines vertical strokes with bowls and diagonals because it finds its origin in the Humanistic minuscule. This breaks up the measurable uniformity of the distances between vertical strokes: for example the distance measured from curve to stem differs from the distance measured from stem to stem (Figure 4.13). Jenson was not the first punchcutter to be confronted with this problem; others before him, such as Adolph Rush, Conrad Sweynheym and Arnold Pannartz also had to tackle this problem. However, being more refined than any of its precursors, Jenson's type especially shows a highly systematised handling of the fitting.

Figure 4.14 Fitting of Jenson's roman type on a textura-based pattern.

Although the shapes clearly differ, the morphology is in essence the same for textura and roman type. Hence the curved parts can be considered overshoots of the straight strokes. Defining the side bearings for roman type can therefore be done in the same simple way as for textura type (Figure 4.14). This implies that the same groups of letters share the same character widths in both textura type and in roman type. Jenson's roman type clearly shows the same fence posting as textura type; further evidence of this fence posting will be presented in the next chapter. It is interesting to see in Figure 4.15 that Van Krimpen's drawings for Haarlemmer (which were made on an existing Monotype unit-arrangement system to reduce costs)[152] clearly show the simple rhythmic pattern ('fence posting')[153] that I traced in Renaissance type. This structure is in fact inherent to calligraphy, although because of inevitable inconsistencies in handwriting it does not appear as rigidly in the Humanistic minuscule as in roman type.

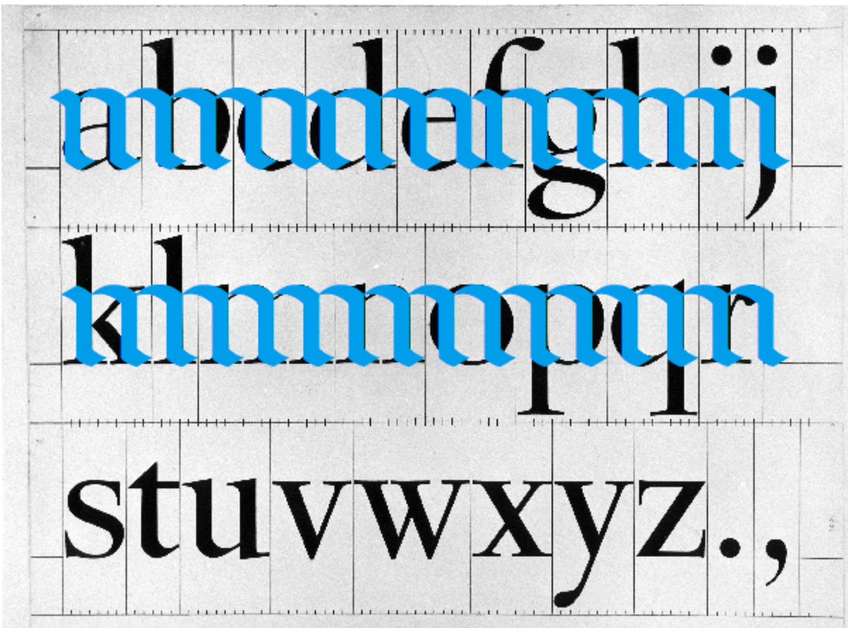


Figure 4.15 Fence posting appears in Van Krimpen's drawings for Haarlemmer.

Besides the above evidence distilled from historic prints, one additional piece of historic information supports the idea that these punchcutters directly applied structures from textura type to roman type: the Da Spira brothers, Sweynheim and Pannartz, and Jenson all worked in Germany before they went to Italy (Jenson from 1458 to 1461 in Mainz). Jenson was especially sent by the King of France

[152] John Dreyfus, *The Work of Jan van Krimpen* (Haarlem/Utrecht: Joh. Enschedé en Zonen/W. de Haan, 1952) p.35.

[153] The pattern that is the result of positioning the stems at equal distances ressembles a fence.

Charles VII to Mainz to learn printing from Gutenberg and to bring the profession to France.[154] Lowry describes this mission as 'industrial espionage'.[155] All aforementioned Renaissance punchcutters, renowned for their roman types, were therefore not only familiar with textura; all of them had also cut gothic type. This lends further support to my hypothesis that the roman type production process was analogous to that of textura type; it seems highly likely that the Renaissance punchcutters directly applied textura patterns to roman type.

This chapter described the practice of optical type fitting and presented arguments in favour of a systematised process. It introduced and illustrated the concept of the standardisation of character widths in gothic and Renaissance prints. A horizontal grid fitting system was then introduced and, due to the morphologic relationship between the handwritten origins of textura and roman type, this could be applied to both gothic and roman prints in order to highlight similarities in both types. The aim is to draw further parallels between textura and roman type production, thus supporting my hypothesis that the Renaissance punchcutters standardised handwriting to the type production process and that, more generally, roman type was possibly largely the result of technical rather than purely æsthetic considerations. The next chapter will elaborate on the horizontal grid fitting and will use the resulting framework to try to distil evidence of such a standardisation system in both textura and roman type.

[154] Albert Kapr, *Johannes Gutenberg: Persönlichkeit und Leistung* (München: C.H. Beck, 1988), p.252.
[155] Lowry, *Nicolas Jenson and the Rise of Venetian Publishing in Renaissance Europe*, p.49.

CHAPTER 5

The previous chapter introduced the concept of standardising horizontal proportions, resulting in a limited number of character widths. This could have been used for the production of both textura and roman type. The two types were compared and the similarities in the widths of their characters were illustrated. The present chapter examines standardisation of character widths in greater detail. For this a unit-arrangement system is introduced and distilled from examples of both textura and roman type, in an attempt to provide further evidence that roman type, much like textura type, was the result of the standardisation of its handwritten origins to the type production process. If Gutenberg, Fust and Schöffer, and other early Renaissance punchcutters did indeed apply such a unitisation, then this seems to be in contradiction with the opinions of typographers like De Vinne, who believed that fifteenth-century types were made without a system and that peculiarities were determined by the handwritten letters that served as models.[156]

5.1 Unitisation in textura type

The division in units as described in the previous section results in a unit-arrangement system: a system in which all character widths and spaces are defined in units. This section will first discuss the advantages of using such a system in type production, before presenting evidence of the use of horizontal unitisation in textura type.

A unit-arrangement system is multifunctional. Units can be used for standardising the design process, for transferring larger-sized pen-based drawings to the punches (although there are no such drawings preserved from the Renaissance), and for standardising the widths of copper bars for the production of matrices. In addition, the justification of lines is relatively simple if spaces are defined within the same unit-arrangement system. This is especially the case for typesetting short lines such as the ones found, for instance, in early German bibles. For example, in Figure 5.1, the word space is defined by the number of units on which the letters are placed. Each unit in the example equals the width of the stems.

[156] Theodore Low De Vinne, *The Invention of Printing: a Collection of Facts and Opinions* (New York: Francis Hart & Co., 1876), p.518.

Figure 5.1 The word space amounts two units in this example.

Besides simplifying the justification of type, another advantage of defining character widths in units is that fixed-width moulds can be standardised. Extrapolating this idea, it is tempting to consider that such units could even have been used as common denominators in movable type from different punchcutters. While this is purely speculation, it could be tested in research.

As evidence of the use of a unit-arrangement system in textura type production, Figure 5.2 shows the textura type applied by Johann Fust and Peter Schöffer in their famous *Psalterium* from 1457 on a bisected version of the grid shown in Figure 4.12. The width of the i is divided in this case into two units and hence the n is placed on four and the m on six units.

Figure 5.2 Textura type by Johann Fust and Peter Schöffer on a relatively refined grid.

This refinement is necessary to accommodate the letters that do not fit into the three-unit grid (for the m), such as the c, e, long s, and t. The c and e in Figure 5.2 have been placed on three units.

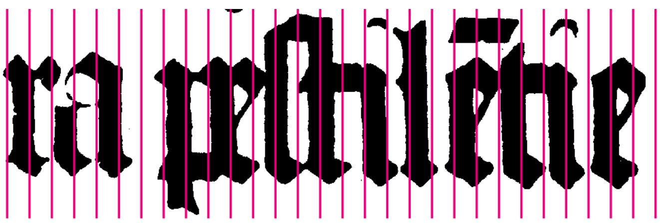


Figure 5.3 Detail of the grid fitting of the textura type from Fust and Schöffer.

A closer look at the grid-fitted textura type from Fust and Schöffer (Figure 5.3) reveals some shifting in certain locations. Most of the deviations from the grid can probably be explained by inaccuracies resulting from the type-manufacturing, typesetting and printing processes. The x-height of the textura type is roughly five millimetres. Some of the deviations are the result of shifts within the grid, such as the 'ra', 'pe', and 'sti' ligatures on the bottom line of the figure, that seem logical considering the structure of these ligatures. They seem to require a more refined grid with eight units for the n, such as the one shown in the Figure 5.4.

Figure 5.4 Further refined grid for the textura type by Fust and Schöffer.

Although somewhat less refined than Fust and Schöffers's textura type in the aforenamed *Psalterium*, the one Gutenberg applied in his 42-line Bible (Figure 5.5) two years earlier also fits on a grid with eight units for the n. This is unsurprising, considering the fact that Gutenberg employed Schöffer.[157]

Figure 5.5 Gutenberg's textura type from his 42-line Bible (1455).

[157] Kapr, *Johannes Gutenberg*, p.197.

To what extent were fifteenth-century punchcutters able to refine grids? There must undoubtedly have been a technical limitation at a certain point in the process. What should be taken into account when considering this question is that one can calculate in units without having to apply each unit on the punches and matrices; the most important point to remember is that the characters' widths are multiplications of units. The units can also be used to calculate the positions of the stems. Having illustrated examples of this unitisation in textura type, the next section will show evidence of a similar unit-arrangement system in roman type, thereby supporting my hypothesis that roman type production made use of standardisation analogous to the production of textura type.

5.2 Unitisation in roman type

If, as I hypothesise, the textura-type pattern was used for roman type, then a similar refinement of the grid is a logical step for roman type as well. The fact that Adobe Jenson, the digital revival of Jenson's roman made by the American type designer Robert Slimbach (1956), quite closely follows the original proportions of the letters –although somewhat deviating in details because of optical spacing (Figure 5.6)– makes it suitable for investigating whether it can be placed on a grid. Such an investigation is illustrated in this section.

Figure 5.6 The outline of the lowercase m of Adobe Jenson placed on top of Jenson's m.

The stem interval is the dominant factor in the rhythmical patterns of textura and roman type. It therefore makes sense to divide the distance between the centres of the stems of the lowercase n into smaller units by bisecting this distance. One can imagine that a course grid is easier to control than a very refined one because it helps to limit the number of different widths.

Figure 5.7 Jenson's roman placed on a simple grid.

For the grid shown in Figure 5.7 I divided the distance between the stems into four units. This resulted in eight units for the character width of the n and 12 units for the m. My fitting of Adobe Jenson on 12 units for the m resulted in nine rows of character widths, each with letters that share the widths of the n, i, f, a, m, E, A, H, and M respectively. For kerned versions of letters, such as the capital T, rows with (slightly) smaller widths can be used. It would be interesting to investigate whether the total number of rows can be further reduced.

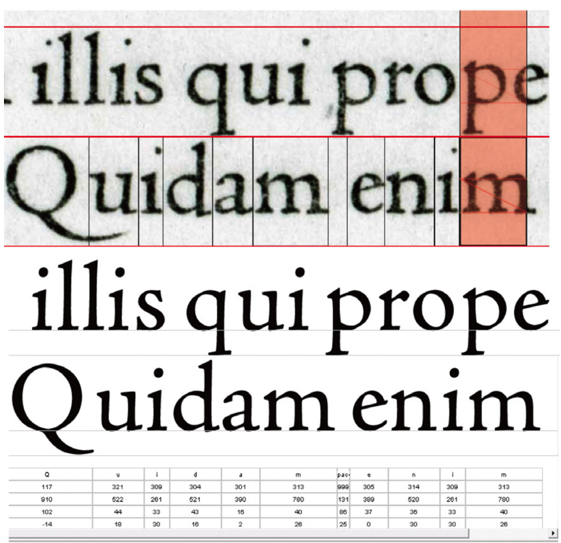


Figure 5.8 Jenson's original roman reproduced with a unitised version of Adobe Jenson.

Providing further evidence of the use of unitisation in Renaissance font production, the original printing by Jenson shows some irregularities in fitting, such as a the relatively large trailing space of the q and the tight spacing between the d and the a, and the e and the n, that cannot easily be explained optically (as was discussed in the previous chapter), but that could however be explained by fitting his type on units (Figure 5.8). This would mean that the number of widths was standardised and limited using a unit-arrangement system and that the position of the characters was adapted, i.e., rounded, to fit the grid.

The original size of Jenson's type is quite small; this inevitably resulted in some deviations when striking, casting and printing. Nevertheless, the first result of unitised fitting of the digital version as shown in Figure 5.7 is far from disappointing when compared with (enlarged) original prints from the fifteenth century. It illustrates the same kind of irregularities in spacing as those prints. This is a very simple system: the word space used in this type is two units. It is plausible that the fewer grid units there are, the stronger the rhythm of the type is. A simple beat could in this case be better than a complex one.

Adobe Jenson is a digital revival of a historic typeface. Its fitting does not show any standardisation such as the one that I applied based on 12 units for the m. When it comes to the character widths in revivals of Renaissance type, the fitting is usually done optically, as described in the eighteenth century by the French punchcutter, typefounder, and author Pierre Simon Fournier (1712–1768) in his *Manuel Typographique, utile Aux Gens de Lettres.* Any standardisation of character widths seems not to have been considered nor investigated before. At the Museum Plantin-Moretus in Antwerp I closely examined French Renaissance foundry type and matrices to investigate such standardisation. The technical details of Renaissance type production will be discussed in detail in the next chapter.

To further illustrate the effect of the rounding of character widths to units, I show once more in Figure 5.9 the outcome of the designing of roman type on a template generated with LeMo, as discussed in Section 3.4.

quill jumped and bounced
and one headline of penman
compiled a bad headache

Figure 5.9 Text typeset with roman type that finds it origin in systematised writing.

In Figure 5.10 I rounded the original spacing from the geometric pattern that was generated with LeMo to a highly simple unit-arrangement system, using the stem thickness here as the base value. This resulted in only six units for the width of the lowercase n.

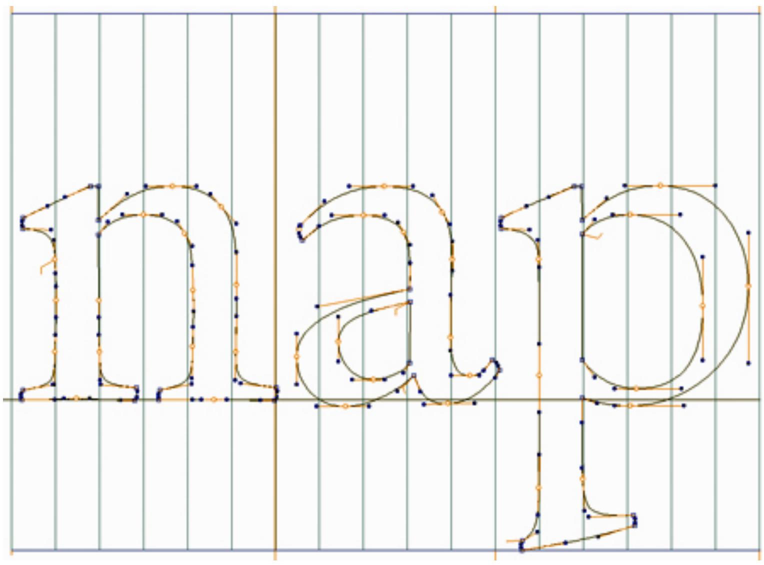


Figure 5.10 The template-based roman type converted to a simple grid system.

The original character proportions are preserved here; the fitting becomes slightly tighter overall, but the default word spaces (for an unjustified line) become just slightly wider, resulting in three units. The outcome is presented in a text in Figure 5.11. Throughout the process until this point, the character proportions and their widths were generated ‘artificially’: no optical corrections were made to the character widths.

quill jumped and bounced and one headline of penman compiled a bad headache

Figure 5.11 Text typeset with the grid-fitted roman type.

If the grid is refined, optical adjustments can be made by decreasing the size of the units. For example, the proportions of the letters can at this point be redefined by adjusting them to the grid. A way to refine the grid is to double the number of units, as shown in Figure 5.12.

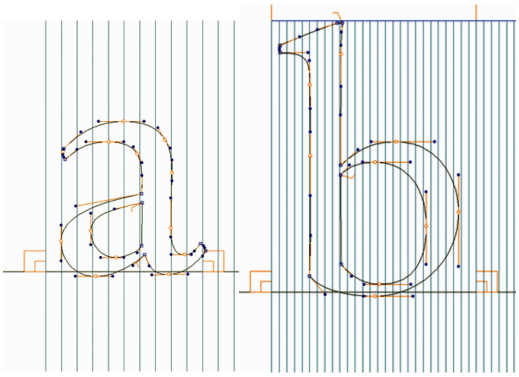


Figure 5.12 Refinement of the grid.

5.3 The unit-arangement system

As discussed in the previous section, it is highly likely that Jenson standardised the widths within his roman type in line with the morphologically related textura. The construction of the latter makes it very well suited to subdividing the stem interval into units. The present section discusses this unit-arrangement system in greater detail, highlighting the natural pattern in roman type and using that pattern to distil standardised units, or ‘cadence units’, from that type.

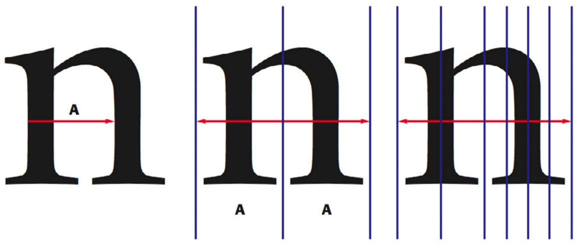


Figure 5.13 The creation of character widths and units based on the stem interval.

The grid shown in Figure 5.13 is based on the division of the counter of the n into two equal space parts. The line is drawn exactly in between the stems. Subsequently the distance from stem to stem, indicated with ‘A’, is used to define both side bearings so that the resulting character width is twice A. This distance can be divided into a number of equal parts. Repetitive bisecting can do this, which makes the outcome a power of two. This division is organic because the size of the units stems from the design itself. The fact that the other lowercase letters belong to the same rhythmic pattern implies that this unit-arrangement system should work for them as well. Although the basis of the unitisation is different here than the one displayed in Figure 5.9, the stem-based units of the latter equal a division of the stem interval into four units.

There is no documentation that proves the existence of unitisation based on the stem interval in roman type from the Renaissance and later times. Hence, one could argue that such a unitisation is artificial, even if it seems to capture the patterning of the archetypal models, as shown in Figure 5.7. However, there is evidence that unitisation was applied before the Romain du Roi. In *Mechanick Exercises on the Whole Art of Printing* from 1683–84, the English printer, punchcutter, and typefounder Joseph Moxon (1627–1691) shows a proprietary unit-arrangement system for which he divided the body into 42 units (Figure 5.14).

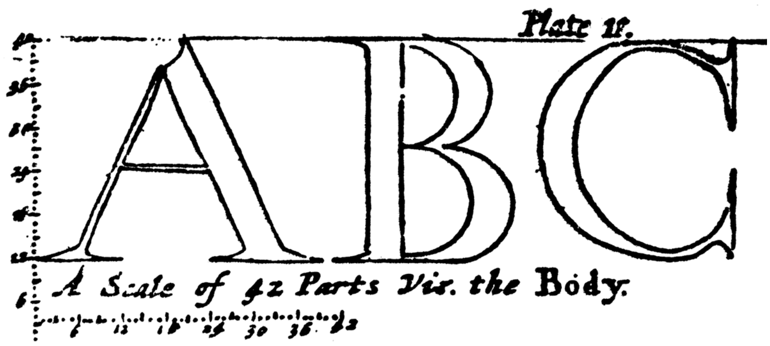


Figure 5.14 Moxon’s division of the body into 42 units.

Moxon provides no clue about how he defined these units. In Appendix 6, *Units and grids* I elaborate further on interpretations of Moxon’s grid, such as the one by De Vinne, but for the purposes of this chapter I investigated whether the grid could find its origin in the stem interval; hence whether or not it is represented by cadence units.

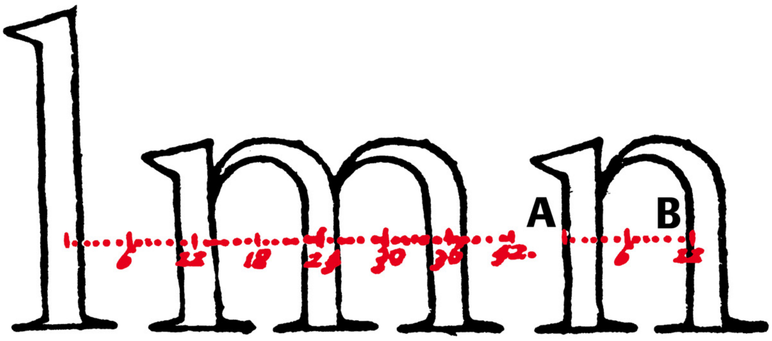


Figure 5.15 Moxon's division into 42 units positioned on the stem interval.

I cut and pasted the unitisation in Moxon's engravings from *Mechanick Exercises* and I placed the units on the stem interval of the lowercase letters (Figure 5.15). I did not alter the distances between the letters in the engravings. Moxon uses a division of the body in 'seven equal parts' of six units each. Twelve units seem to fit perfectly on the stem interval (Figure 5.16).

Figure 5.16 Moxon's grid from *Mechanick Exercises* seems to be based on the stem-to-stem distance.

This results in a character width of the n of 24 units. These units are not the result of a repetitive bisecting of the stem interval; in that case the outcome is always a power of two. But any division can be used: the outcomes will always remain organic.

Word spaces are a part of the pattern and should also be unitised. Dividing character widths and word spaces into units was already done by the Roman carvers of the Scriptura Monumentalis. The size of the units was based on the stem width: 'In brief, the stem width of a letter of whatever height provides the spacing measure for that line.'[158]

[158] Richard D. Grasby, *Processes in the Making of Roman Inscriptions* (Oxford: Centre for the Study of Ancient Documents, 2009,) p.12.

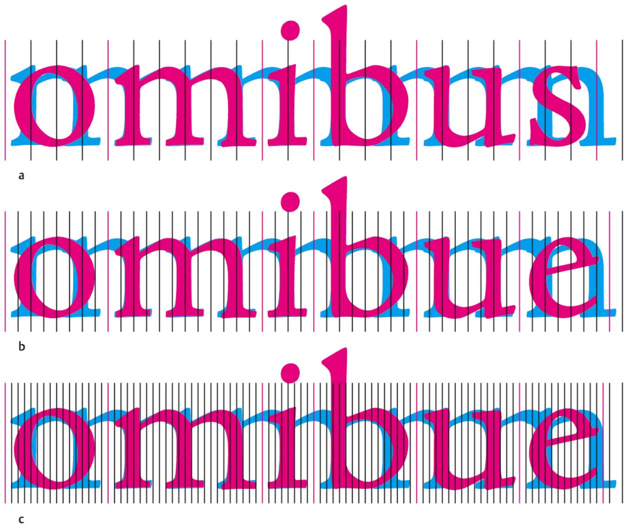


Figure 5.17 Refinement of applied unitisation (on Adobe Jenson).

On the top line in Figure 5.17 the background is formed by the stem interval. This grid is sufficient for positioning the letters in ‘omibu’. However, the incorporation of the s requires a refinement of the grid. To this end, the stem interval is bisected. On the second line in Figure 5.17 the e replaces the s, and for the left side bearing no extra refinement is required. The curved part is an overshoot of the stem. However, the grid is too coarse for positioning the right side bearing of the e. Thus, it is bisected again. On the bottom line in Figure 5.17 the resolution of the grid in the second line has been doubled. This makes it possible to apply small corrections to the spacing. These corrections obstruct the stem interval, but improve the equilibrium of white space, especially if type has not been designed with the preservation of the stem interval in mind.

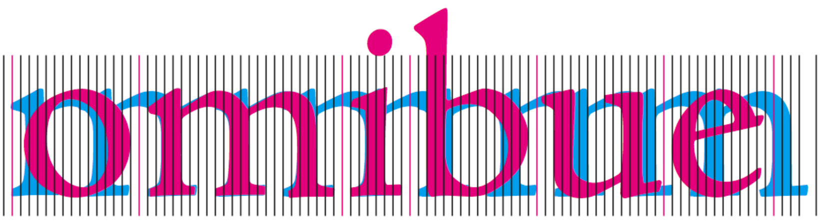


Figure 5.18 Repositioning of letters using a refined grid.

Figure 5.18 shows some shifting of the letters within the grid. In Figure 5.19 the grid is doubled again to make a small reduction of the space between the stem of the b and the left side bearing possible.

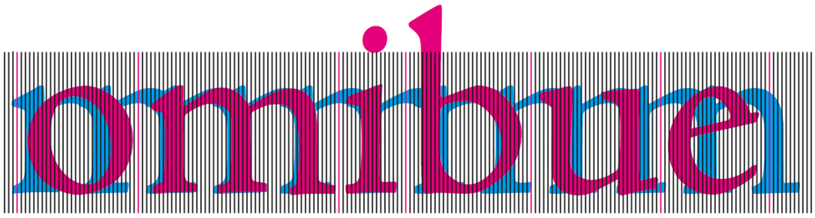


Figure 5.19 Further grid refinement

Figure 5.20 illustrates a division of the character width of the n in the top row into 16 units. The bottom row shows a division of the character width of the n into 32 units. In practice it seems that 32 units for the n (which results in 48 units for the m when this letter is made of a clear repetition of the n) is refined enough to control the spacing of present-day digital roman and italic type. Of course, for digital type the grid can be bisected infinitely.

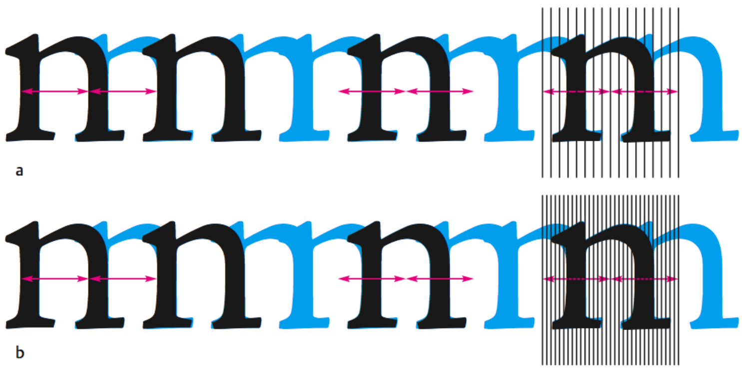


Figure 5.20 Defining cadence units.

The fact that the units applied here are derived from the proportions of the type makes them an intrinsic part of its design. The units represent the rhythmic flow in pattern. I labelled them 'cadence units' for this reason, referring to music and the way in which a cadence represents the beat. Their usage is not restricted to roman type; they can be distilled from, and applied to, italic type as well.

Figure 5.21 Cadence units applied on a cursive.

The stem interval and overshoot of curves is identical in roman and italic type. Figure 5.21 shows the italic of DTL VandenKeere, which I based on the Ascendonica Cursive from the Renaissance punchcutter François Guyot, on a cadence units grid.

Due to its morphologic relationship to textura, the natural pattern in the Humanistic minuscule can be distilled in roman type. This section demonstrated how this pattern can form cadence units in type, forming a useful framework for width standardisation.

5.4 Comparing unitised and optical type fitting

To provide further evidence that the Renaissance punchcutters used a unit-arrangement system in their type production process, this section compares optical fitting with unitised grid fitting of type. Spacing via cadence units is an extremely simple and fast method when applied manually, and no knowledge of letters or any experience with spacing is necessary. The algorithm is also simple and the cadence fitting can be computerised accordingly. The question is then what this means for roles of æsthetics and the eye, which are widely believed to rule in roman type production.

In *Letters of Credit,* the English type designer, typographer, book designer, and author on typography, Walter Tracy (1914–1995) advises the reader to space the lowercase n and o first. 'When the two letters look well regulated they are measured against the units gauge and the widths of the letters and their side spaces modified so as to maintain the ideal balance of black to white.'[159]

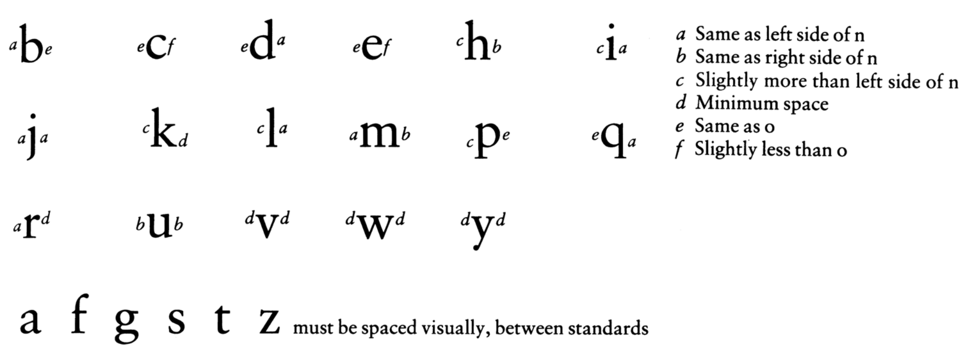


Figure 5.22 Tracy's relative values for the positioning of lowercase side bearings.[160]

[159] Tracy, *Letters of Credit,* p.75.
[160] Ibid., p.75.

Tracy provides a scheme with relative values for the spacing of the other characters, which refer to the side bearings of the n and the o (Figure 5.22). There is also a scheme for capitals (Figure 5.23). A few letters: a, f, g, s, t, z, and S fall outside his scheme and 'must be spaced visually, between standards.'[161]

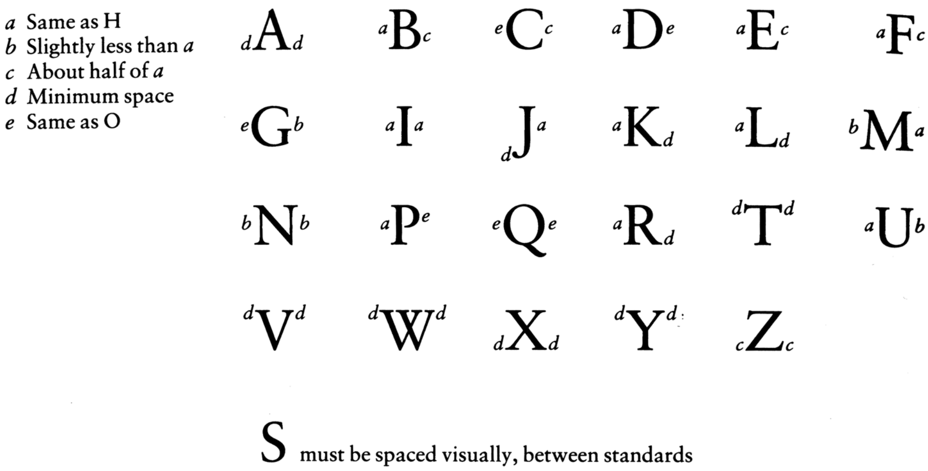


Figure 5.23 Tracy's relative values for the positioning of uppercase side bearings.[162]

To be able to apply Tracy's systematisation, first a number of letters have to be spaced by eye. In contrast, the application of cadence units does not require an optical basis. Cadence units can be derived organically from the type itself and this makes it possible not to use a relative system like Tracy's, but an absolute one using fixed units. If the morphology of a typeface is related to that of the archetypal models, the same spacing method –translated into cadence units– can be applied. It does not seem to be logical to exclude the a, f, g, s, t, z, and S from a spacing system, like Tracy did, because these letters are adapted (optically balanced) by the designer to the same pattern as the other letters.

161 Ibid., p.75.
162 Ibid., p.74.

Cadence_units arrangement

1	A	1	(left and right from x-axis extreme)	2	a	6	(left and right from x-axis extreme, right from stem)
8	B	3	(left from stem, right from x-axis extreme)	5	b	2	(left from stem, right from x-axis extreme)
3	C	2	(left and right from x-axis extreme)	2	c	1	(left and right from x-axis extreme)
8	D	3	(left from stem, right from x-axis extreme)	2	d	6	(left and right from x-axis extreme, right from stem)
8	E	2	(left from stem, right from x-axis extreme)	2	e	1	(left and right from x-axis extreme)
8	F	2	(left from stem, right from x-axis extreme)	6	f	1	(left from stem, right from x-axis extreme)
3	G	6	(left from x-axis extreme and right from stem)	2	g	1	(left and right from x-axis extreme)
8	H	8	(left and right from stem)	6	h	6	(left and right from stem)
8	I	8	(left and right from stem)	6	i	6	(left and right from stem)
6	J	6	(left and right from stem)	6	j	5	(left and right from stem)
8	K	1	(left from stem, right from x-axis extreme)	6	k	1	(left from stem, right from x-axis extreme)
8	L	2	(left from stem, right from x-axis extreme)	6	l	6	(left and right from stem)
8	M	8	(left and right from stem)	6	m	6	(left and right from stem)
8	N	8	(left and right from stem)	6	n	6	(left and right from stem)
3	O	3	(left and right from x-axis extreme)	2	o	2	(left and right from x-axis extreme)
8	P	2	(left from stem, right from x-axis extreme)	6	p	2	(left from stem, right from x-axis extreme)
3	Q	3	(left and right from x-axis extreme)	2	q	5	(left from x-axis, right from stem)
8	R	1	(left from stem, right from x-axis extreme)	6	r	1	(left from stem, right from x-axis extreme)
3	S	3	(left and right from x-axis extreme)	3	s	3	(left and right from x-axis extreme)
1	T	1	(left and right from x-axis extreme)	5	t	1	(left from stem, right from x-axis extreme)
6	U	6	(left and right from stem)	5	u	5	(left and right from stem)
1	V	1	(left and right from x-axis extreme)	1	v	1	(left and right from x-axis extreme)
1	W	1	(left and right from x-axis extreme)	1	w	1	(left and right from x-axis extreme)
1	X	1	(left and right from x-axis extreme)	1	x	1	(left and right from x-axis extreme)
1	Y	1	(left and right from x-axis extreme)	1	y	1	(left and right from x-axis extreme)
2	Z	2	(left and right from x-axis extreme)	2	z	2	(left and right from x-axis extreme)
				3	.	3	(left and right from x-axis extreme)
				3	,	3	(left and right from x-axis extreme)

Figure 5.24 Cadence unit-arrangement system based on 36 units for the n.

Figure 5.24 shows a table with the distances between stems or extremes on the x-axis of the upper- and lowercase letters and the side bearings. The values in this table are based on a number of (digital revivals of) archetypal models I analysed. The distances are defined in cadence units, based on 36 units for the width of the n (Figure 5.25), which is refined enough to suit digital roman type. For the first range of tests I used 18 units for the stem interval. For later tests, as presented in Appendix 11, *Parameterized fitting results*, I used 32 units, which is in the power of two range and hence closer to the bisected units distilled from Renaissance prints, as described in Chapter 5.

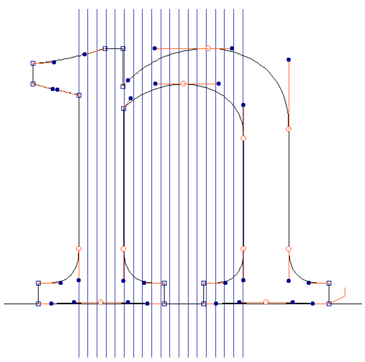


Figure 5.25 The division of the stem interval into 18 units, resulting in 36 units for the character width.

The width of the units depends on the width of the typeface. For example, the n of a condensed typeface has a relatively short stem interval. The total number of cadence units used for dividing the stem interval is the same as in the case of a wider n. Hence, the applied number of units for spacing is the same for narrow and wide types. The system can be compared to a harmonica.

For digital font production the width of the cadence units can be translated into a number of units[163]. If the resulting width contains fractional parts, the value has to be rounded to the nearest integer.

To apply these cadence units, the letters must be moved (slightly) on the grid if the grid was not used to define the proportions of the letters. If the resolution of the applied grid is more refined, for instance 72 or 144 units instead of 36, eventually the grid can fit *any* typeface and the letters do not have to be moved. More refined grids can also make sense if for instance the spacing has to be made slightly tighter and hence smaller units are required for fine tuning.

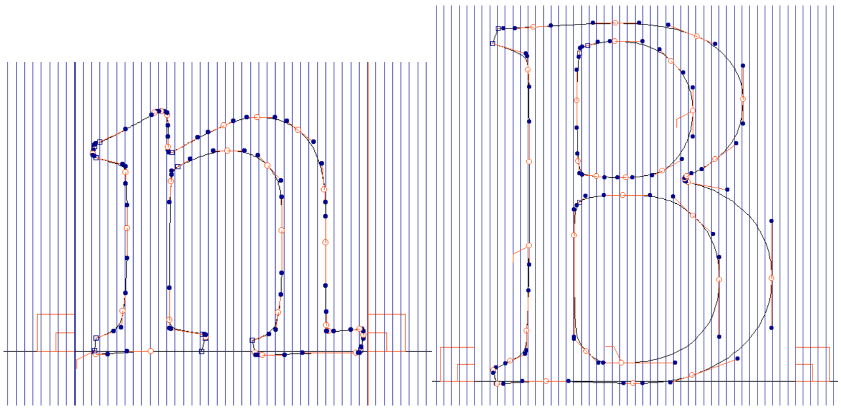


Figure 5.26 Grid fitting of the n and B from Adobe Jenson.

Figure 5.26 depicts six units applied from the left stem of the n to the left side bearing, and five units from the right stem of the n, according to the table shown in Figure 5.24. The proportions of the n and B almost perfectly coincide with the grid. Figure 5.27 shows the n of Adobe Garamond on the derived cadence units. Because the proportions of Adobe Jenson and Adobe Garamond differ slightly, the size of the cadence units differs accordingly. If a roman type design is based on a patterning that deviates considerably from for example Jenson's archetypal model, the cadence unit table can be adapted to the specific details of the typeface. If other typefaces follow the same pattern, also the same cadence unit table can be used for spacing.

[163] PostScript-based digital fonts usually have an em-square of 1000 units, while TrueType-based fonts usually have 2048 units on the em.

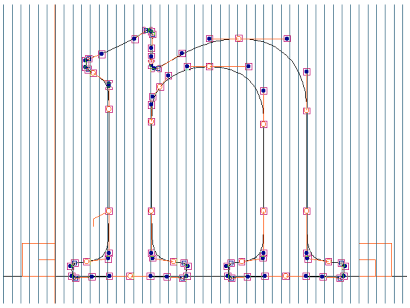


Figure 5.27 The n from Adobe Garamond on cadence units.

The cadence-unit system is suitable for computerisation. For the following examples I applied the unitisation by hand in a font editor. I placed the grid in the background of the glyphs and used the values from the aforementioned table. The top half of Figure 5.28 shows the original 'factory' spacing of Adobe Jenson with no additional kerning. The second variant shows the same typeface spaced using the cadence-unit system. The result of the fittings applied in both texts is very close. I have to note here that Adobe Jenson was one of the typefaces that I investigated for calibrating the cadence-units system, so the resemblance in fitting is not completely coincidental.

Original: ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equiped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day. The invention of Printing from movable types was one of the chief

Cadence: ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equiped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day. The invention of Printing from movable types was one of the chief

Figure 5.28 Factory spacing (top) and grid-fitting on cadence units of Adobe Jenson.

The top half of Figure 5.29 shows the original spacing of Adobe Garamond without kerning. The second variant shows the same typeface spaced using the cadence-unit system. Although there are some minor differences between both fittings, in general the cadence-units fitting comes very close to the factory fitting.

Original: ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equiped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day. The invention of Printing from movable types was one of the chief events

Cadence: ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equiped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day. The invention of Printing from movable types was one of the chief

Figure 5.29 Factory spacing (top) and grid-fitting on cadence units of Adobe Garamond.

If the table values work for these two archetypal models, one would expect that this is also the case for all morphologically related roman type. For the following examples, the same table (Figure 5.24) was used. The size of the units are font-specific, therefore for each type I first measured the stem interval and defined the grid by dividing it by 36.

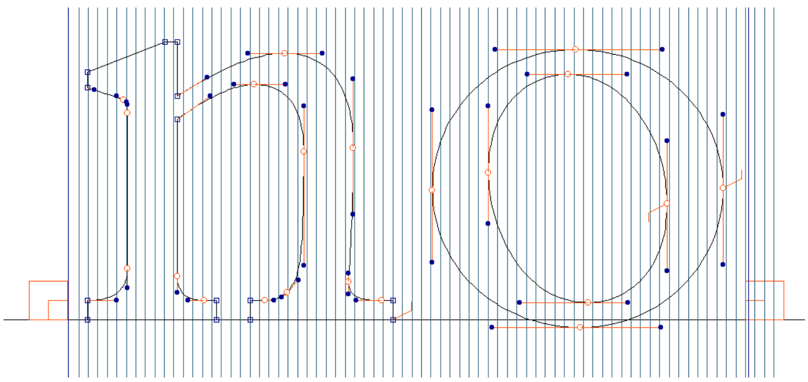


Figure 5.30 The n and o of Monotype Bembo Book placed on cadence units.

Figure 5.30 shows the n and o of Monotype Membo Book on a 36 cadence unit grid for the n. The application of the table values results in the spacing shown in the second line of Figure 5.31. This spacing comes quite close to the original one in the first line.

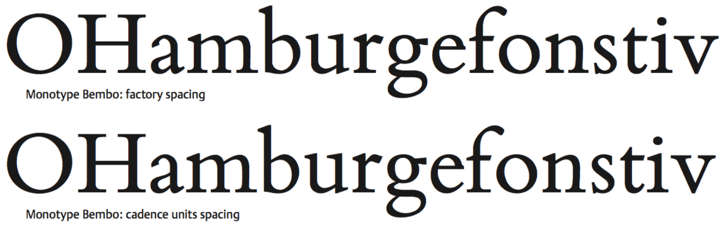


Figure 5.31 Montoype Bembo Book on factory spacing (top) and cadence-units spacing.

Differences can be found in the combinations ‘e-f’ (too narrow) and ‘I-v’ (too wide). Otherwise the spacing looks remarkably similar. The single unit defined for the side bearing of the e is clearly not enough and the single unit for the side bearings of the v seems to be too much. The uneven spacing of the e and the v also appear in Figure 5.32, which contains a comparison of the original and cadence-units spacing of Swift. This seems to be a structural problem, so it could make sense to change the values in the table into two units for the right side bearing of the e and zero for both side bearings of the v.

Figure 5.32 Swift on factory spacing (top) and cadence-units spacing.

Although in all details clearly a design from the twentieth century, the underlying patterns and structures in Swift are directly related to that of the archetypal models, and hence the fitting can be handled in an identical manner. The original spacing of the capitals is relatively narrow in Swift, and this is where the biggest differences can be found. Figure 5.33 shows three spacing variants of DTL Documenta. The first line shows the fitting that I applied by eye around 1990. The second line shows the cadence-units spacing. The distance from the e to its right side bearing is too narrow, as is the case with the u. The third line shows the spacing generated with the URW Kernus 3.0 application for Mac OS 9. Kernus 3.0 calculates the space between glyphs and to this end uses a few key glyphs, like the lowercase n and o. It does not recognise stems and curves as such and only targets a white-space equilibrium.

Figure 5.33 DTL Documenta on optical spacing (top), cadence-units spacing (centre) and equilibrium spacing.

Because the size of the units depends on the size of the stem interval, the size of the units differ per typeface. However, a typeface can be spaced using a cadence-units table that has been defined for a morphologically related typeface irrespective of its width. It does not matter whether such a typeface is expanded or condensed: the system works like a harmonica. Furthermore, if a table is adapted for a bold variant of a typeface, the units can be applied on other, design-related bold versions as well.

One could argue that such measurements do not have to be defined in units. The amount of space between the stems and side bearings of an archetypal lowercase n can also be measured in relation to the n's counter, and subsequently the spaces for the other letters can be calculated and adapted as well. This is actually how URW Kernus works: it does not use a table but translates the space into units, like one can do with graphic paper, and then makes the number of units between letters even. As previously mentioned, the application does not recognise stems, and purely focuses on the white-space equilibrium. This results unfortunately in fitting differences if serifs are not all identical.

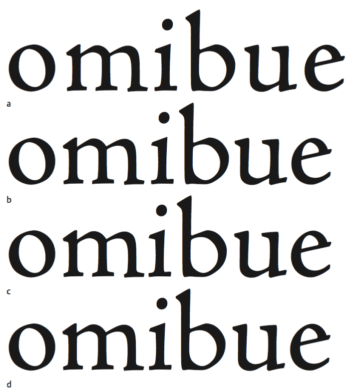


Figure 5.34 Fence-posting (a), refined fence-posting (b, c) and original spacing of Adobe Jenson (d).

As another example, Slimbach optically spaced Adobe Jenson without the use of units, much in the same way as it is generally accepted that Jenson himself did it. However, a very similar fitting can be obtained using a refined unit-arrangement system. Figure 5.34 shows the spacing as a result of grid refinement in four steps. The line (a) shows purely fence posting on a grid of four units for the n, as also shown in the top line in Figure 5.16. In the next line (b) the grid has 16 units for the n. The positioning of the letters is improved because the refined grid makes smaller corrections possible. The third row (c) in Figure 5.33 shows a 32-unit grid for the n. The last line (d) shows the original spacing (by eye) of Adobe Jenson, as provided by its designer, Slimbach. The original spacing and the 32-unit grid spacing are remarkably similar. Æsthetic considerations lead here to a refinement of the grid to 32 units for the n. If such refinements have been optically established once, one can apply them as rules without the requirement to optically judge the outcome. The fact that optical spacing of roman type can easily be translated to such a grid can be considered proof of the fact that roman type finds its origin in patterning on an organic grid that is based on the stem interval.

In line with the previous chapter, this chapter focused on the width standardisation in roman type. A unit-arrangement system was distilled from the inherent patterns of textura and roman type. The chapter then compared optical and grid fitting to illustrate the extent to which seemingly æsthetic preferences can be obtained systematically. The aim was to provide further evidence that roman type production, much like textura type production, was the result of the standardisation of its handwritten origins by the Renaissance punchcutters to the type production process. Evidence of this standardisation can also be distilled from Renaissance artefacts; however, before this evidence can be presented, a technical introduction to the Renaissance type production process is necessary. The following chapter will provide this introduction.

CHAPTER 6

There is no known documentation about the production of movable type that dates from the fifteenth or sixteenth century. This could imply that this information was never written down, for instance because of trade secrets protection; that it got lost over time; or even that there was never any standardisation applied. Nevertheless, in the absence of recorded information, measurements and analysis of Italian Renaissance prints and French Renaissance matrices and type, as well as actual casting from these matrices are useful in distilling evidence of a standardised and systematised Renaissance font production process.

The previous chapter made a case for the standardisation of character widths both in textura and roman type. It provided evidence of the application of a unit-arrangement system in type production by applying a standardised grid to historical prints and font revivals. The aim of the next chapter is to provide further evidence of the use of such a system by distilling it from artefacts. However, an understanding of the Renaissance type production process is necessary in order to explain the standardisation and systemisation of type by the early punchcutters. For this reason, the present chapter describes technical details of the Renaissance type production, discussing first the general process and then focusing on the technical possibility for width standardisation of the matrices.

6.1 Historical artefacts

In the inventory of the Museum Plantin-Moretus in Antwerp one can view the records of the type cast for Christoffel Plantin, catalogued as *Volume 153* (Figure 6.1). These records date from Plantin's life. The figures in *Volume 153* look impressive.

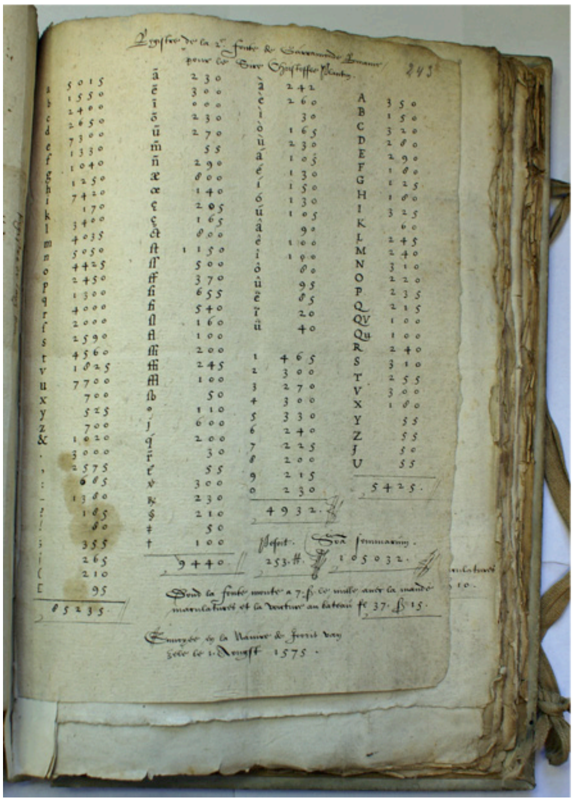


Figure 6.1 Records of type cast for Plantin, as collected in *Volume 153*.

The Museum Plantin-Moretus has an imposing assortment of matrices and punches from the French Renaissance. Vervliet notes that the most important part of the typographical collection consists of 4,500 punches, 20,000 matrices, and 60 moulds, which are largely the work of Garamont, Granjon, Le Bé, Haultin, Van der Keere, Guyot, and Tavenier.[164]

Figure 6.2 Matrices of Van den Keere's Canon Flamande from 1570.

[164] Vervliet, 'The Garamond Types of Christopher Plantin', p.15.

For my measurements I focused especially on the material produced by punchcutters renowned for the technical quality of their work, such as Garamont, Granjon, and Van den Keere. The idea behind this selection is that if these very skilled punchcutters did not apply standardisation, then it is also likely to be missing in the work of somewhat less sophisticated punchcutters, such as François Guyot, Joost Lambrecht, Ameet Tavenier, or Jean Thibault.

6.2 The typefounder's mould

'A typefounder's mould is a very simple instrument.'[165] With this line Mike Parker starts his inventory and description of moulds in the collection of the Museum Plantin-Moretus. A hand mould consists of two halves that are held together by the caster (Figure 6.3). The interieur of the mould is made of metal that is surrounded with wood. Moxon's moulds were made of iron but those of the early typefounders were made of brass.[166] The halves can be slid in one direction to control the width of the shank, which determines the width of the cast character.[167]

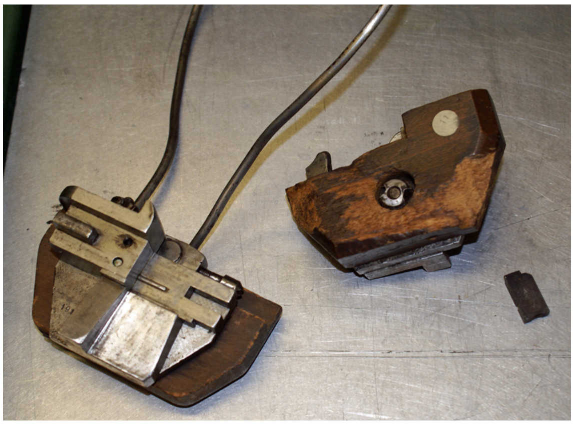


Figure 6.3 Two halves that, together, form a nineteenth-century mould.

In Figure 6.4 the aperture of the shank can be seen in the centre of the mould. The height of the aperture, which determines the body of the cast type, is usually fixed and for every body size a different mould is required. De Vinne describes the fixed vertical height (body) in combination with the horizontal flexibility of the mould: 'Although the two sides of the mould are fixed so as to be immovable in the

[165] Parker, 'Early Typefounders' Moulds at the Plantin-Moretus Museum', pp.93–102 (p.93).
[166] De Vinne, *The Practice of Typography*, p.20.
[167] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.8.

direction which determines the body of the type, they have great freedom of motion and nicety of adjustment in the direction which determines its width.'[168]

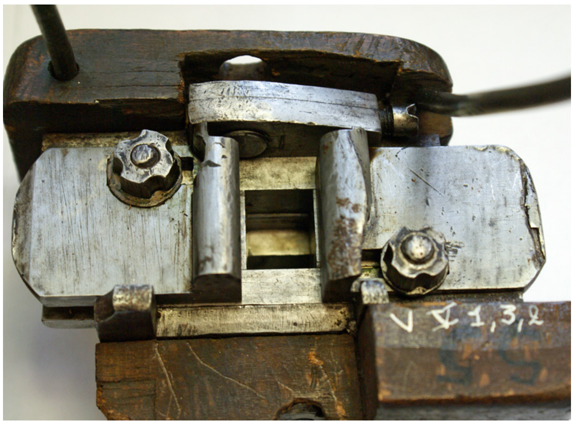


Figure 6.4 The aperture in the centre is the result of sliding the two halves.

In fact, there were (early) moulds in which the dimensions of the body could also be altered vertically. Carter notes that the Dutch mould specifically, unlike other moulds, could be justified to the body size.[169] According to Vervliet the French mould could also be adjusted to the body, but this required a complicated series of operations and it was normal practice to use different moulds for different body sizes.[170] Fournier mentions differences when it comes to material and details between moulds from France, Holland, Flanders, 'and elsewhere', and that the ones from France ('ours') were more complicated, but also more accurate.[171]

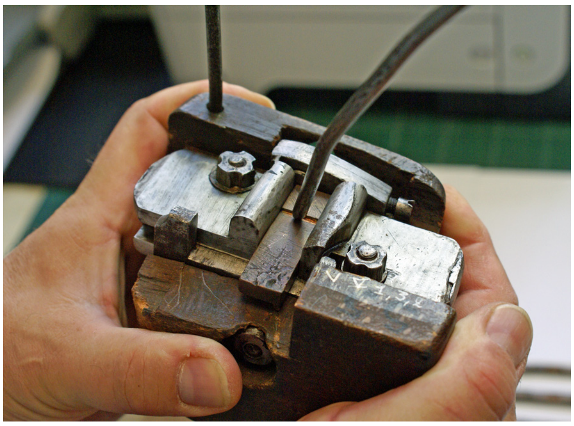


Figure 6.5 A large metal spring keeps the matrix in position.

---

[168] De Vinne, *The Invention of Printing*, p.58.
[169] Carter, *Fournier on Typefounding*, p.197.
[170] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.8.
[171] Ibid., p.8.

For the casting of type a matrix is placed at the end of the shank, i.e., at the bottom side of the mould. The matrix is kept in position by a large spring (Figure 6.5).

Figure 6.6 Molten lead is poured into the shank.

The caster pours molten lead (more specifically an alloy) into the shank (Figure 6.6). The hollow image of the letter in the matrix at the end of the shank is filled with molten lead. To distribute the lead evenly in the hollow image and in the shank, the caster gives the mould a strong shake.[172]

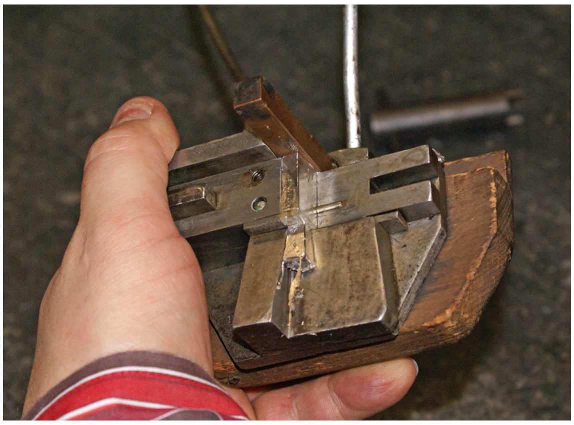


Figure 6.7 The two halves of the mould have to be separated to remove the cast letter.

The caster subsequently separates the two halves of the mould (Figure 6.7) and removes the letter from the matrix. The shank is actually longer than the height of the type; it accommodates space for the tang (Figure 6.8). Thanks to this wedge-shaped tail the caster can remove the letter –when it sticks– with a hook that is mounted on the mould. This prevents that the caster will burn his fingers on the hot metal parts at the bottom of the mould, or will damage the letter.

[172] Moxon, *Mechanick Exercises*, p.169.

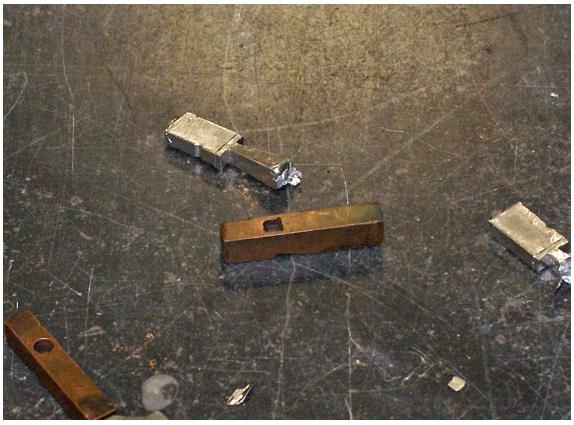


Figure 6.8 The tang is a wedge-shaped tail.

The tang is actually wedge-tailed because the opening of the shank is widened to make the pouring of the lead easier.

Figure 6.9 The rough edges are filed.

The tang is broken off and next the caster files the rough edges to make sure that all cast letters have the same height. Also other irregularities are removed by filing (Figure 6.9). Moxon describes this process as 'rubbing of letters', and in his time a stone was used for this.[173]

Moxon notes that a workman could cast 4000 letters ordinarily in one day. Davis and Carter annotate that Fournier mentions 2000–3000 in his *Manuel Typographique* and that later descriptions cite increased numbers due to technically improved hand moulds. [174]

---

[173] Moxon, *Mechanick Exercises*, p.173.
[174] Ibid. p.173.

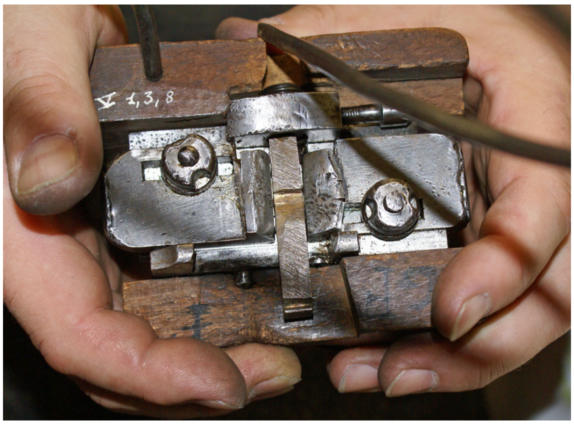


Figure 6.10 Mould's registers with matrix.

The width of the cast type is set with the mould's registers. Figure 6.10 shows the bottom part of the mould with a matrix in between two sliders of which the positions are fixed by bolts. These sliders are called registers and they are used to control the offset between the matrix's width and the side bearings of the cast type. This offset is a prerequisite: if the width of the matrix was identical to the character width, the molten lead would leak out of the mould. The setting of the registers determines the width of the shank. Fournier describes this as follows: 'The thickness is regulated by the two registers of the mould, which hold the matrix between them. Their position determines the width of the cavity between the bodies of the mould, into which flows the metal destined to form the shank with the letter on its end.'[175]

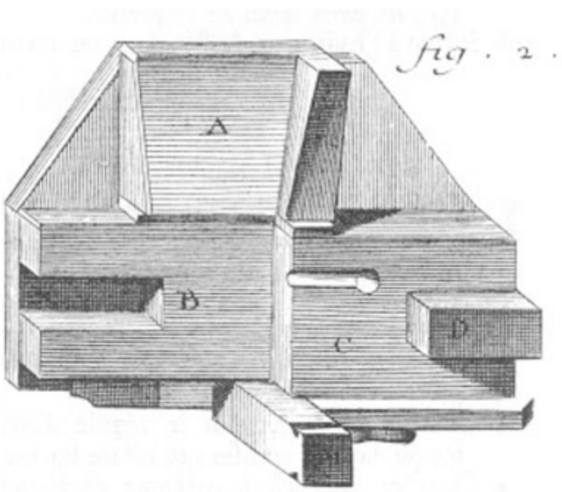


Figure 6.11 Plate from Diderot & d'Alembert's *Encyclopédie* showing part of a hand mould.[176]

175 Carter, *Fournier on Typefounding*, p.158.

176 <http://www.circuitousroot.com/artifice/letters/press/hand-casting/literature/index.html #diderot-dalambert-encyclopedie-1752>

Looking at historical images of the construction of moulds, such as for instance the ones shown in Diderot & d'Alembert's *Encyclopédie* from 1752, one is provided with a lot of details (Figure 6.11). To understand the relation between body size, character width, and the shank of the mould, more simple diagrams can be useful. Therefore I have created the following images, although I realise that they may be considered a simplification.

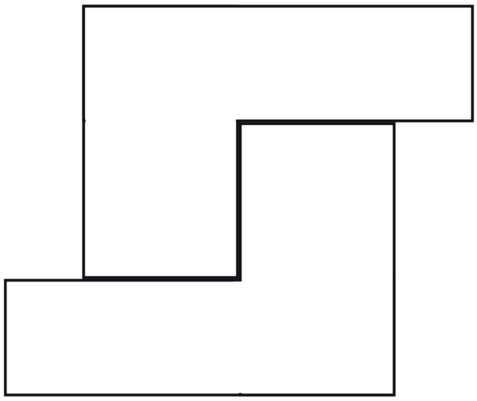


Figure 6.12 The two halves of the mould.

Figure 6.12 shows the two halves of the mould put tightly together and seen from above; for this reason there is no aperture. Figure 6.13 shows the bottom part of the mould. A matrix is positioned between two registers, the positions of which are fixed by nuts (could also be bolts or screws). The registers can be moved sideways and in this way determine the offset of the matrix, which is the relation between the width of the shank, i.e., the character width, and the width of the matrix.

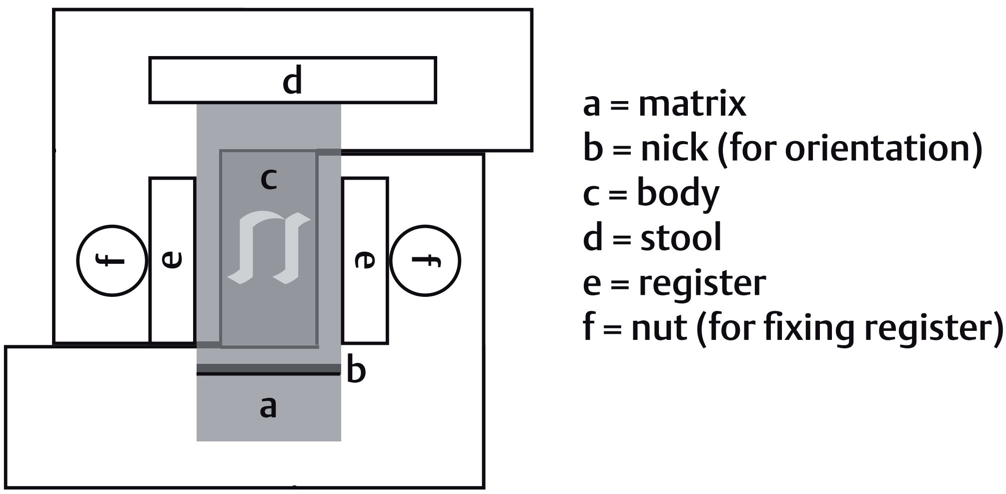


Figure 6.13 Bottom part of the mould with the matrix positioned between the registers.

It is important to note that the image of the letter is not visible at the bottom of the mould; it is on the other side of the matrix, where it connects to the shank. The nick is a groove that indicates the orientation of the matrix: after all the hollow image of the letter is invisible for the caster. Additionally the nick can be used to fix the spring that holds the matrix in its place. The stool determines the vertical position of the matrix. The position of the stool is usually fixed, but, as mentioned, some types of moulds have adjustable stools. Figure 6.14 shows a mould with bolts for extra control over the vertical positioning of matrix and hence of the vertical position of the characters on the body. The cast type that is kept in position by the thumb in Figure 6.14 is used here for checking the vertical positioning of the character on the body.

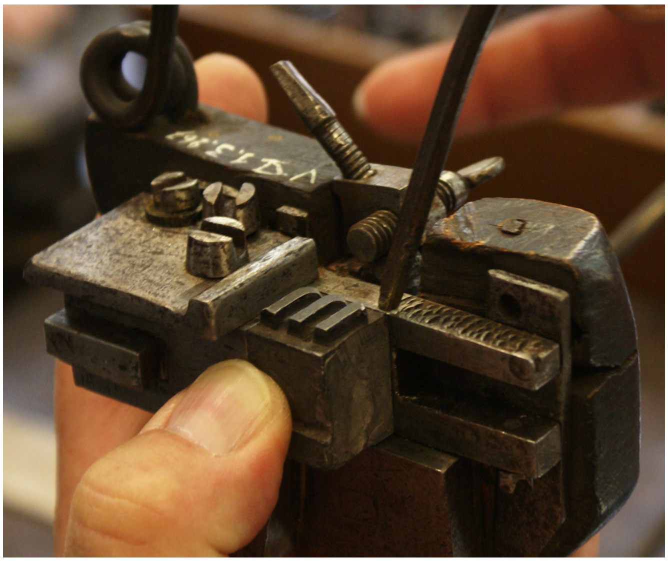


Figure 6.14 Half of a mould that contains an adjustable stool in the form of a bolt.

6.3 Width standardisation of matrices

In the early days of foundry type, the punchcutter was often also the caster but around the end of the fifteenth century casting became a separate profession.[177] The result of this change was that the punchcutters did not have any control over the fitting of the type if it was cast by a third party. The spacing of type during the casting process required that the caster had a trained eye, such as that of the punchcutter. However, one can hardly expect that every caster had such a trained eye. To preserve the quality of the fitting and to ease the casting process, the punchcutters often standardised the matrices in such a way that the process of

[177] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.12.

casting did not require optical skills. This section discusses the technical aspects of this standardisation and illustrates it with the use of the geometric letter model.

The image of the letter in the matrix is represented in Figure 6.13 by the n from the geometric letter model. In the underlying pattern of the Humanistic minuscule (and morphologically related textura), represented by this model, many letters share the same character widths. In line with this one can imagine that when the punches –for the purpose of striking– were positioned according to the similarities of the letters, this resulted in a standardisation of matrices' widths analogously to the shared character widths.

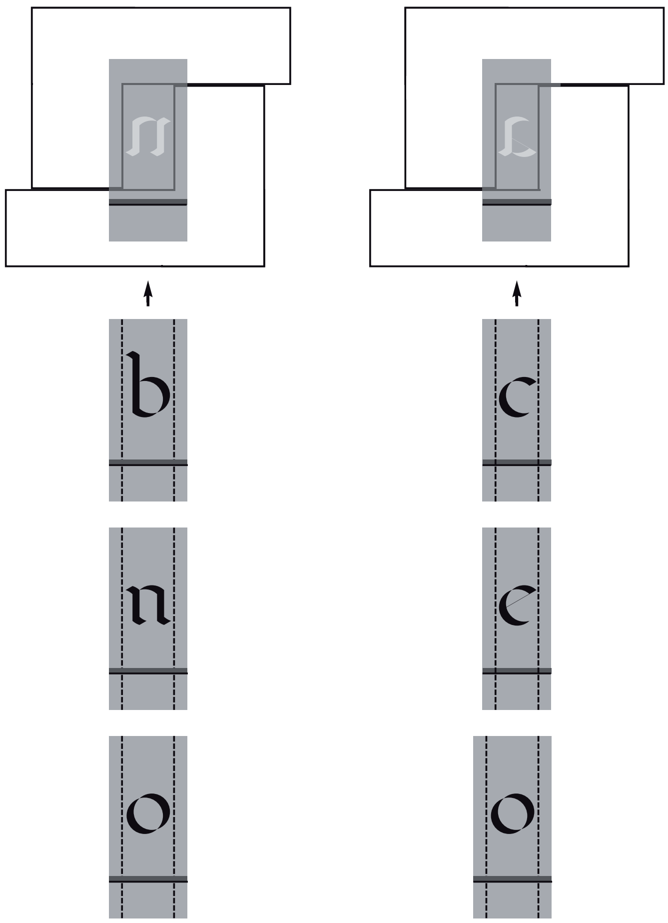


Figure 6.15 Matrices of corresponding letters on standardised widths.

However, it is important to note that although standardised widths of the matrices can simplify their production, it is as such not a prerequisite for casting with fixed registers. Matrices can have different widths while the offset remains identical across all of them. After all, character widths can deviate while remaining the same offset because of the sliding two halves of the mould. Figure 6.15 shows a mould containing the matrix of the n on the left and the same mould containing

the matrix of the a on the right. In case of the matrix of the a, the two halves of the mould come closer together horizontally than in case of the matrix of the n. However, the offset of the registers is identical in both cases.
Figure 6.15 also represents three matrices for n, o, and b that have identical widths. The dotted lines indicate the positioning of the side bearings. The left and right offsets created with the registers are identical, as are the widths of the characters. In the row on the right the matrices of the c and the e share the same width, but the matrix of the o is clearly wider. However, the dotted lines indicate that the offsets at both sides are identical for all three matrices. The two halves of the mould will be closer together for the c and the e, and hence the widths of these characters will be smaller than those for the n, b, and o. But the caster does not have to adjust the registers when he changes matrices. If a whole set of matrices was prepared, i.e., justified for the use of fixed registers, the caster would only have to set the registers once and could then cast all other letters without further alteration.[178] As I have determined empirically, for setting the registers for roman type, the caster could use the lowercase l. This letter is symmetrical within the x-height and the caster could simply add the same space to both serifs. There was no optical judgement required. My measurements seem to prove that the lengths of the serifs were related to the preferred spacing: for instance Garamont shortened the serifs for his display types, which made possible a tighter spacing than for his text types.

Figure 6.16 shows the matrices of Granjon's Ascendonica Romain or Double Pica Roman, from the collection of the Museum Plantin-Moretus (archived under 'MA7'). The matrices were clearly justified for casting with fixed registers. This was empirically tested at the Museum Plantin-Moretus in early 2014 when Guy Hutsebaut, who is the technical expert at the museum, and I cast a range of letters directly from these matrices.

[178] Harry Carter, *A View of Early Typography: Up to About 1600* (Oxford: Clarendon Press, 1969), p.20.

Figure 6.16 Granjon's Ascendonica Romain matrices in rows with lines that indicate the registers' settings.[179]

Type founding was a complex and sophisticated production process that comprised, besides the design aspect, the cutting of punches, the striking and justification of matrices, and the casting of type. Everything that reduces variable factors in the type production will be embraced by the manufacturer. That is the case nowadays, and it was undoubtedly the case in the time of foundry type. The standardisation of the character widths made the standardisation of the matrices easier. The standardisation of the matrices made casting without any optical skills possible. Hence the punchcutter could preserve the quality of the cast type from a distance, because its spacing was an extrapolation of the inherent patterning.

This chapter introduced the Renaissance type production and discussed the technical aspects of the matrix width standardisation for simplified type casting. The next chapter will present evidence based on artefacts from the Museum Plantin-Moretus to support my hypothesis that, like textura type, roman type was the result of the standardisation of its written origin to the type production process.

[179] These were used by former EcTd-student Nicolas Portnoï (he took the photograph) as basis for his revival named 'Ascendonica'.

CHAPTER 7

Having discussed the technical aspects of Renaissance type production in the previous chapter, the present chapter presents my investigation of Renaissance artefacts at the Museum Plantin-Moretus in Antwerp. After all, if the fitting of roman type was based on the system used for textura type, then this system should be present in Renaissance matrices and foundry type. To distil evidence for standardisation and unitisation from Renaissance artefacts, I examined and measured type and matrices from the sixteenth century. This in an attempt to further support my hypothesis that roman type was the result of the standardisation of handwriting to the type production process, in a process analogous to the textura type production.

7.1 Renaissance foundry type

I began my research at the Museum Plantin-Moretus by examining foundry type. Garamont's Gros Canon Romain (Figure 7.1), which appeared for the first time in 1555, was extremely widespread over Western Europe from about 1560 onwards.[180]

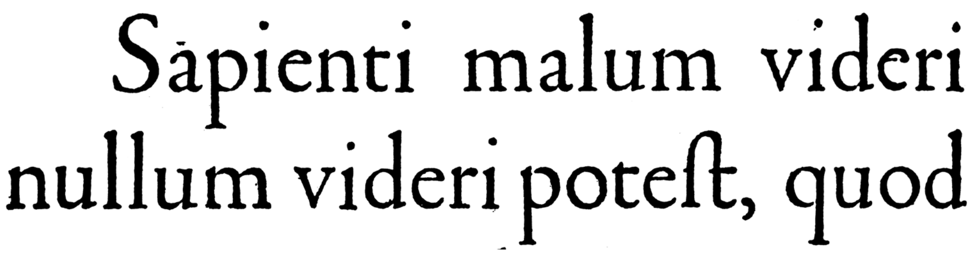

Sapienti malum videri nullum videri poteſt, quod

Figure 7.1 Garamont's Gros Canon Romain in print.[181]

The Moyen Canon Romain (Figure 7.2) is an adaptation of this type commissioned by Plantin, for which Van den Keere shortened the ascenders and descenders.[182] The characters within the x-height coming from Garamont were combined with the letters Van den Keere cut. The latter also cut the smaller accompanying capitals, which appear in Plantin's books from 1571 onwards.[183]

---

[180] Hendrik Désiré Louis Vervliet and Harry Carter, *Type Specimen Facsimiles* 2 (London: The Bodley Head Ltd, 1972), p.3.

[181] Ibid., Plantin's Index Characterum, no.16.

[182] The Moyen Canon Romain is also known as Middelbaar Canon.

[183] Vervliet and Carter, *Type Specimen Facsimiles* 2, p.8.

The shortening of ascenders and descenders, which was often executed by individuals other than the original punchcutters, was a practice adopted by Plantin and his contemporaries for economical reasons.[184] This changed the relationship between x-height and descenders/ascenders of Jenson's archetypal model.

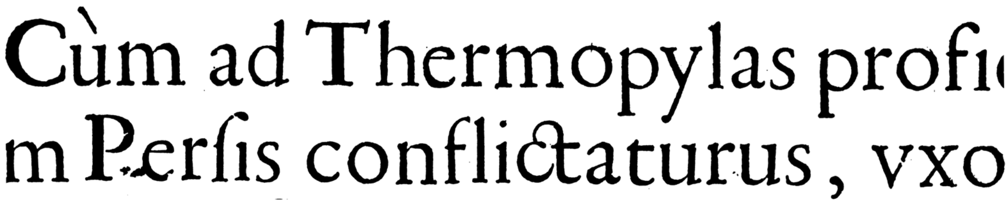

Cùm ad Thermopylas profi
m Perſis conflictaturus, vxo

Figure 7.2 The Moyen Canon Romain.[185]

In 1959 type was recast from the original matrices of the Gros Canon Romain. This was done under the supervision of Vervliet, who writes that 'by casting sharp new types and carefully proofing them we can see these letters for the first time with the clarity that modern methods make possible.'[186] The newly cast type shows many different character widths (Figure 7.3). The clearly different fittings of the h and n indicate that the applied spacing method was not very accurate or consistent and that no fixed register settings were used. That does not come as a surprise because there is no literature on this subject.

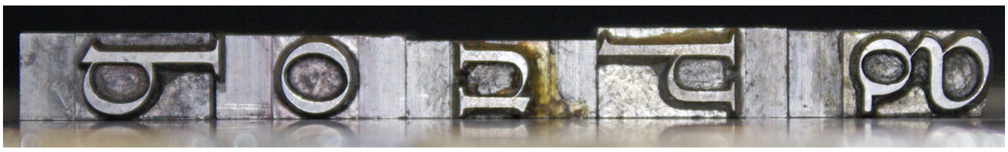


Figure 7.3 Garamont's Gros Canon Romain, as cast in 1959.

There is much older foundry type cast from the matrices of Gros Canon Romain and Moyen Canon Romain in the collection of the Museum Plantin-Moretus. It probably dates from the sixteenth or, at the latest, the seventeenth century. In contrast with the type that was cast in 1959, this type shows a clear standardisation of widths. The letters can be placed in a limited number of groups, like [a, c, e] [b, d, g, h, n, o, p, q, v, fi] [I, j, l] and [r, s, t] (Figure 7.4).

[184] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.66.
[185] Vervliet and Carter, *Type Specimen Facsimiles* 2, Plantin's Folio Specimen, no.5.
[186] Vervliet, 'The Garamond Types of Christopher Plantin', p.17.

Figure 7.4 Historic foundry type: Garamont's / Van den Keere's Moyen Canon Romain.

The results of the measurements (listed in Appendix 5) of the widths of the old foundry type, for which I used a digital calliper, show deviations within these groups of approximately 0.2–0.4 mm. The deviations cannot be felt with one's fingers, even when a nail is used to check differences in thickness in rows of letters, such as shown in Figure 7.4.

The quality of the applied alloy influences the degree of expanding or shrinking. The more precious the applied metal, the more expensive the alloy is. Plantin reportedly used cheap alloys to reduce costs. In *Calligraphy & Printing in the sixteenth century*, a dialogue attributed to Christoffel Plantin, the editor Ray Nash refers to Plantin's cheap alloys.[187] In *The Golden Compasses* Leon Voet explains that Plantin started to make his own metal, of which the quality was not always very good, after all his possessions were sold in April 1562, because it was quicker, or cheaper, or both.[188] Plantin provided punchcutters and casters, such as François Guyot, with his alloy.

The age of the historic foundry type shown in Figure 7.4 is not exactly clear. It could well date from Plantin's times, but the possibility cannot be excluded that the type dates from the seventeenth century. Radiocarbon dating would have been an option if there was enough carbon in the alloy, but there is not.

That being concluded, it made sense to put foundry type aside and to focus on matrices. After all, these should show the same standardisation if casting with fixed registers results in standardised character widths.

7.2 Evidence of standardisation in matrices

As evidence of the use of standardised widths in Renaissance type production, the matrices of the Ascendonica Romain in Figure 7.5 depict how in Granjon's roman type the widths were standardised according to a pattern generated with the geometric letter model.[189] The letters that find their origins in the capitals, the k, s, v–z, are placed on the widths of the letters that can be generated with the letter

[187] Plantin, *Calligraphy & Printing in the Sixteenth Century*, p.42.
[188] Voet, *The Golden Compasses*, Vol.2, p.106.
[189] The Ascendonica Romain is also known as Gros Parangon and Double Pica Roman.

model. The s shares its width with the f, r, long s, t, 3, and 5. The k and the v–z range all fit on the width of the n. At that time the w was not yet in use.

Figure 7.5 Ranges of characters that share widths in Granjon's Ascendonica Romain.[190]

Given the fact that Granjon's high level of skill was for instance equaled by Garamont, it is likely that if he made use of standardised processes in type production, so too did Garamont. Also housed at the Museum Plantin-Moretus, the matrices of the Gros Canon Romain are attributed to Garamont:

> In 1563 Plantin had 143 matrices for the 'Gros Canon Rom[m]ain de Garamont' acquired since 1561 […]. […] They are attributed to Garamond in the Frankfurt 1590, [the] 1572 and 1581 Inventories. The 1590 Frankfurt Inventory gives the number of matrices as 156, no doubt including the Moyen Canon shortened letters.[191]

---

[190] Photo's by Nicolas Portnoï, made with a digital microscope.

[191] Voet, *Inventory of the Plantin-Moretus Museum*, p.14.

Figure 7.6 Matrices of Garamont's Gros Canon Romain.

Considering the spotless refinement of these matrices (Figure 7.6), it seems likely that the French master produced them. As discussed in the previous section, I already measured the Gros Canon Romain type cast from these matrices. In order to further investigate the use of standardised widths in Renaissance type production, I subsequently measured the matrices.

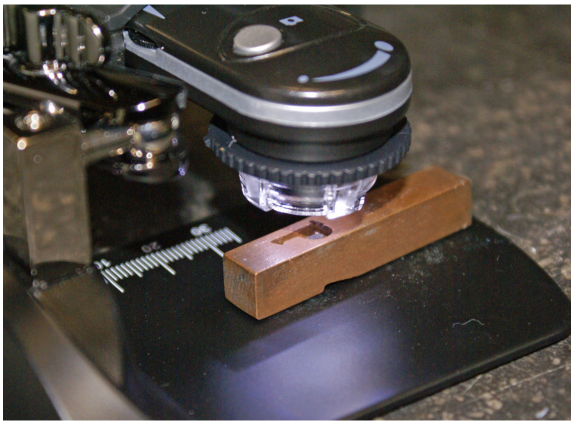


Figure 7.7 Digital microscope camera and a matrix of the Gros Canon Romain.

With a digital microscope camera (Figure 7.7), which is meant for checking computer-circuit boards, I investigated the matrices. I also used it to take the detailed photographs shown below. The high quality of the Gros Canon Romain matrices is evident: the strikes of the punches are placed exactly and perfectly perpendicularly in their visual centres, as can be seen in Figure 7.8.

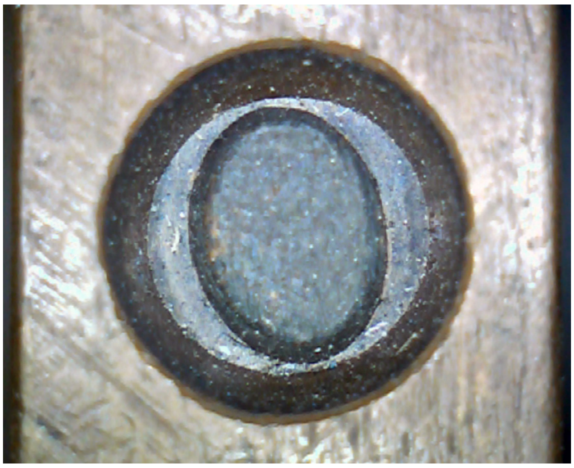


Figure 7.8 Digital-microscope photo of the Gros Canon Romain matrix for the lowercase o.

The measurements of these matrices revealed the same standardisation of widths as the ones I found in the sixteenth- or seventeenth-century cast type: rows can be made of letters sharing the same widths (Figure 7.9).

Figure 7.9 Matrices of the Gros Canon Romain showing groups of equal widths.

Before striking the punches had to be positioned as exactly as possible on the matrices. In his *Manuel Typographique* Fournier explains that, after polishing the matrix, the place where the punch should be struck is marked. The exact place of the strike is empirically and gradually found.[192] In *Mechanick Exercises*, Moxon describes the vertical positioning of the punch on the matrix in relation to the mould: '[…] Then if the punch to be sunck be an ascending Letter, He with a fine point Needle, makes a small Race by the upper side of the Carriage upon the Face

[192] Carter, *Fournier on Typefounding*, pp.82,83.

of the Matrice […].'[193] The related annotations by Davis and Carter note that Moxon used a particular mould as a gauge for alignment.

The depth of the strike is the result of beating the punch with a hammer: '[…] as perpendicularly as possible until it has gone in as much as a twelfth of an inch or thereabouts—more for big letters and rather less for small ones.'[194] Carter comments that striking by hand is very difficult 'because the punch must be held (1) perpendicular; (2) quite still so that it may not shift between the blows.'[195]

Figure 7.10 Word typeset in Gros Canon Romain matrices.

A way to check standardised widths of matrices is to use them to typeset a word (Figure 7.10). The distances between the letters should automatically result in an even distribution of white space between the letters, although the spacing will be too wide in relation with the space in the letters. Because the matrices include the offset for the registers, in order to obtain a spacing that is based on a repetition of the stem interval of the n, a reduction of the matrices' widths with a constant factor is required. This is what the mould's registers are used for.

As can be seen in Figure 7.8, the matrices of the Gros Canon Romain are very refined. Van den Keere's additional matrices for the Moyen Canon Romain (Figure 7.11) are slightly rougher: the surface is less polished and the angle of strike-taluses less steep. However, the widths of the matrices and the positions of the strikes follow those of Garamont's type. Therefore, the same fixed setting for the registers can be used for Van den Keere's Moyen Canon Romain as for the related matrices from the French master, as I proved empirically.

---

[193] Moxon, *Mechanick Exercises*, p.153.
[194] Carter, *Fournier on Typefounding*, pp.83,84.
[195] Ibid., p.84.

Figure 7.11 Digital microscope photo of the Moyen Canon Romain matrix for the lowercase g.

In the collection of the Museum Plantin-Moretus, other matrices attributed to, for instance, Granjon and Van den Keere show the same limited ranges of widths. Van den Keere's textura types as shown in Figure 7.12 can be placed in rows as those of Garamont's Gros Canon Romain.

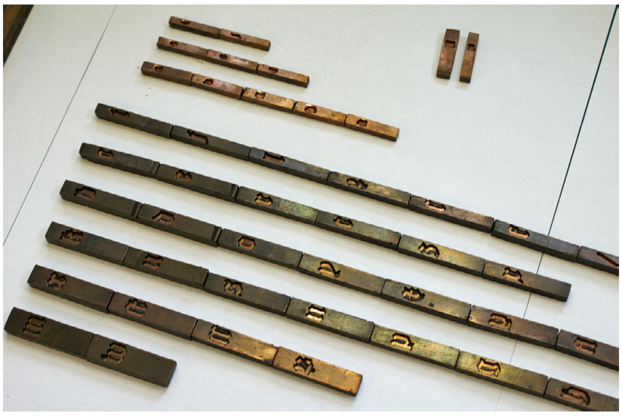


Figure 7.12 Van den Keere's matrices for Canon Flamande and Parangonne Flamande in rows.

7.3 Unitisation of matrices

As described in Section 5.2, Jenson's roman seems to fit on a simple unit-arrangement system. Jenson's archetypal model was used by Griffo as the basis for his roman, and Garamont used Griffo's type as the basis for his own type. Hence, one would expect that Garamont's type, and consequently his matrices, would also reveal the same unitisation as Jenson's. This section presents evidence to support this idea.

Due to the organic morphologic relationship between textura and Humanistic minuscule, it was logical to use the textura production method for Jenson's roman type. Curves in Jenson's type were overshoots of the stems, as can be explained with the geometric letter model. Hence the bowls of the b, c, d, e, o, p, and q preserve the stem interval throughout a text. This stem interval can be divided into a certain number of units. If one wants to define a unit-arrangement system for standardising the width of matrices as well, then it makes sense to use the stem interval as a starting point.

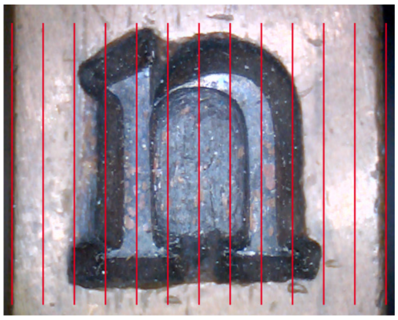


Figure 7.13 Lowercase n of the Gros Canon Romain on a character width of eight units.

In Figure 7.13 I divided the stem interval of the n from the Gros Canon Romain into four units. This resulted in eight units for the character width, in line with what I used for the research into the unitisation of Jenson's roman as described in Section 5.2. The complete width of the matrix is 12 units. Furthermore the letters that share the width of the n (and hence the width of its matrix), like o and p, can be placed on the same number of units. I could then use these units to change the spacing of the matrices (Figure 7.14).

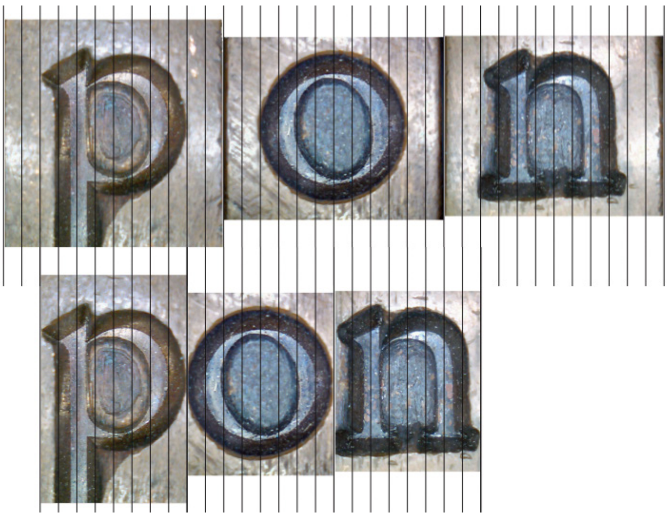


Figure 7.14 Tightening the spacing of matrices of Garamont's Gros Canon Romain using unitisation.

If units were used to define character widths, the proportions of the characters should then be related to the units. If the punchcutter wanted to further refine the type, an option could be to subdivide the existing units into smaller units. This could be done by bisecting the units a certain number of times. In Figure 7.15 the number of units has been doubled in comparison to Figure 7.14.

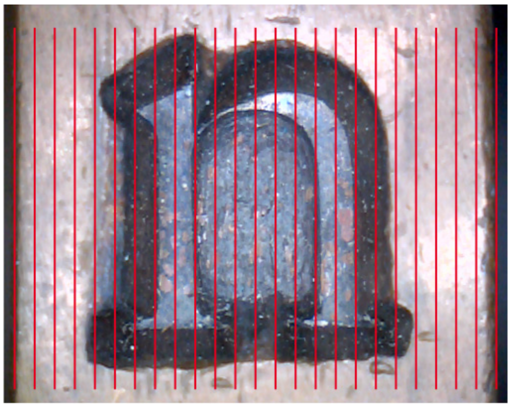


Figure 7.15 The n-matrix of the Gros Canon Romain with refined units.

In my measurements the division of the stem interval into four units, which resulted in eight units for the width of the n of the Gros Canon Romain, was not refined enough for all matrices. The more refined units seem to fit exactly on a selected range of other matrices, which also represent groups of letters with identical widths, such as [e, a, c], [s, r, t] and [I, j, l] (Figure 7.16).

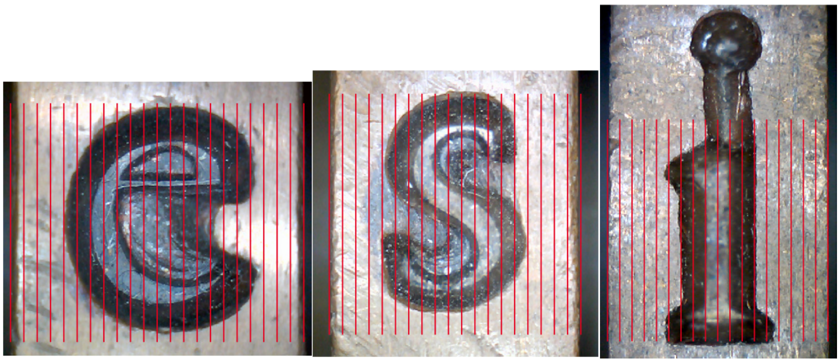


Figure 7.16 Gros Canon Romain matrices with a refined unitisation.

It should be noted that, although the units fit perfectly on the pictures of the matrices shown here, there seems to be some deviation in the size of the letters. This is the result of differences in the exact point on the matrix on which the digital microscope camera was focused. The thickness of the matrices, which is not of importance for the casting of type, sometimes differed slightly. It should also be noted that the size of the letters is quite small; the height of a cast o of the

Gros Canon Romain is 5.25 mm. Subsequently the smallest deviations in focus had a relatively large impact.

This section provided evidence of the use of standardised widths in Renaissance type production by showing standardisation of widths of matrices from Granjon and Garamont. It furthermore demonstrated the way in which the matrices for Garamont's Gros Canon Romain reveal a simple unitisation system for the width of the characters. This provides further support for my hypothesis that, like textura type, roman type production was based on the standardisation of its handwritten origins. The production of matrices in the sixteenth century as well as their related standardisation and systematisation are further discussed in Appendix 5, *Details of the Renaissance type production*.

7.4 Unitisation and optical spacing

As the next step in my investigation of unitisation in Garamont's type, I compared two different sizes of his type: the larger Gros Canon Romain and the relatively small Parangon Romain. In present-day type design fonts are optically spaced, and the generally embraced idea is that this always has been the case. Slimbach optically spaced Adobe Garamond based on Garamont's Parangon Romain, and obviously he never investigated the standardisation and possible unitisation of Garamont's type. However, if one uses a simple scheme for spacing defined in units (as discussed in the previous section) for the Parangon Romain, then the outcome very closely approaches Slimbach's optical spacing, which because of the current technology could be ultimately refined. Of course, Slimbach was conditioned with Garamont's model (which used the same standardisation patterns at Griffo's and thus Jenson's), and hence it is not surprising that he optically reproduced what could be done easily using a simple cadence-units based scheme, as presented in Chapter 5.

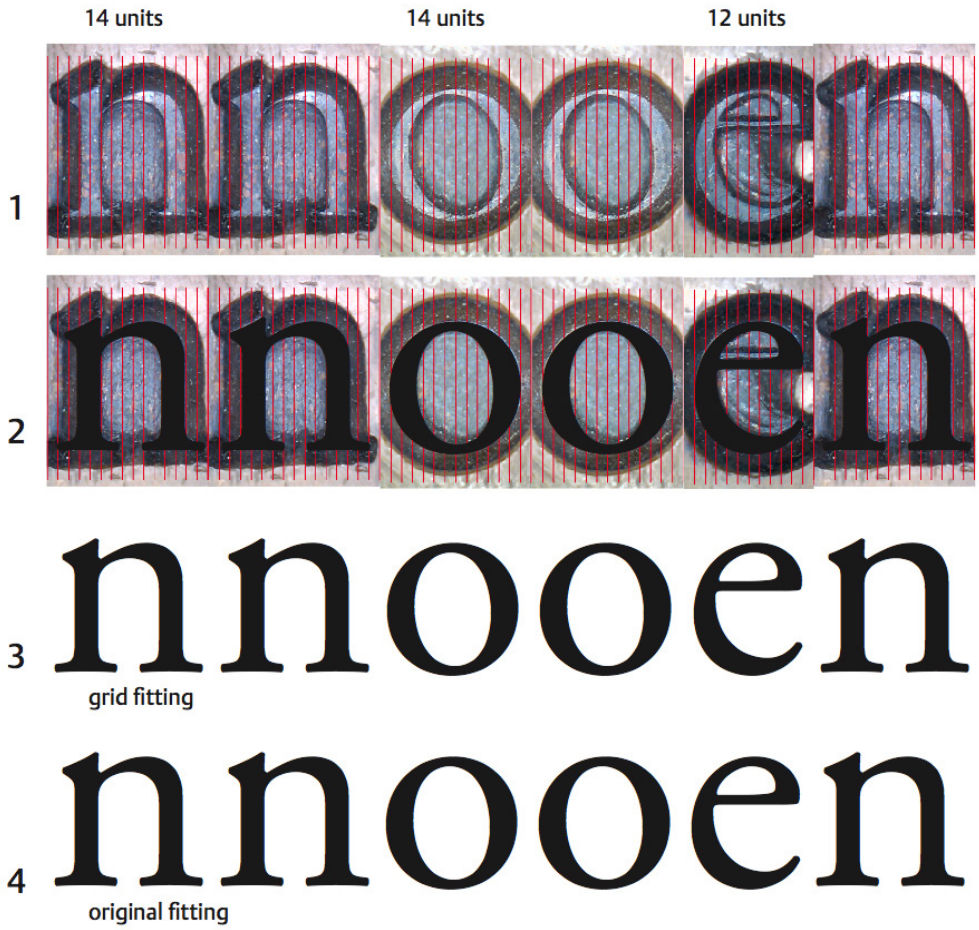


Figure 7.17 Gros Canon Romain matrices (1), Gros Canon Romain matrices with superimposed Adobe Garamond (2), Adobe Garamond with grid fitting (3), Adobe Garamond with original fitting (4).

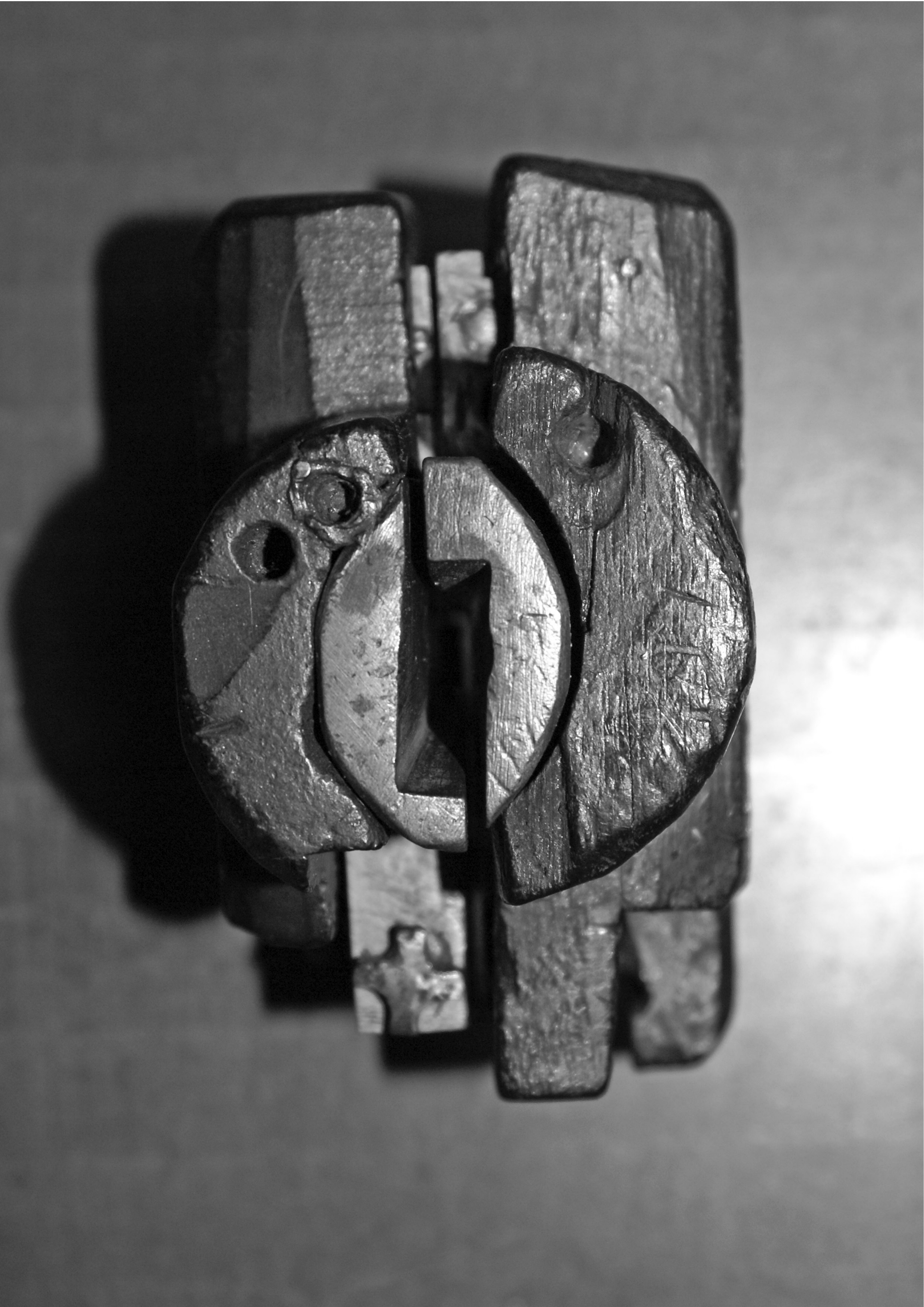
Figure 7.17 depicts Garamont's Gros Canon Romain with the n placed on 14 units, together with Adobe Garamond. The Gros Canon Romain is a relatively large type, and requires a tighter spacing. This was clearly taken into account by Garamont, who made the serifs shorter than in his Parangon Romain (which formed the basis for Adobe Garamond), but overall maintained the same proportions as those of the Gros Canon Romain. Figure 7.17 shows that only the eye of the e was made larger for the smaller point sizes. The overall identical proportions are in direct contradiction with the generally accepted theory that every individual type size was created separately and optically by the punchcutters.

Garamont's letters for the two different sizes are much more similar than one would expect from type produced long before Benton invented his pantographic engraving machine. This device for scaling and modifying type is considered to have changed the type design métier: '[…] pantographic enlargement or reduction is with hand cutting impossible, and each size of type has to be cut as though it were a new design,' writes Eric Gill in *An Essay on Typography*.[196] The similarities in his different type sizes strongly suggest that Garamont's production methods were highly systematised, and this also makes the application of sophisticated methods like unitisation very plausible.

Adobe Garamond is slightly more tightly spaced in comparison with the Parangon Romain; this is because digital type does not have physical limitations for point sizes and can be unlimitedly scaled. Therefore, digital type requires a fitting that also functions well at larger point sizes. The original –optical– fitting of Adobe Garamond seems to come quite close to the unitised fitting of the Gros Canon Romain matrices, as shown in the second row of Figure 7.17.

In this chapter I presented the distilled evidence of a unit-arrangement system from various Renaissance artefacts housed at the Museum Plantin-Moretus, thus suggesting that the early punchcutters standardised widths in the production of roman type. This evidence served to further strengthen my hypothesis that the Renaissance punchcutters made use of standardised handwriting in the production of roman type; this was done in a process analogous to the more obvious standardisation of textura handwriting for textura type. Having thoroughly examined the evidence for the standardisation of horizontal proportions in roman type, the next chapter will present a dynamical framework for determining the relationship between the horizontal and vertical proportions of roman type analogously to textura type.

[196] Gill, *An Essay on Typography*, p.76.



CHAPTER 8

The last few chapters discussed the evidence supporting the use of width unitisation in Renaissance font production, and thus the horizontal standardisation of the Humanistic minuscule to the roman type production process in a process analogous to the standardisation of textura hand to textura type production. This chapter will discuss the possible standardisation of vertical proportions in Renaissance type and investigate these in relation to the horizontal standardisation as the last argument to support the hypothesis. To this end dynamic frameworks that may have been used will be presented. Then, as was done with the unit-arrangement system in Chapter 5, the use of the framework will be distilled from historical prints.

My geometric reconstructions of the archetypal models from Jenson and his peers presented in this chapter are not meant to indicate that the early punchcutters above all looked for 'ideal' proportions such as the golden ratio. Geometric patterning was required to control proportions within a prefixed body: the height of the aperture of the mould, which equals the height of the body, was the constraining factor. By defining the proportional relationship between roman and gothic type, the size of the letter parts within a certain mould could be preset, hence preventing an experimental process for every body size.

The fact that the archetypal models are considered optically appealing can be explained by the fact that the golden ratio can be traced in the proportions. However, the question is whether these proportions are purely the result of visual preferences that can be captured in golden section rectangles, or whether they are the result of moulding letters into a geometric framework adapted to both the technical constraints of the Renaissance type production and optical preferences.

8.1 Geometry and roman type

Before introducing my dynamic framework model for the translation of horizontal proportions of roman type to vertical ones, a discussion of the importance of geometry in the Renaissance, on which the model relies, is necessary. The present discussion aims to illustrate the widespread use of geometry in the time of the first punchcutters, and thus to demonstrate the likelihood that they would have encountered it.

How plausible is it that Renaissance punchcutters deliberately applied geometric systems? It is at least likely that goldsmiths were familiar with geometry. Richard A. Goldthwaite writes in *The Building of Renaissance Florence: An Economic and Social History* that goldsmiths knew how to make drawings and that they possessed a working knowledge of geometry. For that reason, building patrons also turned to goldsmiths for architectural ideas.[197] Many of the early punchcutters, such as Gutenberg, Griffo, Garamont, and Granjon, were in fact goldsmiths.

Geometry was commonly applied in the fine arts and the architecture of the Renaissance. For example the painter Pierro della Francesca (ca.1415–1492) was not only an artist, but also a mathematician and geometer. Therefore, he used geometrically based constructions for the layout of his paintings. The mathematician Luca Pacioli applied his theories on geometry in his *De divina proportione*. Geometry was also used during the Renaissance for reconstructing the Roman imperial capitals, as can be seen in the aforenamed publication by Pacioli. His contempories, such as Feliciano and later Albrecht Dürer, also reconstructed the Roman imperial capitals using compass and ruler. Morison writes about this in *Early Italian Writing-Books*: ‘The geometrical construction of letters was a branch of the renaissance preoccupation with the revival of the classical canons […]; as such its theory might engage the dilettante as well as its practice the craftsman.’[198]

The Renaissance attempts by scholars and artists to reconstruct the Roman imperial capitals have always been considered to be independent from the Renaissance type production. Morison clearly excluded the possibility of the application of geometry in the early roman type. He was convinced of the ruling of the punchcutter’s eyes: ‘Having learned and memorised the true proportions of roman letter as taught in the manuals of Moille, Pacioli and others, the goldsmiths, punch-cutters and printers relied on their eyes and not upon their measuring tools.’[199] However, there are no records by the early punchcutters preserved, and Morison does not seem to have provided documented support in his publications for this statement. Although Morison’s statement that the punchcutters purely relied on their eyes seems to be no more than an assumption, it is generally embraced within the world of type. Historians connect the attempts to reconstruct the Roman imperial capitals by Renaissance artists and scholars with

[197] Richard A. Goldthwaite, *The Building of Renaissance Florence: An Economic and Social History* (Baltimore/London: The John Hopkins University Press, 1982), p.358.

[198] Stanley Morison, *Early Italian Writing-Books: Renaissance to Baroque* (Verona/London: Edizioni Valdonega/The British Library, 1990), p.45.

[199] Morison, *Pacioli’s Classic Roman Alphabet*, p.78.

the Romain du Roi, but the application of geometric systems in the work of the Renaissance punchcutters seems to be completely out of the question. Interesting in this context is the remark by Herbert Davis and Harry Carter in the introduction of the 1958 reprint of *Mechanick Exercises* that Moxon's account of the whole process of letter-cutting '[…] certainly leaves an impression on the reader that he […] designed his letters on paper according to the mathematical proportions he sets down […].'[200]

Whether or not the Romans themselves used geometric constructions as basis for their inscribed imperial capitals is also fodder for discussion. In his 1971 article on Cresci's capitals in *Visible Language*, Anderson described the differences of opinion on the origin of the construction of the Roman imperial capitals between Morison and William Lethaby, the English writer, architect, and designer (1857–1931). Morison followed the epigrapher Emil Hübner in his idea that 'the more elegant inscriptions were drawn or painted with aid of the rule and compass,'[201] whereas Lethaby believed that '[…] most of the great monumental inscriptions were designed in situ by a master writer, and only cut by the mason, the cutting being merely a fixing, as it were, of the writing […].'[202] It is noteworthy that Morison considers it plausible that the Roman capitals were drawn on paper using measuring tools first, whereas in case of the early punchcutters he excludes the usage of measuring tools.

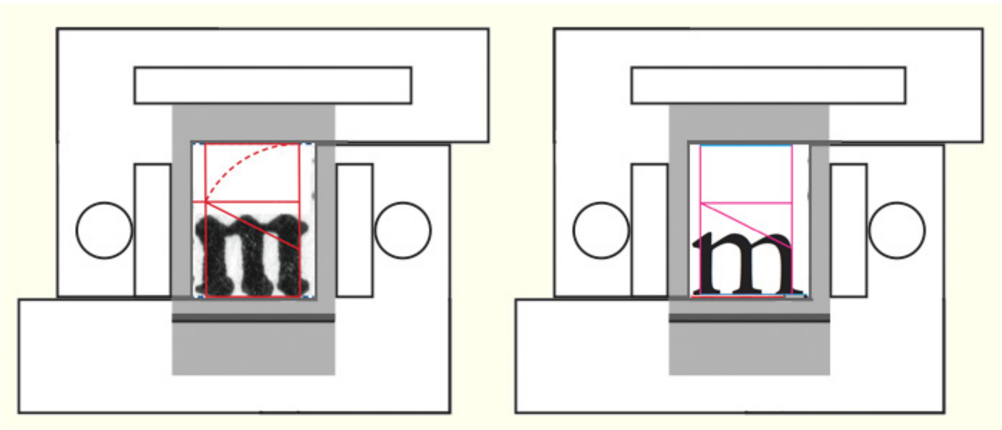


Figure 8.1 Defining the proportions of textura and roman type within a fixed body size.

[200] Moxon, *Mechanick Exercises*, p.xxxvii.

[201] Donald M. Anderson, 'Cresci and His Alphabets', *Visible Language*, Volume v, Number 4 (Cleveland: the Journal, 1971), pp.331–352 (p.346).

[202] Ibid. p.345.

The fact that Gutenberg and Jenson lived in a time in which the application of geometry and the search for divine proportions were warp and weft makes it plausible that they investigated geometric ways to standardise type and that they looked at geometric constructions such as the golden ratio. Gutenberg and Jenson had –one way or another– to set the vertical proportions of the letter parts within a prefixed body: the mould was defining the borders and by controlling the relation between roman and gothic type, the outcomes (x-height, X-height, lengths of ascenders/descenders) on a certain body size could be made predictable (Figure 8.1).

Such a standardisation is useful if one is making type for the first time in history. Of course, one could try to do this empirically and determine the proportions by trial and error, but setting proportions before punchcutting makes the process more controllable and reproducible. In theory a geometric framework for defining the vertical proportions of letter parts had to be made for every body size only once; as soon as the proportions are defined, one can copy these, measurably or optically, without the need for knowledge of the original standardisation. By defining the proportional relationship between roman and gothic type, the size of the letter parts within a certain mould could be preset across different type models. When Gutenberg started producing textura type cross-model standardisation may not have been taken into consideration by him, although it is possible that he was aware of the fact that in Italy the Humanistic minuscule had partly replaced textura handwriting. However, Jenson was from 1458 to 1461 in Mainz to study printing and typefounding before he established his printing firm in Venice.[203] Although Jenson became famous because of his roman type, he cut and applied more gothic type.[204] Cross-model standardisation must have made it easier for Jenson to cut and cast his roman type: he did not have to start from scratch.

The application of the 'divine proportion' in the frameworks presented in this chapter raises the question whether the type was adjusted to it, or whether the golden ratio approximated the proportions they already had in mind. In any case the early punchcutters had to balance technical constraints with visual preferences. One could argue that the fact that the proportions of early type can be

---

[203] Kapr, *Johannes Gutenberg*, p.252.

[204] Martin Davies, *Aldus Manutius, Printer and Publisher of Renaissance Venice* (London: The British Library, 1995), p.8, and Stanley Morison, *Type Designs of the Past and Present* (London: The Fleuron, 1926), p.15.

captured in geometric models does not necessarily imply that such models were applied. On the other hand, the usage of frameworks for fixing vertical proportions in relation with horizontal proportions is in line with the horizontal standardisation and unitisation I measured and distilled from textura and roman type –especially if it can be proven that the same frameworks can be used for defining the vertical proportions for both textura and roman type. After all, both type models were jointly produced by Renaissance punchcutters.

Having discussed the role of geometry in the context of the Renaissance punchcutters, the next sections will focus on the use of geometry to standardise the proportions of textura and roman type. The application of geometric constructions in Renaissance (applied) arts is further discussed in Appendix 7, *Geometry in the Renaissance.*

8.2 Width-height relationship

For movable type, letters have to be placed on rectangles. The height of such a rectangle (body size) is defined by the lengths of the ascenders and descenders plus some additional height. The latter is required in order to keep some distance between the extremes of the ascenders and descenders and the edges of the rectangles. One option to define such a rectangle would be to do so by eye. This would result in trial and error. Fixed proportions cannot automatically be applied on other type that is morphologically related. For instance, the relatively small counters in textura type require shorter ascenders and descenders than the larger counters in roman type. Defining the proportions by the eye would also not be the most convenient option for scaling type to other body sizes. It is possible that Gutenberg started with defining the size of his textura type empirically. It is also possible that Jenson did the same. However, the possibility cannot be excluded that Jenson related the body size of his type to Gutenberg's.

Horizontally standardised letter proportions result in equally systematised widths of matrices, and this makes the use of standardised copper bars possible. If the horizontal-vertical relationship could be captured in a (geometric) model, then would it even be possible to standardise the relation between character width and body size across different models of gothic and roman type? Such a standardisation within the rectangle is irrespective of whether the actual body size was defined as part of the units of measurement in use in Europe during the Renaissance and in later times, such as the foot, the inch, the cubit, the pace, the thumb, etcetera. This section discusses the possibility that a system related to the horizontal standardisation of character widths discussed in the previous chapters was used to standardise heights in roman type production.

As was described in the previous chapter, the horizontal proportions of Renaissance roman type were based on the n because this letter shows the stem interval perfectly, and the latter can easily be divided into units. For standardising vertical dimensions it would make sense to link these dimensions to the horizontal ones, since the width of characters is inseparably connected to the lengths of ascenders and descenders, and also to the height of the capitals. In both textura and archetypal roman type the m was a repetition of the n. In Fournier's time, and probably also in earlier times, the m was used for defining a pattern for the fitting of the other letters. Furthermore, the height of the capitals seems to be related to the width of the m. Might it then be possible that the m initially formed the basis for defining the body as well?

There is some evidence to indicate that the Renaissance punchcutters used such a system for the production of both textura and roman type. For example, if we look at Jenson's capitals in print, then their heights and widths both appear to be related to the proportions of the m (Figure 8.2). In his type the counters of the m are identical to the ones in the n. In the image, a fence of n's is used at the bottom to show the relationship between the width and the height of the capital N. To the left of the capital is a rotated m built out of two n's. This illustrates the fact that the height of the N equals its width (without the serifs).

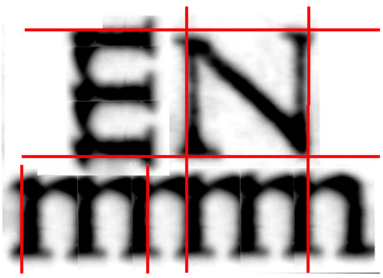


Figure 8.2 The relation between the height and width of Jenson's capitals and the width of the n.

This is a fairly crude image, but examining the relationship between the m and the height of the H (which has the same height as the N) of Adobe Jenson results in related proportions (Figure 8.3). There is a clear difference to Figure 8.2, because a serif of the m is added here to reach the height of the H. Nevertheless, the horizontal unitisation seems to prove that the proportions of the serifs are part of the grid, and hence such a grid could also work in a vertical direction. This is further described in Section 8.6.

Figure 8.3 The relation between the capital height and the width of the m in Adobe Jenson.

There is no documentation from the early days of typography that proves that standardised structures were used to calculate the vertical proportions. If such standardisations were applied during the Renaissance, then evidence has to be distilled from historic prints and from the measuring of matrices. The question is how this can be measured and mapped. What geometric models could have been applied by Renaissance punchcutters to create a flexible, dynamic rectangle for the body size, which is applicable to both gothic and roman type? The following section begins to answer this question by introducing a standardised framework that I distilled from historic prints.

8.3 Standardised proportions in textura and roman type

Before examining the proportions in roman type, it is logical to start with textura type if roman type was produced on the structure of textura type, as I hypothesise. If a framework can be distilled from textura type, it is likely that the same framework can be observed in roman type. To determine whether a standardised construction could be traced in Gutenberg's type, I measured the textura type from his 42-line Bible from 1455. This was simply a matter of trial and error, because I had no idea what kind of structure could have been used. I applied several root rectangles and the related golden section rectangle using the m as the basis for a square.[205] This approach was based on the idea that horizontal proportions formed the basis for the vertical ones. At the end of my investigation I

[205] Root rectangles are rectangles of which the long side equals the diagonal of a square made out of the short side. The ratio of the longer side to the shorter side of a root rectangle is the square root of an integer: √2, √3, etc. See also: <http://www.heamedia.com/Documents/Geometry/A_Closer_Look_at_Root_Rectangles.html>. The golden section rectangle is constructed in a manner related to that of the root rectangles: in this case the diagonal is not drawn from the corner of the square that is made out of the short side, but from the middle of the short side. The length of the diagonal is added then to point where it originated to define the length of long side of the rectangle. See also: <http://www.cut-the-knot.org/do_you_know/GoldenRatio.shtml>.

could reconstruct the proportions of the body textura type from Gutenberg's 42-line Bible by extending the m to a golden section rectangle. The length of the descenders was defined using a root 2 rectangle (Figure 8.4).

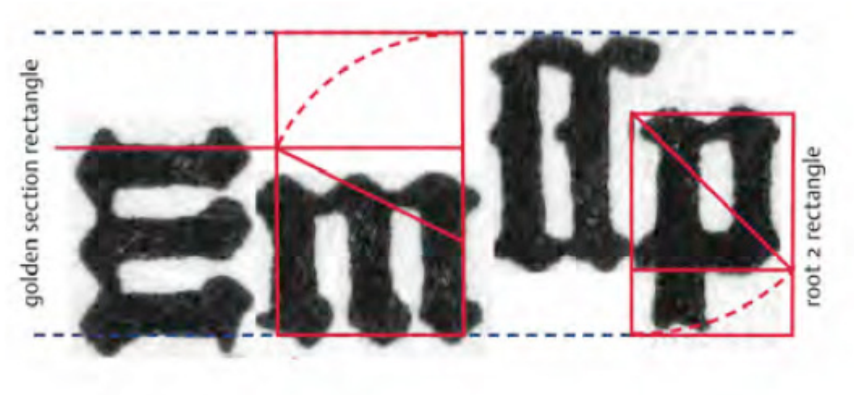


Figure 8.4 Relationship between the proportions of the m and the body size of Gutenberg's textura type from his 42-line Bible.

Assuming that Jenson treated his roman type as a variant of textura type, then it should reveal the same relation between the width of the m and the length of the ascenders and descenders. As Figure 8.5 shows, it does.

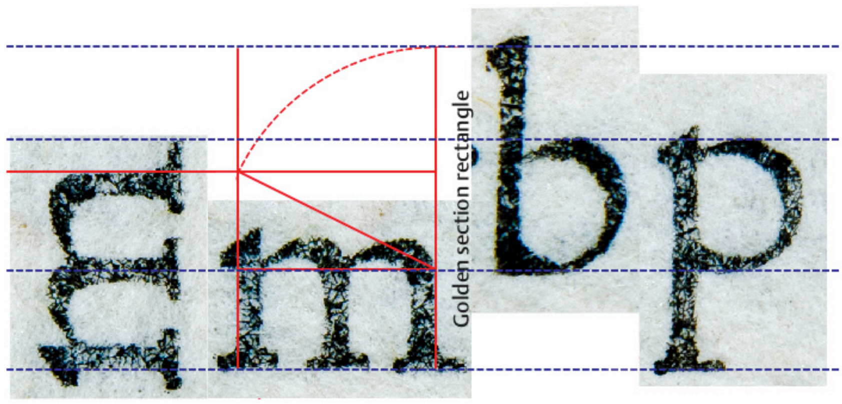


Figure 8.5 Jenson's roman and the extended m-based golden section rectangle.

There is a small deviation noticeable on top of the ascender of the lowercase b: the top serif is a little bit outside the framework. It has to be taken into consideration here that Jenson's roman type is quite small and the x-height is less than two millimetres. Hence, small irregularities in print, but also in the photographs used here, can easily cause such deviations. Figure 8.5 shows that the length of the descenders of Jenson's roman is half the width in between the outside stems of the lowercase m.

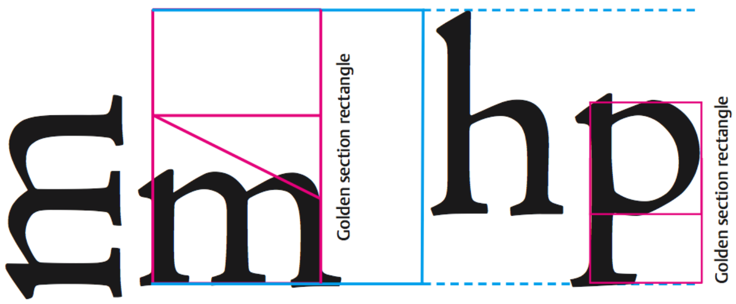


Figure 8.6 Adobe Jenson and the extended em-square.

Most of the proportions of Adobe Jenson are very close to the original model. If a square based on the outside stems of the m of Adobe Jenson is used to calculate a golden section rectangle (the body size), the ascenders and descenders of Adobe Jenson's type fit perfectly into this golden section rectangle. If a square based on the x-height is subsequently made and extended to a golden section rectangle, then the proportions of the descenders can also be determined. The rest of the space is then used for the ascender. Obviously the lengths of the descenders of Adobe Jenson differ from the original ones as shown in Figure 8.5. This can be explained by the fact that Adobe Jenson is part of a modern type family, which contains bold variants (Figure 8,7). Because the x-height of a bold version of roman type is usually larger than that of the regular weight –to prevent that the bold version will look smaller than the regular– the relationship between the lengths of the descenders and ascenders will change. To anticipate this, type designers will make the ascenders a bit longer than the descenders. Jenson never had to deal with this, because there were no bold variants of roman type in his time.

Figure 8.7 Adobe Jenson regular and bold.

The golden section rectangle used here to define the body size is an extension of the 'm-square' or 'em-square'. This offers some room for speculation: maybe the term 'em' originates from the rotated m (which actually reads like a capital E) in combination with the normally positioned m? This 'em-square' is definitely something else than what is called 'em-square' or 'em' nowadays. It is clear what is meant with 'em' but it is unknown what exactly forms the origin for the term. This subject is further discussed in Appendix 6, *Units and grids*.

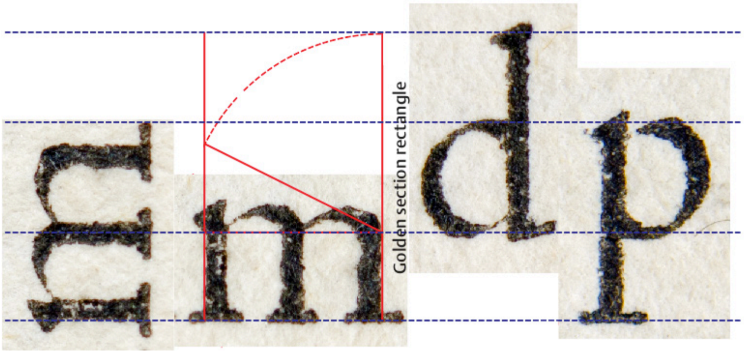


Figure 8.8 The em-square of Griffo's roman type for De Aetna (1495).

Considering the relation between Jenson's and Griffo's roman types, one would expect that the relation between em-square and the length of the ascenders and descenders found in Gutenberg's and Jenson's types could also be traced in the types of Griffo. Figure 8.8 shows that this is undoubtedly the case for Griffo's roman type from 1495, which was applied by Manutius in *De Aetna*. In 1929 The Monotype Corporation faithfully copied the proportions of Griffo's type and hence the em-square for the production of Monotype Bembo (Figure 8.9).

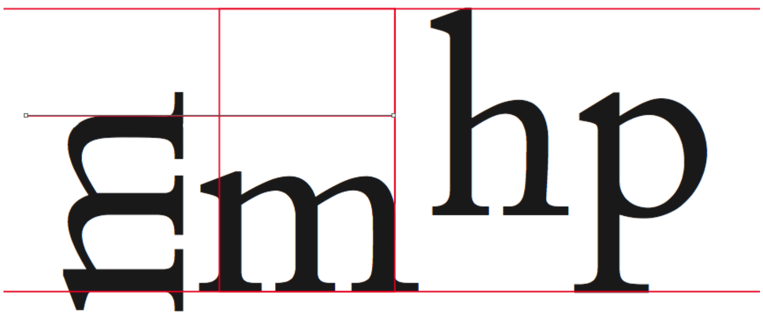


Figure 8.9 The em-square of Monotype's Bembo (Book weight).

Adobe Garamond, a revival by Slimbach based on Garamont's Parangon Romain has, not surprisingly, similar proportions (Figure 8.10).

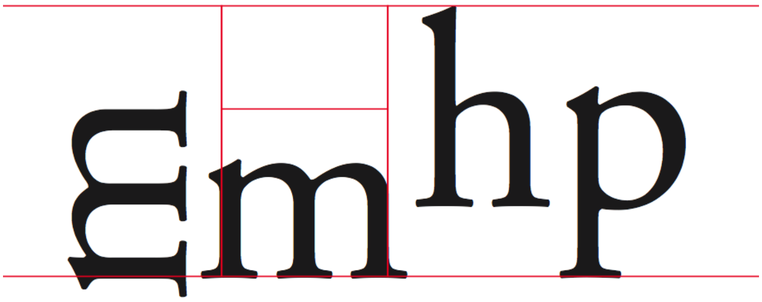


Figure 8.10 The relation between em-square and ascenders/descenders in Adobe Garamond.

Renaissance punchcutters did not need nanotechnology to apply the geometric constructions to their punches, and thus to standardise proportions. The relations between the letter parts could have been drawn and calculated at any size and could then have been translated into a gauge. Furthermore, the sophisticated standardisations I found during my measurements at the Museum Plantin-Moretus in the type and matrices by Garamont, Van den Keere, and Granjon lead me to believe that it is plausible that the Renaissance punchcutters would not have been deterred by technical complications.

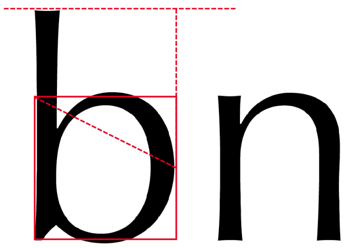


Figure 8.11 Hermann Zapf's Optima is based on the golden ratio.

There is at least one piece of documented evidence of a deliberate application of the golden section on type; but the typeface in question was not designed in the Renaissance but in the 1950s by Hermann Zapf. However, it finds its origin in the fifteenth century: Optima (Figure 8.11) was based on sketches that Zapf made in Italy in 1950 of the Renaissance inscriptions in Florence's Santa Croce.[206] The x-height of Optima forms the square on which the golden rectangles that mark the length of the ascenders and descenders are based.[207]

[206] Hermann Zapf, *Alphabetgeschichten : eine Chronik technischer Entwicklungen* (Bad Homburg/ Rochester: Mergenthaler Edition, Linotype GmbH/RIT Cary Graphic Arts Press, 2007), p.43.
[207] Lawson, *Anatomy of a Typeface*, p.329.

In spite of the lack of documented evidence, the appearance of the geometric constructions distilled from historic prints in this section suggests that the Renaissance punchcutters used a framework to standardise the proportions of roman type. The next section discusses the versatility of such a framework by investigating its dynamic aspect.

8.4 The dynamic em-square model

The hierarchical relation between the size of the counters and the length of the ascenders and descenders is captured in the geometric em-square model, which I introduced in the previous section. The em-square model is dynamical because changing the width of the m will result in different lengths of the ascenders and descenders. Widening the m results in a relatively smaller x-height and, conversely, condensing the m results in a larger x-height (Figure 8.12). The geometric em-square model is supplementary to the geometric letter model, discussed in Section 3.1, which only maps the horizontal widths.

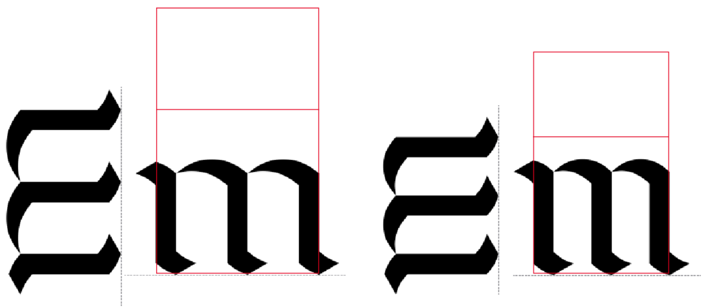


Figure 8.12 A wider m results in relatively smaller x-height; a more condensed m in a relatively larger x-height.

Figure 8.13 shows Adobe Garamond on a dynamic framework. All letter proportions are derived from the widths of the m and n, and the subsequent application of the golden section rectangle. For defining the width of the n-square in Figure 8.13 the h is used because in Garamont's model, and hence in Adobe Garamond, the proportions of the n and the h are identical within the x-height. Additionally the h also shows the length of the ascenders. This dynamic framework works in all directions: changing one of the proportions automatically changes all others too. The resulting proportions can be drawn or calculated at any size and subsequently the outcomes can be transferred, for instance, to a punch.

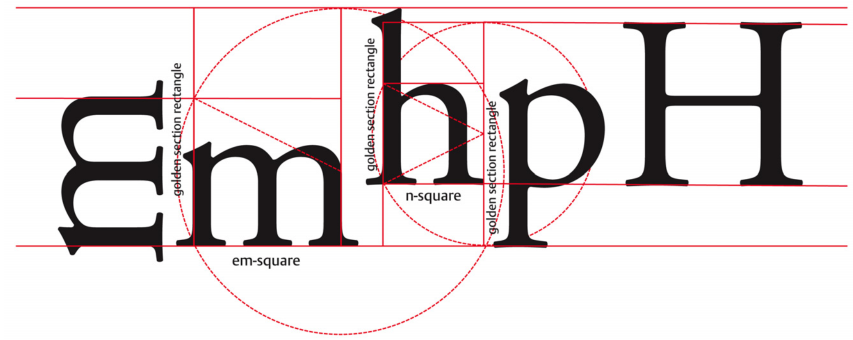


Figure 8.13 Framework for Renaissance type applied on Adobe Garamond.

Such a dynamic framework should cover the space hierarchy. For instance, compression of letters should not only result in shorter ascenders and descenders, but also in the reduced height of the capitals. The framework presented in Figure 8.13 perfectly captures the relationship between lowercase and uppercase letters too.

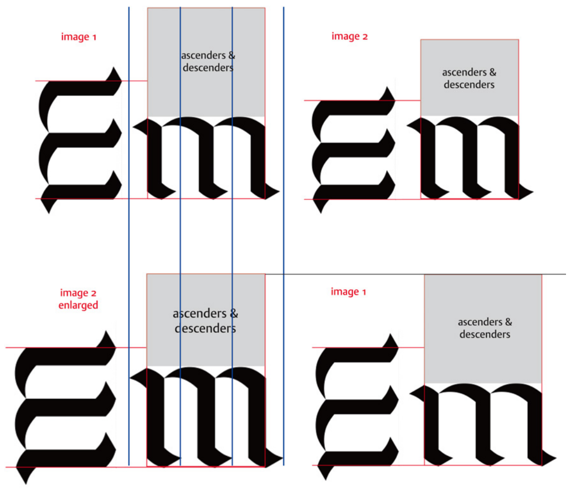


Figure 8.14 Compressed and expanded type sharing widths.

Figure 8.14 illustrates the effect of compression on the relationship between x-height and space remaining for the ascenders and descenders. To obtain the same body size for the compressed m on the right of the top row as for the uncompressed m on the left, the compressed m has to be enlarged. This not only results in a larger x-height and bolder image but also in identical character widths for the uncompressed and compressed m's, as is shown at the bottom row of the figure. The larger x-height of the compressed m results in shorter ascenders and descenders. This is precisely the relationship that textura and roman type reveal at the same body size.

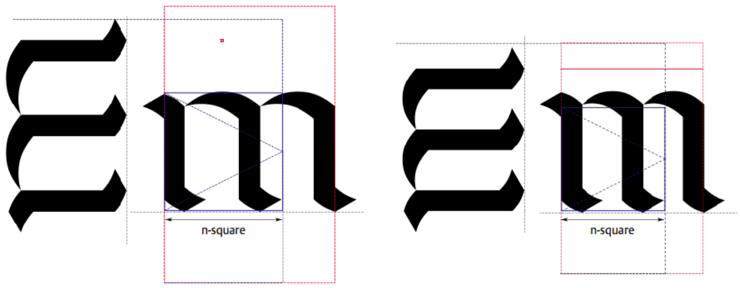


Figure 8.15 A condensed n results in smaller capitals.

If the width of the n is taken as the basis for the 'n-square', as shown in Figure 8.15, the height of the capitals will follow (indicated with blue lines). The fact that on the left the capital height equals the height of the rotated m plus its serif, is purely coincidental. At some point the height of the capitals will equal the length of the descenders, as is shown in the variant on the right. This marks the boundary of the convention for text letters: it is highly unusual that the height of the capitals extends the height of the ascenders.

Having introduced the dynamic em-square model for type proportions, the next section will present further evidence of its use in Renaissance type production by distilling it from Renaissance prints and matrices.

8.5 Distilling evidence of frameworks in Renaissance type

Section 8.3 presented distilled evidence of a dynamic framework in Gutenberg's textura type and Jenson's roman type. In the previous section the relation between the horizontal and vertical proportions of Adobe Garamond, which finds its origin in Garamont's Parangon Romain, was captured in a dynamical framework. The proportions of Garamont's Parangon Romain are closely related to those of Jenson's archetypal model, hence it does not come as a surprise that closely related frameworks can be used to capture the proportions of both types. However, in the French Renaissance the proportions of larger 'display' type deviate from that of the type for text sizes. Some are bolder and more condensed, like textura type, and other variants show relatively large ascenders and descenders. If there was a dynamic framework used for the vertical patterning of type that is related to Jenson's archetypal model, was such a framework also used for type that deviates from the archetypal model, in line with Figure 8.11? This section aims to explore this question.

Figure 8.16 The proportions of Van den Keere's Gros Canon Romain on a dynamic framework.

Van den Keere's Gros Canon Romain from 1573 is shown in Figure 8.16.[208] Applying the em-square, n-square, and related golden section rectangles reveals that the capital E and the descenders fit in this system, but that the ascenders are in fact smaller than the capitals. These are unexpected proportions and result in relatively huge and bold capitals.

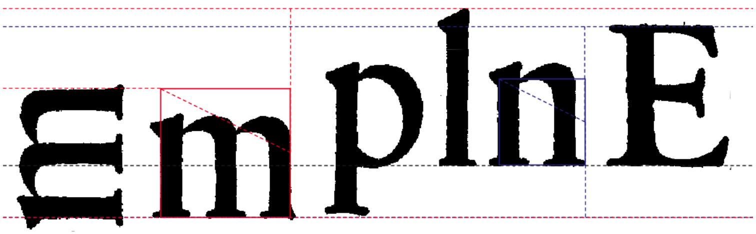


Figure 8.17 Adapted proportions of Van den Keere's Gros Canon Romain.

In Figure 8.17 I adapted the height of the E to the dynamic framework and the result is much more balanced. The unexpected relationship between the height of the ascenders and that of the capitals in Figure 8.16 can be explained by the fact that Van den Keere cut the capitals as a separate font in 1570. These 'Grasses capitales de 3 regles mediane' were combined with the Canon Flamande in 1571 and with the Gras Canon Romain in 1573.[209]

Figure 8.18 shows the 'display' type Double Canon Romain (approx. 45 Didot points) attributed to Guillaume I Le Bé (1525–1598). Le Bé was a French Renaissance punchcutter, trader in matrices, bookseller and paper merchant, who was in his younger years an apprentice to Robert Estienne, in whose house he applied himself to cutting punches for type and the business of typefounding.[210] After working in Venice, Le Bé returned to France in 1550 where he cut a Hebrew type for Garamont. Le Bé's Double Canon Romain shows extremely large

---

[208] The Gros Canon Romain is also indexed as Canon Romain and Gras Canon Romain (Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.230).

[209] Voet, *Inventory of the Plantin-Moretus Museum*, pp.12,13.

[210] Vervliet and Carter, *Type Specimen Facsimiles* 2, p.12.

capitals, of which the height optically exceeds the length of the ascenders. This is clearly a completely different relationship between the x-height of the lowercase and that of the capitals than the one that can be found in Garamont's Parangon Romain.

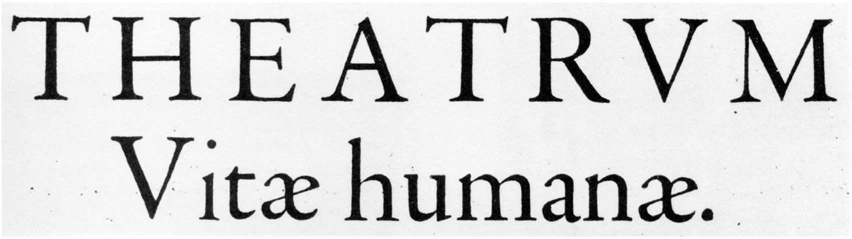


Figure 8.18 Double Canon Romain attributed to Guillaume le Bé the elder.

According to Beatrice Warde (writing under the pseudonym of Paul Beaujon), the 'Estienne face' (a couple of related types for different point sizes) was designed by 'a master with a real knowledge of the mechanics of typecutting.'[211] Although she does not go into detail, according to Warde the proportions are 'much more scientifically effected than by modern typefounders.'[212] I interpret 'scientifically' here as the application of standardisations, such as for instance geometric ones.

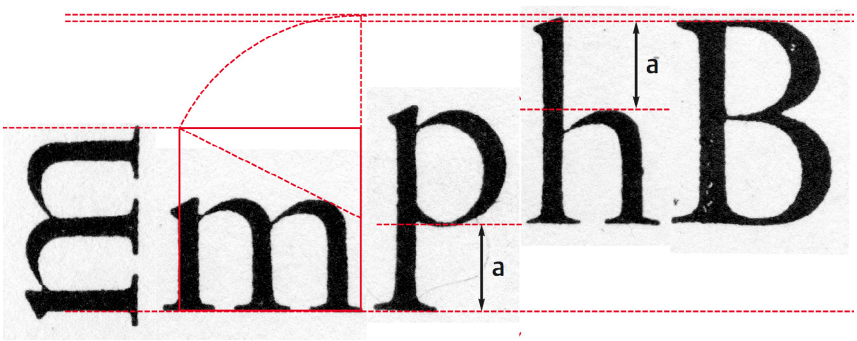


Figure 8.19 Le Bé's Double Canon Romain and the golden section rectangle.

Although the proportions of Le Bé's Double Canon Romain differ from those of Jenson's archetypal model, it is still possible to use a related dynamic framework to explain the relation between x-height, ascenders/descenders and capitals in (Figure 8.19). A small adaptation –the inclusion of the right serif– of the m results in an em-square that fits the lengths of the ascenders and descenders. If the distance from the baseline to the bottom line (the descender of the p) is added to the x-height, then this results in the height of the capitals. This is a simple system

[211] Beaujon, 'The "Garamond" Types', p.195.
[212] Ibid., p.195.

and hence the relatively more complex application of the n-square for defining the capital height is not required here. The relationship between the horizontal proportions of the lowercase letters and capitals in Renaissance roman type is described in Appendix 8, *Proportions of capitals in roman type.*

Long ascenders and descenders can also be found in Garamont's Gros Canon Romain. A closer look at this type, which appeared for the first time in 1555, reveals that ascenders and descenders are considerably longer than the ones in Le Bé's Double Canon Romain. The proportions of Garamont's large type cannot be explained with the dynamic framework. However, a simpler underlying structure can be observed; the lengths of the ascenders and descenders equal the x-height, as is shown in Figure 8.20.

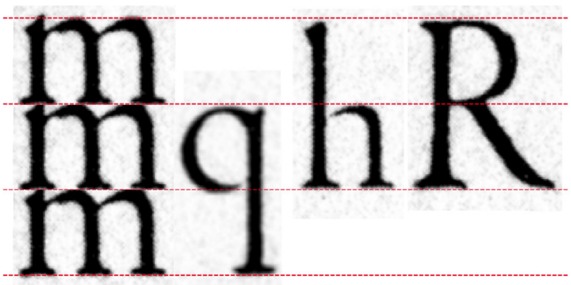


Figure 8.20 Proportional relationships found in Garamont's Gros Canon Romain.

The fact that the body sizes of Renaissance type can be reconstructed using geometric constructions such as the golden ratio could be a remarkable coincidence. However, as I hypothesise in this dissertation, it could also be part of a larger Renaissance scheme to standardise the production of gothic and roman type. For the previous examples I used prints, but would it be possible to distil evidence for such a cross-type standardisation from matrices? Unfortunately there are no matrices or foundry type from Gutenberg or Jenson preserved, but there are French Renaissance matrices from gothic type and roman type in the collection of the Museum Plantin-Moretus. On Wednesday 17 June 2015, together with Hutsebaut, I measured and cast from the matrices (Figure 8.21) of Van den Keere's Gros Canon Romain (1573), which is presented as Canon Romain in the folio specimen from ca.1580, and Van den Keere's Canon d'Espaigne (1574), which is also shown in the aforenamed specimen.

Figure 8.21 Matrices by Van den Keere of the Gros Canon Romain and the Canon d'Espaigne.

When the matrices of both types are compared, it is obvious that their height and thickness are almost identical, as if they were part of the same production process. However, there is a big difference between the sizes of the types. At first sight the Gros Canon Romain and the Canon d'Espaigne do not seem to have much in common. However, the Canon d'Espaigne is a rotunda, which is part of the same morphologic model as textura and roman type, and the Gros Canon Roman is also quite bold and highly condensed.

Vervliet notes on the Canon Romain: 'In the design of this face Van den Keere kept to the regional tradition of bold, fat-faced Romans with a big x-height, comparable for weight with Gothic letters [...].'[213] But could it be that Van den Keere went one step further: that he used an identical pattern for both the Gros Canon Romain and the Canon d'Espaigne and only changed the body size and details?

Figure 8.22 Prints of the Gras Canon Romain (left) and the Gros Canon Flamande compared.

[213] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.230.

At first sight both types have not much in common (Figure 8.22). However, when prints are scaled to the same x-height (Figure 8.23) it becomes clear that the roman and rotunda types were made on exactly the same scheme. They share the same proportions, the same character widths, and the same positioning between the side bearings. This clearly points towards a high degree of standardisation.

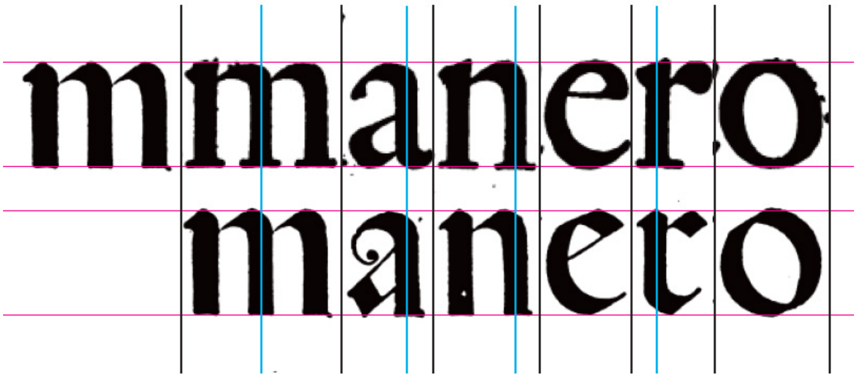


Figure 8.23 Prints of the Gros Canon Romain (top) and the Canon d'Espaigne scaled to the same x-height.

Van den Keere cut the Canon Flamande, which is a textura type, and his 'Grasses capitales de 3 regles mediane' in 1570. Both were combined in Plantin's *Psalterium* from 1571.[214] The body sizes of the Gros Canon Romain and the Canon Flamande are identical. The widths of both m's are also identical and the height of the textura m equals the distance between the stems of the roman m (Figure 8.24).

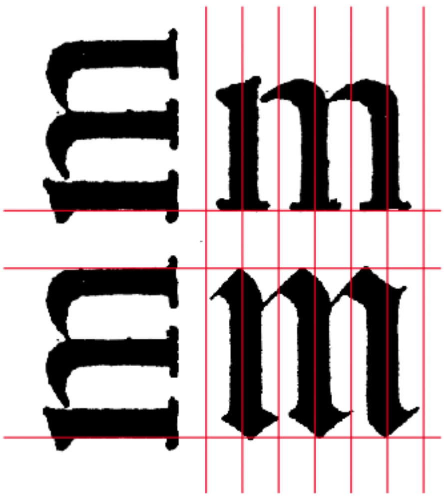


Figure 8.24 Prints of the Gros Canon Romain (top) and the Canon Flamande compared.

[214] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.86.

This section presented further evidence for the fact that the proportions of textura and roman type were in the same way standardised in Renaissance type production. This supports my hypothesis that roman type was the result of the standardisation of the Humanistic minuscule to the Renaissance type production process, in a process analogous to the standardisation of textura hand for textura type production.

8.6 Underlying unitisation in vertical proportions

In the previous two chapters I discussed the horizontal unitisation of Renaissance roman type. If horizontal proportions were used by Gutenberg and Jenson and their successors for defining vertical proportions, is it possible that the same unitisation that can be distilled horizontally can also be distilled vertically? In this section I investigate and illustrate examples of such unitisation using prints of Renaissance type.

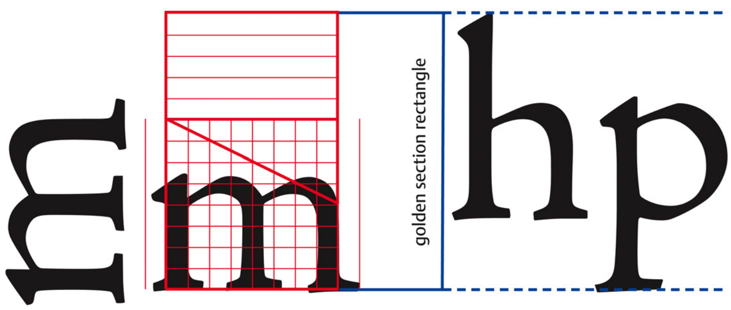


Figure 8.25 Simple unitisation of the em-square.

For the calculation of the body size in Figure 8.25 I used only the distance between the outside stems of the m. One could argue that the whole structure is therefore quite arbitrary. However, the fact that this seems to work for both Gutenberg's textura type and Jenson's and consorts' roman types, as discussed in the previous sections, makes the use of such a framework plausible. The stroke endings of textura are less prominent than the serifs in Jenson's type. That makes it difficult to take the stroke endings into account when defining a standard for the body size that also has to work for roman type.

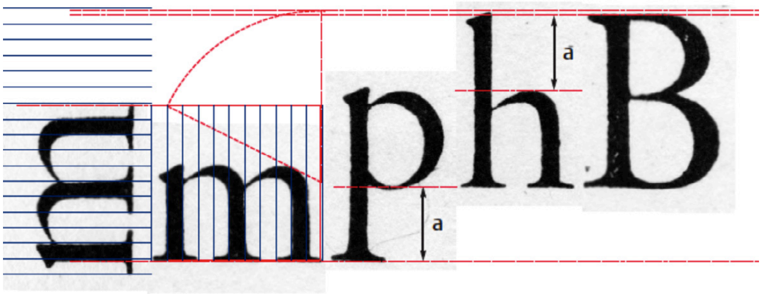


Figure 8.26 Le Bé's Double Canon Romain fits on an enlarged em-square.

On the other hand, the stroke endings of textura type and the serifs of roman type are part of the pattern. Serifs in roman type preserve the stem interval because they function as wedges between the letters and this way preserve equilibrium of white space. The serifs are not additional elements, but rather intrinsic segments of roman type. All elements of archetypal roman type, including the serifs, can be captured in a unit-arrangement system. Such a unit-arrangement system is not meant for defining the space between characters, as discussed in Chapter 5, but for defining the proportions of stems and serifs within the body. As part of a dynamic framework, such a system is versatile because its basis (the em-square) can be enlarged and reduced by adding or subtracting units. Figure 8.26 shows Le Bé's Double Canon Romain on such a grid; in this case the width of the em-square includes both serifs and subsequently results in larger ascenders and descenders.

The body size of the textura and roman-type m in Figure 8.1 equals the distance from ascender to descender, because the body size is defined by the dynamic framework. This body size is in line with Moxon's definition in *Mechanick Exercises*: 'By Body is meant, in Letter-Cutters, Founders and Printers Language, the Side of the Space contained between the Top and Bottom Line of a Long Letter.'[215] Moxon's definition is annotated by Davis and Carter as being 'Not a good definition because letters are often cast on a body larger than it need be. It is the dimension of type determined by the body of the mould in which it was cast (from the punchcutter's point of view: "is intended to be cast").'[216]

[215] Moxon, *Mechanick Exercises*, p.102.
[216] Ibid. p.102.

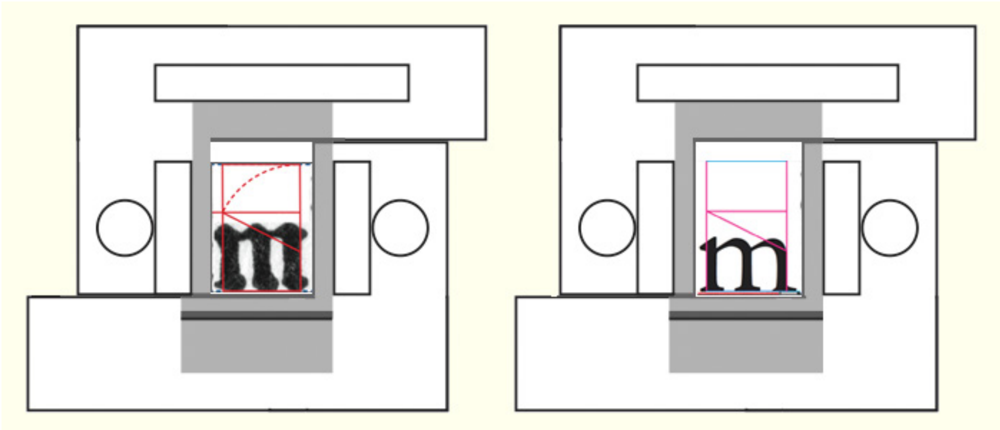


Figure 8.27 Early foundry type was cast on a body that exceeded the boundaries of the dynamic framework.

The reason for casting letters on a larger body was to incorporate some extra distance between lines. One needs this not only for the separation of the lines, but also for positioning diacritics, especially for the ones on top of capitals and ascenders.[217] Figure 8.27 shows that for the 'real' body as described by Davis and Carter, the dynamic rectangles on which the letters are placed have been made smaller in relation to the height of the aperture of the mould, i.e., the body size. This results in a certain amount of additional space to the dynamic rectangles. This amount does not have to be calculated using a geometric construction: it simply can be a division of the dynamic framework, such as one fifth, or even an arbitrary value (although the latter is unlikely considering the discussed forms of standardisation by the early punchcutters). Present-day type is designed on an em-square that equals the dynamic framework, i.e., from top ascender to bottom descender. But a digital typeface contains additional table values that prevent clipping of parts that are placed outside the em-square. Quite often the amount that is added is around one fifth of the em-square.[218]

217 In case the additional space on the movable-type body was not required, it was not uncommon to cast type on a smaller body using a different mould.

218 This is defined by the WinAscent/WinDescent for Windows and related 'hhea' entries for macOS. One fifth will roughly correspond with the extra 20 percent that InDesign adds by default as line spacing. For Vietnamese diacritics even more space is needed (that was certainly out of the scope of the Renaissance punchcutters).

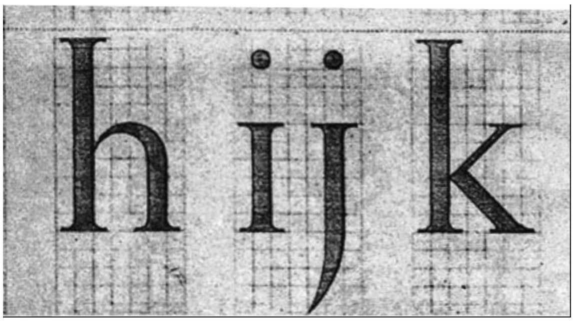


Figure 8.28 Letters of the Romain du Roi on a simple grid.

Such a grid was perhaps also required for transferring large-sized written or drawn letters to the punches, as was done many centuries later for the Romain du Roi (Figure 8.28). The instruction plates for constructing Rotunda in Sigismondo Fanti's *Theoretica et practica* from 1514, which were reprinted in Ugo da Capri's *Thesauro de Scrittori* from 1535 (Figure 8.29), could give us an indication of such a practice. These are clearly not instructions for writing but for constructing lowercase letters using a compass and ruler. The Rotunda type used on several pages of Da Capri's book seems to be modelled after the instruction sheets.

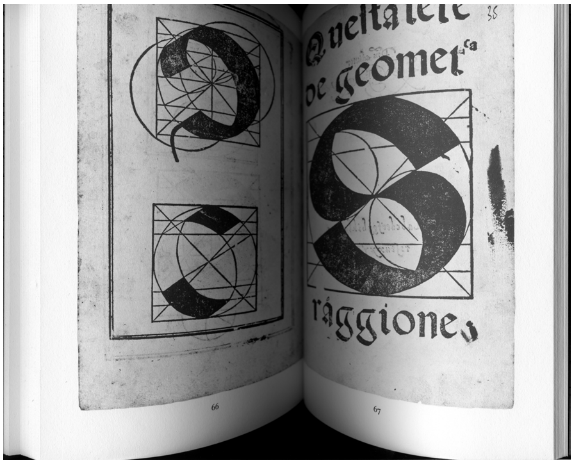


Figure 8.29 Rotunda type constructions in Ugo da Capri's *Thesauro de Scrittori*.

The standardisation by the use of frameworks and grids presented in the previous sections contradicts Morison's statement that the goldsmiths, punchcutters and printers relied on their eyes and not upon their measuring tools. Standardisation is simply a prerequisite for the production of type and it is plausible that grids were used long before the production of the Romain du Roi.

8.7 Digital dynamic frameworks

Present-day tools for digital font production are perfectly suited for applying the dynamic framework to fonts. The design process can be made simpler by connecting the width of the characters directly to the lengths of the ascenders/descenders and the capital height. By changing the width of a character, the lengths of the ascenders/descenders and the height of the capitals change automatically as well. This process requires intelligent scaling, as the thickness of the stems and curves has to remain the same when condensing or expanding glyphs. The new font editor named FoundryMaster, which is developed at URW++ in Hamburg in cooperation with the Dutch Type Library contains this technology.[219]

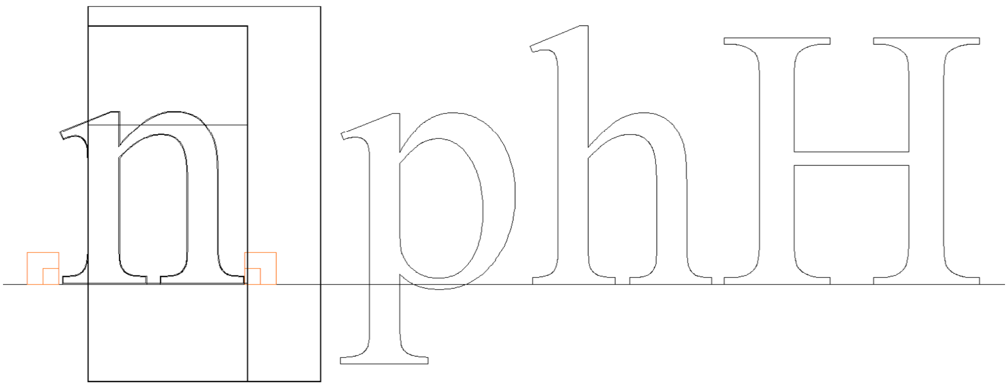


Figure 8.30 Original proportions of Times New Roman.

The dynamic framework fixes the relation between the letter parts. If applied on an existing typeface, such as Times New Roman for example, then the proportions of the ascenders/descenders and the capital height would change. Figure 8.30 shows the original proportions of Times New Roman. The smaller rectangle indicates the height of the capitals calculated using the n-square and the larger rectangle indicates the body based on the em-square. Figure 8.31 shows the glyphs adapted to these calculated proportions, i.e., to the dynamic framework.

219 <https://www.youtube.com/watch?v=uOsYMctPRNg>

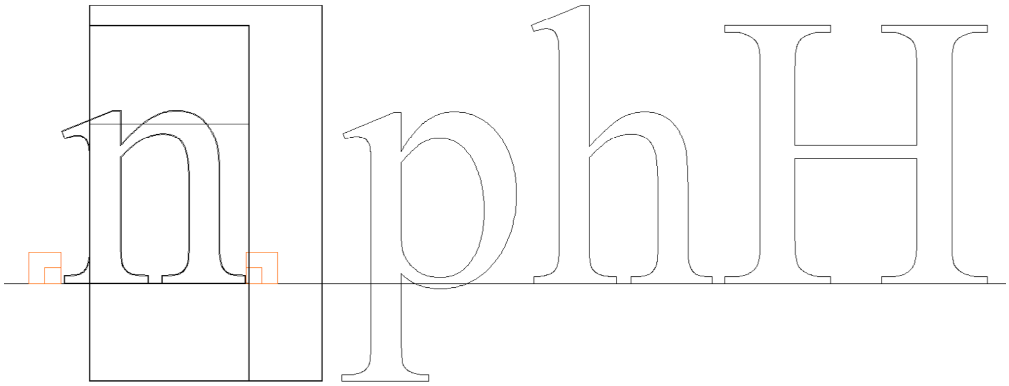


Figure 8.31 Proportions of Times New Roman adapted to the dynamic framework.

8.8 Details and optics

Before concluding this chapter, this section addresses an argument that may be used against my theories about the application of geometric models in Renaissance roman type: that it is likely that the punchcutters were technically incapable of applying very minute details to type. However, if one looks at the details of Pierre Haultin's Nompareille Romaine (approx. 5.3 Didot points) and accompanying cursive, or at Van den Keere's Iolie Romaine or Granjon's Iolie Cursive (approximately 5,6 Didot points) it is my opinion clear that the most skillful Renaissance punchcutters were able to control the tiniest details.

The research on the 'in-house norms in the typography of Manutius' by the typographer, artist, teacher, and author on typography Peter Burnhill (1922–2007) also seems to suggest that Renaissance punchcutters were capable of controlling minute details: '[…] Griffo was working near the limits of vision, using a sub-modular unit of measurement discernible with little if any optical assistance.'[220] Optical assistance was available in Manutius's time however. Eye glasses and magnifying lenses were used long before Jenson and Griffo made their type:

> […] by the end of the thirteenth century in another comprehensive synthesis based on classical and Latin translations of Arabic optical sources, the Perpectiva [ca.1265] by Roger Bacon (ca.1214/1220–ca.1292), magnifying lenses were mentioned as reading aids without fanfare, implying their long-standing use.[221]

---

[220] Peter Burnhill, *Type Spaces* (London: Hyphen Press, 2003), p.87.

[221] Vincent Ilardi, *Renaissance Vision from Spectacles to Telescopes* (Philadelphia: American Philosophical Society, 2007), p.41.

Bacon described the functioning of the magnifying glass and how it would enlarge letters for 'those who have weak eyes.'[222] In fifteenth-century Italy there was a 'massive diffusion of spectacles.'[223] Therefore, it is in my opinion quite reasonable to assume that magnifying glasses were used for the production of type.

This chapter focused on the standardisation of vertical proportions in relation to the horizontal standardisation in textura and roman type production. It discussed the widespread use of geometry in the Renaissance, and then presented a framework for proportion standardisation that can be distilled from Renaissance type. Along with the previous chapters on width standardisation, the information presented in this chapter further supports my hypothesis that roman type was the result of the standardisation of the Humanistic minuscule to the Renaissance type production process; this was in analogy to the more straightforward standardisation of the written textura quadrata for the textura type production.

By supporting this hypothesis, the present chapter also supports the overarching hypothesis of my dissertation, which is that roman type was largely the result of technical rather than æsthetic considerations. Having now thoroughly discussed the technical evidence that supports this hypothesis, the next chapter will focus on changes in the production of movable type that show up after the Renaissance and their effects on the the role of æsthetics in roman type production.

[222] Ibid., p.41.
[223] Ibid., p.64.

CHAPTER 9

The overall hypothesis that this dissertation aims to support is that the creation of roman type was largely influenced by technical rather than æsthetic considerations. The first eight chapters delved into the technical aspects of roman type. This final chapter will supply evidence to support my second hypothesis: that æsthetic preferences in roman type were and continue to be conditioned by the initial standardisation of the Renaissance type production. To this end, the chapter will first discuss changes in the production of movable type that appear after the Renaissance. It then investigates the origins of these changes and their effects on the casting process.

This chapter also tries to find an answer to the question why later roman type designs show a greater diversity in proportions and details than can be found in the archetypal models. Did the declining need for standardisation in type production made it possible that later punchcutters could place a greater emphasis on the eye, this way providing more freedom and turning the punchcutter more and more into the role of the present-day type designer? And if so, is it possible that due to conditioning optical judgment took for granted the underlying patterns, almost without consciousness, because it was simply the framework in which things were done? The latter would imply that the initial standardisation forms the basis for the æsthetic conventions in type production and hence for the conditioning of the type designer, typographer, and reader. Without the technical requirement of the initial patterning, roman type can be reproduced as a collection of images –as long as these images apply to the conventions.

Finally, this chapter will discuss the use of archetypal patterning in the digital type production and it will demonstrate how this allows greater control over the harmonic and rhythmic aspects in type design today, irrespective of whether the proportions of the characters were optically or measurably determined. After all, it is inevitable that the eye reproduces the initial patterning if Renaissance movable Latin type has set the rules for conditioning.

9.1 Increased freedom in type design

Especially after the Renaissance the proportions and details of roman type started to deviate more from those of Jenson's archetypal model. Figure 9.1 shows Adobe Jenson at the top followed by DTL VandenKeere, a digital revival based on Van den Keere's Parangon Romain I made more than twenty years ago. Both Italian- and

French-Renaissance typefaces show essentially the same proportions. The third typeface from the top is DTL Elzevir, a revival based on typefaces from the Baroque, mainly attributed to the Dutch punchcutter Christoffel van Dijck (1606/07–1669). In comparison to its Renaissance counterparts, this type is narrower and has a larger x-height. Even more condensed is DTL Fleischmann at the bottom, a revival based on the work of the famous eighteenth-century German punchcutter Johann Michael Fleischmann (1707–1768), who worked most of his life in the Netherlands. The ascenders and descenders are shorter in Fleischmann's roman type than in any of its precursors.

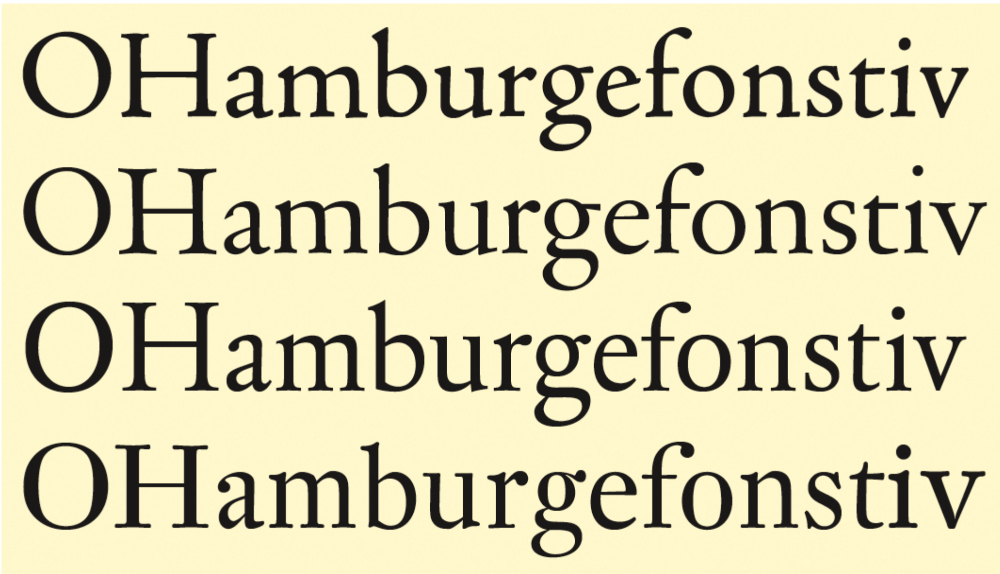


Figure 9.1 Development of proportions is the fifteenth (top) to the eighteenth century.

Fleischmann's types represent the 'Dutch style', better known as 'Goût Hollandais', which were designed in accordance with economic principles.[224] Obviously in the course of time punchcutters encountered an increased freedom when it comes to the proportions and details of roman type. Clearly the overall patterning remained but technical changes made tolerances to Jenson's standardised patterns possible.

The following section will focus on the alterations in the roman type production in the eighteenth century.

[224] Morison, *Letter Forms*, p.33.

9.2 Set patterns

Section 3 of Chapter 6 discussed the casting from matrices that are justified for fixed mould's registers. This section discusses casting from matrices that are not as such justified, which means that the matrices are adjusted and refined after the punches are struck but that their widths have not been standardised. It then introduces an alternative method for setting the characters' widths in case matrices are not justified for fixed registers.

Figure 9.2 Ascendonica Romain matrices of the MA7 set showing standardised widths.[225]

Figure 9.2 shows the matrices of Granjon's Ascendonica Romain that are justified for fixed registers.[226] This set, cataloged as 'MA7' probably has been justified in 1601.[227] Nicolas Portnoï, a student of mine from the Expert class Type design course in Antwerp, discovered while measuring that the MA7 set was justified for fixed registers, but that an older set of justified matrices of Granjon's Ascendonica Romain was not prepared for casting with fixed registers.

---

[225] Photo by Nicolas Portnoï, as are the ones used for Figure 9.3, 9.4, and 9.5.

[226] The type is indexed at the Museum Plantin-Moretus as 'Ascendonica Romaine'. In 1572 it was mentioned as 'La Romaine de Granjon' (see also: Voet, *Inventory of the Plantin-Moretus Museum*, p.21). The matrix case shown in Figure 9.2 is labelled 'Ascendonica Romeyn'; based on the details of the applied type I conclude that the label dates from the second half of the eighteenth century.

[227] Voet, *Inventory of the Plantin-Moretus Museum*, p.22.

Figure 9.3 The MA8 set containing the Ascendonica Romain matrices justified by Van den Keere.

This set, indexed as 'MA8' (Figure 9.3), was justified by Van den Keere in 1569–1570 for Plantin.[228] It does not show standardised widths for, for example, the lowercase n, o, p, and q (Figure 9.4). Hence by definition all offsets differ, otherwise the MA7 set, which shows standardised widths, cannot be used for casting with fixed registers.

Figure 9.4 Ascendonica Romain matrices of the MA8 set showing different widths.

Interestingly, Van den Keere made an additonal and more condensed lowercase m for the MA8 set. Figure 9.5 shows the original m from Granjon on the left and the more condensed one by Van den Keere on the right. The condensed m may have been made especially with spacing in mind. In that case it was the first

[228] Ibid., p.21.

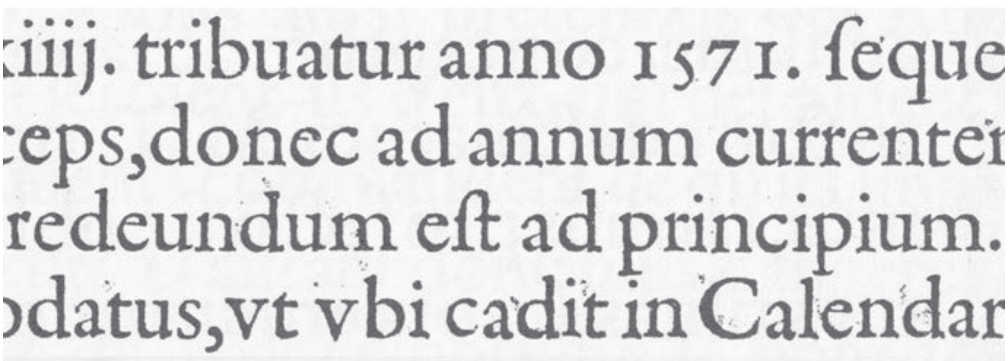
letter to be cast and used as reference for the positioning of the other letters between the side bearings, which are controlled with the mould's registers.

Figure 9.5 The lowercase m from Granjon (left) and the condensed one by Van den Keere.

The usage of the lowercase m as basis for a tighter spacing ('set') is described by Fournier:

> Certain printers occasionally ask for type thinner in set than the normal, to get in more letters to a line. This is perhaps prompted less by taste than by economy. In these circumstances it is necessary to make the m as thin as the extremities of the strokes will permit, so that no shoulder remains, and to regulate the set of the other letters in relation to it.[229]

Fournier describes here the use of the 'standard' m with the positioning of the side bearings as close as possible to the serifs ('extremities'). He points out that in case of condensed roman type 'after the manner of the Dutch ones' the letters should have an interval between them equal to those between the strokes of the m but he does not mention the creation of a separate, more condensed, m as reference.



iiij. tribuatur anno 1571. ſeque
eps,donec ad annum currente
redeundum eſt ad principium.
datus,vt vbi cadit in Calendar

Figure 9.6 Detail from *Psalterium* (1571) showing a relatively tight spacing.

[229] Carter, *Fournier on Typefounding*, p.162.

The *Psalterium* that Plantin published in 1571 (Figure 9.6) shows a spacing between two n's which is narrower than the distance between the two stems of the n. The spacing is tight and consequently some serifs almost collide. The interval between the strokes seem to follow the pattern in Van den Keere's additional m. This condensed m is not used in the text, which makes it plausible that it was only cut to be used by the caster for determining the spacing of the type.

Although Van den Keere's lowercase m must have eased the spacing process, the matrices of the MA8 set must undoubtedly have required a highly trained eye of the caster because the registers had to be adjusted per character. It is likely that the production of justified but not standardised matrices was less expensive but it made casting more complex. However, the optical part of the production process does not have to be repeated when recasting from matrices that are not justified for fixed registers. All letters can first be cast by optically positioning the registers, and the cast type can subsequently be used for the fitting of the registers. For this the precast type has to be put into the matrix, and the registers have to be moved until the position of the type is fixed horizontally. Next the precast type can be removed from the matrix and new type can be cast. The downside of this process is that it has to be repeated for each letter: it is without doubt more time consuming than casting with fixed registers. However, for setting the registers with precast type no training of the eye is required, just like in case of casting with matrices justified for fixed registers.

Figure 9.7 Eighteenth-century set patterns from the inventory of the Museum Plantin-Moretus.

A collection of such precast letters that can be used for positioning the matrices is called a 'set pattern'. During my research at the Museum Plantin-Moretus, Hutsebaut showed me cardboard boxes with collections of set patterns wrapped in mainly eighteenth-century printed sheets (Figures 9.7 and 9.8). Originally these set patterns were delivered together with the related matrices.

Figure 9.8 Eighteenth-century set patterns.

The collections of set patterns are identified by Dutch and French names as ‘pas letters’ and ‘Lettre de la justificasion’ respectively, with additional information about the type in question. Although some of the packages are numbered, they do not seem to be catalogued.[230]

The matrices of Garamonde Romaine, which the punchcutter Jacques-François Rosart (1714–1777) produced around 1750, do not show any standardisation of widths (Figure 9.9). As a result, casting from these matrices cannot be done with fixed registers and hence set patterns were required to make casting easier. The strikes of Rosart’s Garamonde Romaine are clearly surrounded by a significant amount of extra copper. A factor that may have made standardisation of matrices less important, is the increase of copper mining in the eighteenth century that resulted in a lower price for this precious metal.[231]

Figure 9.9 Matrices of Rosart’s Garamonde Romaine from ca.1750.

[230] I hope to find time to do this in the future.

[231] <http://www.geevor.com/index.php?object=138>

When there is a standardised pattern as can be found in the roman types by Jenson, Griffo, and Garamont, the proportions of the letters are consequently fixed. Jenson invented the archetypal model for roman type; a standardisation of letter proportions helped him to keep the production process controllable. In Rosart's time proportions could be copied from other type and strict standardisation was not longer a prerequisite if set patterns were supplied. It is technically plausible that it was easier for the later punchcutters to vary more on the roman-type theme, because they were not restricted to standardised widths anymore.

It is possible that later punchcutters placed a greater emphasis on the eye because knowledge of earlier standardisation was simply lost; after all, there is no documentation of the Renaissance type production. Optical judgment took for granted the underlying patterns in type, almost without awareness. The consequently changing production methods provided the punchcutters with more freedom to diversify from the archetypal pattern.

9.3 Technical and æsthetical considerations

As I have illustrated in this dissertation, the production of the first roman type required extensive technical considerations. In the course of time production methods changed and later punchcutters could place a greater emphasis on the eye. Still, although proportions and details of later roman type show a greater diversity, overall the later punchcutters made variants within an established structure. The initial technical considerations determined the æsthetic conventions, because the proportions and details of the archetypal models were reproduced, for either technical and/or optical reasons. The roman type of Jenson formed the basis for the conditioning of later punchcutters, type designers, and readers up to our time.

The conventions that are firmly entrenched in Jenson's technical constraints continue to influence our view on type today, although the versatility of digital technology makes it possible to put the emphasis largely on the eye. By extrapolating the current situation and without in-depth insight in the constraints of the Renaissance type production, we tend to think of early punchcutters like Jenson, Griffo, Garamont, and Granjon merely as type designers. Details found in their types are considered the result of particular optical preferences.

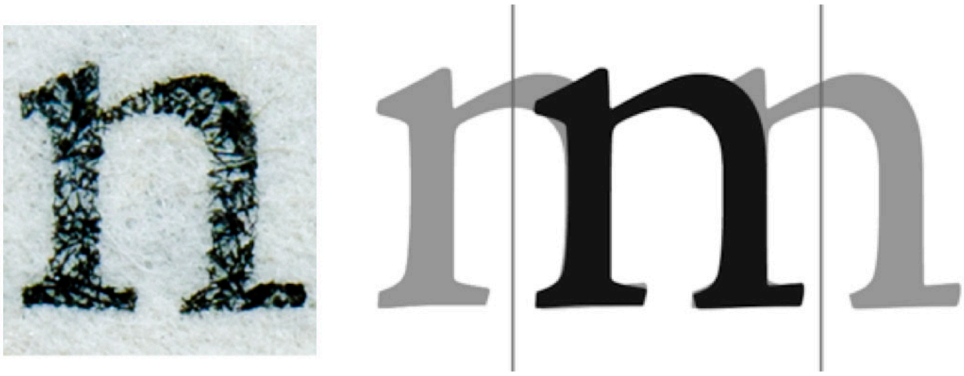


Figure 9.10 Jenson's lowercase n (left) and Adobe Jenson's n centred between side bearings.

This emphasis of the role of the eye also influences the way we interpret historical type. After all, one cannot see more than one knows. Figure 9.10 shows that Jenson's archetypal lowercase n has longer serifs on the right sides of the stems than the digital revival of Jenson's type that Slimbach made for Adobe. The digital version actually shows the present-day approach because Slimbach made the serifs at both sides of the stems of the lowercase n more equal. The fitting of Adobe Jenson indicates that this was done in the 'modern' way, which means optically and not measurably. If the lowercase of Adobe Jenson is centred in its width, as shown in Figure 9.10, then the serifs at the right are too short.

By defining a model for roman type, Jenson set the rules for future conditioning of the eye, i.e., optical preferences, of the later punchcutters, type designers, typographers and readers. Our present-day perception of roman type is the result of cultural habituation. Hence, what is considered to be harmonic, rhythmic, and æsthetical in type is largely the result of conditioning.

9.4 Conventions

Type representing the scripts from all over the world differ. Cultural habituation is preserved by the conditioning of type designers, typographers, and readers; the basis for this conditioning is formed by generally accepted standards: conventions. Conventions differ per script; if harmony and rhythm were absolute matters, there would not be so many disparities among the letter forms from the different parts of the world.

The term convention in relation to typography is often used as synonym of tradition: 'Tradition, […], is another word for unanimity about fundamentals which has been brought into being by the trials, errors and corrections of many centuries. Experientia docet.'[232] The rules for typography are fixed, as Morison made clear: '[…] the infinity and complexity of the reading public today […] makes our alphabet as rigid and irreformable as the very gold standard.'[233]

Some experts suggest that the reason that letterforms have undergone very little change since Jenson and Griffo is probably because these had already largely crystallised and were adapted to 'the ergonomic needs of the readers'.[234] Considering the facts that Jenson's roman distinctively deviates from the Humanistic minuscule and that the type was developed in a relatively short period of time, it seems just as plausible that this archetypal model largely defined the ergonomic needs of the reader.

The nature of conventions and their relation to conditioning is further discussed in Appendix 1, *Typographic conventions and conditioning*.

9.5 Pictures of things

The roman type by, for example, Fleischmann and Rosart shows that it is possible to produce type without directly applying archetypal patterns. If one is not familiar with the origins of the framework in which things are done, letters will merely become images. This means that one can create shapes that are recognisable as letters without having much knowledge of their underlying patterns: as long as the reader recognises the collection of images as words there is no problem. However, the collection of shapes that form a typeface will never be optimally coherent without a clear –deliberately applied– patterning.

Knowledge of the initial systematisation and standardisation of movable type will enhance insight into the basics of the type design process and will help to improve the rhythmic and harmonic aspects of a typeface. Of course, it is possible to circumvent this problem by largely copying existing typefaces that have proven to be functional. This has likely been done by punchcutters for centuries (see also Section 3 of Appendix 5:*Tricks and trade secrets*), thereby preserving Jenson's conventions for roman type.

---

232 Moran, *Stanley Morison*, p.32.

233 Morison, *Type Designs of the Past and Present*, p.62.

234 Gerard Unger, *While You're Reading* (New York: Mark Batty Publisher, 2007), p.93.

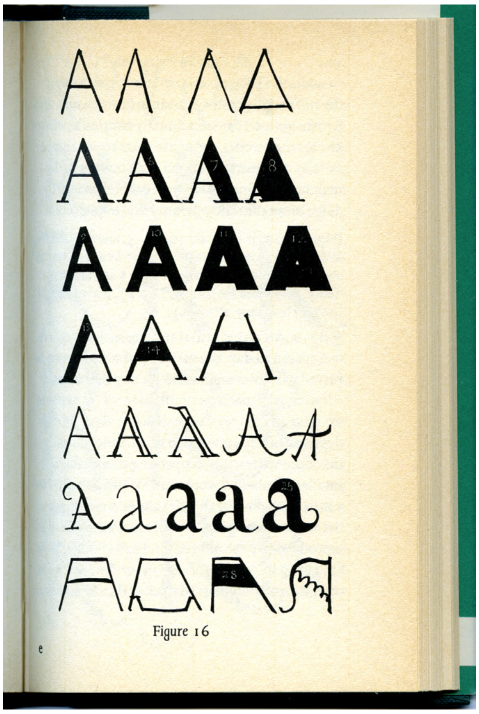


Figure 9.11 Page from Eric Gill's *An Essay on Typography*.

'Letters are things, not pictures of things'[235] is a famous and often quoted statement by the English sculptor, typeface designer, stonecutter, and printmaker Eric Gill (1882–1940). Nevertheless, in *An Essay on Typography* Gill provides most of the information on the shapes of letters by showing pictures with captions like '[…] normal forms; the remainder shows various exaggerations; […] common form of vulgarity; […] common misconceptions […].'[236] Any elementary information on the construction and underlying patterning of the shown letterforms is missing (Figure 9.11).

It is possible that this treatment of letters as pictures of things started as early as the Renaissance, when sixteenth-century French punchcutters copied the types from their Italian precursors. The French Renaissance roman types formed the basis for the Dutch Baroque ones, and in turn the Dutch types formed the basis for later English type. By tracing the letterforms, consecutive punchcutters also automatically copied the underlying structures and patterns, even if they were not, or not fully, aware of their existence. As described in Section 9.2, the methods for producing movable type partly altered in the course of time, and subsequently letterforms could actually evolve into pictures of things.

---

[235] Eric Gill, *Autobiography* (New York: Biblo & Tannen Publishers, 1968), p.120.

[236] Gill, *An Essay on Typography*, p.54.

Initial Renaissance patterning was copied –consciously or unconsciously– and fixed in conventions. It defines present-day digital roman type, irrespective of whether letterforms are treated as pictures of things. The following section will focus on how Renaissance patterns can be used in the digital type design practice and how these can be combined with a production process that merely puts the emphasis on the eye.

9.6 Software

Thanks to digital standardisation, the opportunities for type designers today are vast. Sophisticated type-design software has eased the technical part of the font-production process and supports the increasing role of the eye. Hence, many digital typefaces have been developed without deliberate (concious) patterning such as can be found in Renaissance roman type.

Section 1 of Chapter 4 discussed the optical spacing of roman type, which is very time consuming because it is a recurrent process: the designer applies changes to the type and adapts the spacing until the result is considered satisfactory. The cadence units that I introduced in Section 3 of Chapter 5 are highly suitable for automating the fitting process. The division of the stem interval into a number of units and the application of cadence-units tables, as discussed in Section 4 of Chapter 5, can be translated into a simple algorithm. The spacing of a typeface using cadence units is calculated by a computer in a split second. In combination with a visualisation of the intrinsic underlying patterning to which the design can be adapted, this definitely eases not only the spacing of type but it makes the complete design process more organic, controllable, and reproducible.[237]

During my research I was involved in the development of two applications that are based on my cadence-fitting algorithm: Kernagic and LS Cadencer.[238] A third tool named LS Cadenculator, which is directly related to LS Cadencer, distills the spacing from digital fonts and translates this into cadence units.

The development of the Kernagic application started in 2013.[239] It is an open-source (semi-) automatic spacing tool for the Unified Font Object (UFO) format.[240]

---

[237] A testimonial at <http://www.revolvertype.com/tools/cadencer.html> reads: 'Using LS Cadencer tools provides a refreshing alternative to my usual work flow. They enable me to work with spacing at the earliest stage of a design, and to use spacing as an integral design element. LS Cadencer's simple spacing system has added the visual rhythm of the classics to my type design toolbox.'

[238] <http://www.lettermodel.org/wordpress/?page_id=13>

Kernagic's graphical user interface (Figure 9.12) provides ways to interactively preview changes to the widths of characters and spaces.

Figure 9.12 The graphical user interface (GUI) of Kernagic.

Kernagic's development started in Madrid at the 2013 Libre Graphics Meeting. There, type designer Dave Crossland introduced the programmer Øyvind 'Pippin' Kolås to my research, of which snippets are published on my research blog.[241] The initial spacing approach that Kolås explored before we met was discarded in favour of an approach of stem-rhythm placement that is directly based on –but in the end deviates slightly from– my research and theories. Besides this stem-rhythm approach, Kernagic contains the option to apply the cadence-units.[242] Currently the development of the tool is halted especially because the open-source code seems quite inaccessible for other programmers but Kernagic is available still: versions for macOS (in a Wine-wrapper)[243] and for Windows can be downloaded for free from my research blog.[244]

---

239 Kernagic has to be pronounced as 'Kemagic', because according to its programmer Øyvind Kolås the 'rn' combination can mistakenly be read as 'm', especially when typeset in sans-serif typefaces.

240 The advantage of the UFO format is that it can act as a superset of other formats, and currently several font tools can be used for converting to and from it. See also: <http://unifiedfontobject.org/>.

241 <http://www.lettermodel.org>

242 The cadence-units support is functional, but the program unfortunately contains a small number of bugs.

243 Wine (which stands for 'Wine Is Not an Emulator') is a free implementation of Windows on Unix

244 For macOS: <http://www.lettermodel.org/downloads/Kernagic/Kernagic_b2.dmg.zip> and for Windows: <http://www.lettermodel.org/downloads/Kernagic/Kernagic_b2_WIN.zip>.

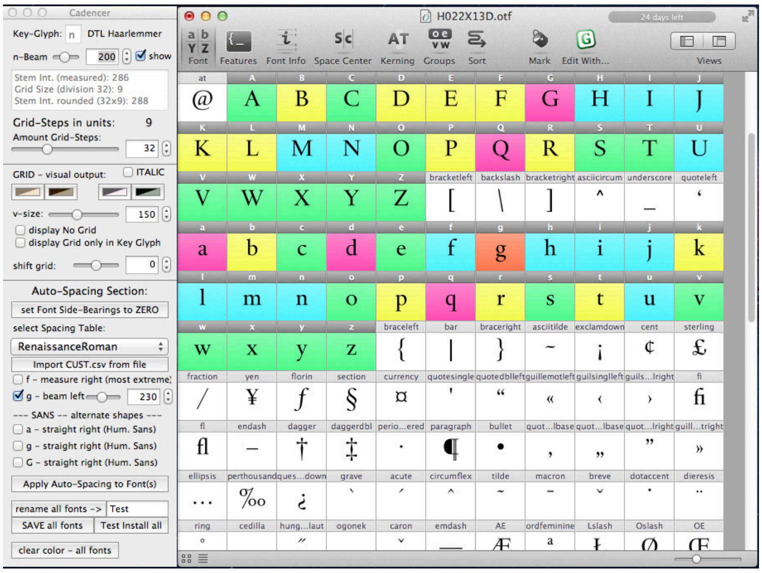


Figure 9.13 The graphical user interface (GUI) of RoboFont with the LS Cadencer extension on the left.

The LS Cadencer (Figure 9.13) and the related LS Cadenculator are (batch) fitting/auto-spacing tools written in Python that can be used as extensions in the Glyphs and RoboFont font-development programs.[245] Type designer Lukas Schneider programs and distributes the tools for which I developed the underlying principle and the algorithm. As in Kernagic, the basis for the unitisation in the LS Cadencer tool is the stem interval (Figure 9.14).

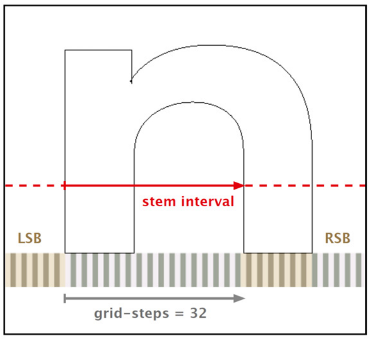


Figure 9.14 In the LS Cadencer the unitisation is based on the stem interval.

The LS Cadenculator (Figure 9.15) is a batch tool for measuring, analysing, and distilling cadence patterns from OpenType CFF fonts and Unified Font Object files.[246] It works on OpenType CFF and UFO files that are opened in Glyphs and RoboFont or directly on folders containing such fonts or files.

[245] Python is a dynamic and extensible programming language. See also: <https://www.python.org/>.

[246] OpenType CFF fonts are a variant of the OpenType format developed by Adobe and contain outlines stored in the Bézier format. OpenType CFF fonts have '.otf' as suffix.

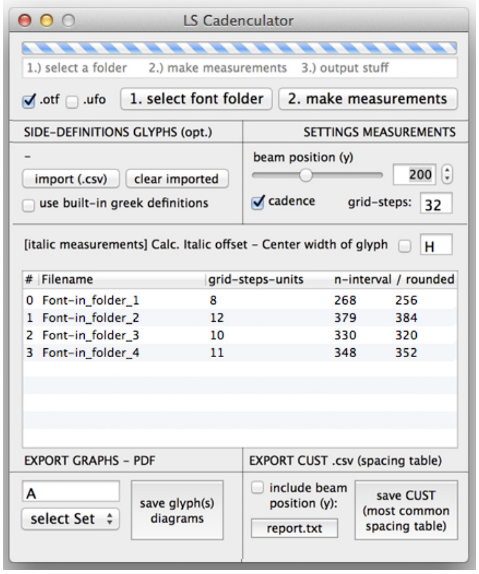


Figure 9.15 With the LS Cadenculator, fonts can be analysed and CUST files generated.

LS Cadenculator can be used to analyse existing spacing in digital fonts and for generating spacing tables that can be used for the fitting of fonts that are morphologically related. The analysis of the existing spacing across multiple fonts is simplified by the use of a common denominator: the cadence unit.

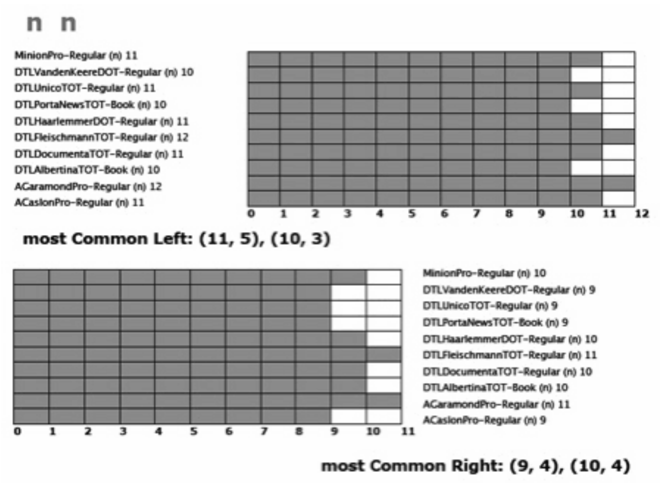


Figure 9.16 LS Cadenculator can report common values across fonts translated into cadence units.

Auto spacing using the Kernagic or LS Cadencer tools can be used to replace optical spacing completely or it can be used supplementally to spacing by eye. In the latter case it can form the bases for the spacing process or provide a second opinion. Together with the option to adapt a type design to its intrinsic underlying patterning, which is based on the stem interval, Kernagic and LS Cadencer provide greater control over the harmonic and rhythmic aspects in type design today.

The cadence-units spacing is based on the archetypal patterning, which also forms the basis for the conditioning of the type designer's eye. Hence, the results of auto spacing using cadence units and optical spacing will by definition be close. Outcomes of the parameterised fitting of ranges of serifed and sans-serif typefaces, which were generated with LS Cadencer, as well as outcomes of measurements with LS Cadenculator can be found in Appendix II, *Parameterised fitting results*.

This chapter discussed the decline in the need for standardisation in the post-Renaissance type production process. It explored how this declining need resulted in more design freedom for the later punchcutters. The discussion then focused on conventions and the conditioning of our æsthetic preferences in roman type and how having fewer technical constraints culminated in the reproduction of letter forms as images. Despite the technical changes, however, the origins of æsthetic preferences are firmly entrenched in Jenson's archetypal patterns due to conventions. Finally this chapter discussed the application of the cadence-units arrangement system that I distilled from archetypal patterns in present-day digital type design, which aided in the process of reducing the role of the eye in the spacing process. The aim of the chapter was to support my hypothesis that, contrary to the widely accepted belief that roman type was solely the result of æsthetic considerations, our æsthetic preferences were and continue to be conditioned by Jenson's roman type patterns, which are for a large part the result of the adaptation of the Humanistic minuscule to the Renaissance movable-type production process.

CONCLUSION

In this dissertation I have demonstrated that the moving force in the evolution of type was above all a technical one. To do so, I first supported my hypothesis that roman type is the result of the standardisation in the Renaissance of the Humanistic minuscule to the type production process, in a process analogous to the one that took place when the gothic hand was used as the basis for textura type. In roman type, horizontal and vertical character proportions, details and æsthetic preferences are clearly the result of the standardisation of the Renaissance production process. Finally I supported my sub-hypothesis that æsthetic preferences in roman type were and continue to be conditioned by the initial standardisation of roman type production.

This contradicts the generally accepted view on the origin and evolution of roman type, which puts the emphasis in the translation of Renaissance handwritten models to movable type on æsthetics. This view places the Renaissance punchcutters mainly in the role of type designers. It ignores the fact that the punchcutters were originally goldsmiths and engravers who invented, organised, and executed a complex and sophisticated production process that comprised, besides the design aspect, the cutting of punches, the striking and justification of matrices, and the casting of type.

Conversely, this dissertation illustrates the ways in which, with the invention of movable type, these craftsmen moulded the handwritten Humanistic minuscule into a fixed structure. This emphasised the rhythmic and harmonic patterns in the Humanistic minuscule, which are an intrinsic part of this Renaissance hand and its mediaeval precursors, but never needed to be mapped and applied in such a clearly structured manner as in movable type. After all, in handwriting a meticulous patterning is not required: there are no strict physical boundaries between characters and between lines, but in printing there are. The oldest roman type that shows a clear standardisation of the rhythmic and harmonic patterns is Jenson's model. It was used by Griffo as the basis for his two roman types from 1495 and 1499 respectively. It is plausible that Griffo used Jenson's model because it nicely combined æsthetics with technical advantages due to its standardisation. French-Renaissance punchcutters, such as Garamont, copied Griffo's model. Subsequently Jenson's patterning became dominant in the world of Latin type and hence determined the typographic conventions that are still used today. Because Jenson's patterning was in part determined by prerequisites for the production of type, the typographic conventions are not purely the result of optical preferences predating the invention of movable type, but are also the result of the standardisation of characters in the Renaissance type production.

The mapping of the initial standardisation of roman type has positive implications for present-day type design. It makes the analysis of type easier, helps to artificially reproduce these aspects, and makes the parameterisation of type design processes possible. The relatively crude Renaissance unitisation can be translated into a related but much more versatile yet still simple system for digital type, such as the software that I developed during the writing of this dissertation. This can be used for the artificial fitting and kerning of letters. By mapping the underlying harmonic and rhythmic aspects, we gain more insight into what exactly the creative process in type design comprises, and what its constraints are.

APPENDICES

The appendices contain information supplemental to the chapters to which they refer. To get the big picture in case of type it is inevitable to look at historical and technical details. The theoretical models and measurements described in the previous chapters are placed in their historic context and they are extrapolated and combined with descriptions of the underlying patterns and structures which I distilled from the archetypes.

Although meant to be supplemental, the appendices that provide detailed information about structures and patterns in type form together a cookbook for the (parametrised) designing of type. Although there is an almost endless list of books on the history of Western type and typography, there are not many books – if any– defining the elementary structures of type on a molecular level. Most attempts ground in a comparison of details of commonly used typefaces. Hence, the following appendices fill a rather remarkable lacuna in the available literature on type and typography.

APPENDIX I: TYPOGRAPHIC CONVENTIONS AND CONDITIONING

AI.1 Introduction

This appendix is supplemental to the Chapter 2 and is referred to in Section 2.6. It provides additional information in the form of notes on what exactly forms the basis for typographic conventions and how the latter relates to conditioning. Typographic conventions are not universal but vary per script. The differences between the scripts in use all over the world suggest that it is plausible that the requirements for the translation of spoken language into visible form are mostly cultural and historical, as are the languages themselves.

The translations into visible forms, graphemes, and the calligraphic and typographic transformations of these forms are the result of a number of developments and events that directed typographic conventions. There were (local) evolutions ('these forms developed still further in character, in different countries, according to the national genius')[247] and direct interferences by scholars ('[…] under the rule of Alcuin of York, who was abbot of St. Martin's from 796 to 804, was specially developed the exact hand which has received the name of the Carolingian Minuscule.')[248], besides changes in taste ('Typography is closely allied to the fine arts, and types have always reflected the taste or feeling of their time').[249] Also technical innovations, such as the invention of movable type played a role.

AI.2 Conventions

Few terms are as vaguely described, misused, or even abused as 'convention' in relation to typography. The term is used as synonym for tradition, as a fig-leaf for conservatism, but is above all generalised and commonly undefined. Some consider typographic conventions to be vague by definition.[250] If this were true, then the typographic concurrences would be arbitrary, and subsequently one could even state that this is the case for the conventions for type design. Morison dismissed the latter by stating that the infinity and complexity of today's reading public makes our alphabet as rigid and irreformable as the very gold standard.[251]

---

[247] Updike, *Printing Types*, Vol.1, p.56.

[248] Thompson, *An Introduction to Greek and Latin Palaeography*, p.367.

[249] Updike, *Printing Types*, Vol.1, p.xxxviii.

[250] Unger, *While You're Reading*, p.85.

[251] Morison, *Type Designs of the Past and Present*, p.62.

It is, of course, tempting to use quotes like those by Morison to dismiss any form of deviation from the conventions. On the other hand, such quotes also provide ammunition for those who want to object to any form of tradition under the motto of modernism. These Dadaists in the type world may argue that the conventions determine the conditioning, and that the conditioning preserves the conventions. Hence conventions too strongly restrict the type designer who wants to deviate from historically formed templates.

One could state that conventions for typography are relative to the nature, i.e., the structure and properties, of specific type and not per se interchangeable with other forms of type. This implies that for instance conventions for typefaces meant for setting texts do not have to be identical for type meant for display purposes. After all, the criteria and therefore rules for composing a text clearly differ from the criteria of, for instance, lettering a book jacket. One could state that the conventions become proportionally less strict with the increase in the point size (Figure A1.1).

Figure A1.1 Conventions become less strict if the point size increases.

Typographic conventions are defined by their purpose and hence this determines the nature of the applied typeface. If a serifed typeface is meant for composing text, it is by definition related to the archetypal models from Jenson and Griffo. Hence, its anatomy and details, which are proportions, weight, contrast, contrast-flow and idiom, can be compared with, and mapped against, the archetypal models.

Harmonic and rhythmic effects in typography will always be judged –directly or indirectly– against text composed with the early Renaissance roman types. A typeface that widely deviates from the anatomy of the archetypal models is not incorrect by definition. Actually, it should be judged against new rules defined by the anatomy of the typeface itself. If the typeface in question is used on a certain scale and the rules are subsequently followed by typographers, these rules may become generally accepted over time and as a result will become conventions.

It is a fact that typography is solidly anchored in history, which alone is proven by the today use of revivals today. Also it is a fact that the technical transformation of foundry type into digital type via hot metal and photo composing machines did not change the nature of type for text composing in the past one and a half centuries. This makes it most likely that deviations will be mostly reserved for the larger point sizes. The developments since the introduction of desktop publishing in the 1980s, which resulted in an increase of all sorts of display type, seem to underline the restricted usefulness of such deviations.

A1.3 Deviations

Wim Crouwel's typeface 'New Alphabet' from 1967 (Figure A1.2) cannot be compared with the archetypal models. The type constructed with only straight vertical and horizontal strokes underlines the fact that Crouwel's concept was not restricted by historical conventions. He formulated this fact in 1970 as follows: 'The letter-type for our time will, therefore, certainly not be based on the written or drawn examples of the past. The type which will now come into existence will be determined by the contemporary man who is familiar with the computer and knows how to live with it.'[252]

Figure A1.2 Wim Crouwel's New Alphabet (1967).

This statement contradicts with Hermann Zapf's view on the future of type, which he described also in 1970: 'The type of the future will surely more and more strip away the historic style elements of the past, yet without descending to a geometric-abstract form of letters. For the optical requirements remain the same so long as the letter-images are still received by the human eye […].'[253]

In *While You're Reading* Gerard Unger comments on Crouwel's New Alphabet: 'A series of characters such as those proposed by Wim Crouwel in 1967 looks at first sight more consistent than the alphabet, using as it does nothing but straight horizontal and vertical elements, but in fact this too is arbitrary. In fact there are no-iron arguments for bringing in changes.'[254] This statement seems to imply that the letterforms in use since the invention of movable type are by definition better than

---

[252] Wim Crouwel, 'Type Design for the Computer Age', *Visible Language*, Volume IV, Number I (Cleveland: the Journal, 1970), pp. 51–58 (p.53).

[253] Zapf, *About Alphabets*, p.66.

[254] Unger, *While You're Reading*, p.93.

Crouwel's, but perhaps they are only are better because the *New Alphabet* is judged here using the conventions defined by roman type. And a comparison with roman type shows many differences. At first sight Crouwel's letters and the division of space seem to have more in common with for instance Hebrew, and (the conventions for) Hebrew type cannot be compared with (the conventions for) Latin type.

It is on the other hand possible that there is room for making improvements to the New Alphabet using the rules defined by its own structures and patterns. As Johnston remarked: 'There are innumerable existing patterns or hands, any one of which the penman may choose to copy closely or choose to modify. But as soon as he has decided just what the letter form shall be, that chosen writing pattern becomes the model which he has set himself to follow, and it becomes a conditioning model till that piece of writing is finished.'[255] That being mentioned, according to Johnston there is no need for a new set of patterns: 'We do not require new forms – in this sense, "that which is new is not true" – but, though we may hope to better their character, we must accept the symbols of present use.'[256]

'What is the norm?', Dick Dooijes asks in his contribution to *Dossier A-Z 1973*, and he proceeds 'It is found in the book types deriving from the Renaissance union of Roman capitals and Carolingian minuscules: in the lettera humanistica and the littera cancelleresca. Why this particular norm? Because it guarantees a recognizability – essential for every booktype – that is firmly based on tradition. [...] No matter how far a Bodoni, an Auriol, or a Crouwel may diverge from this norm, each in turn realizing an authentic and legitimate vision, they were and are constantly subject to correction by the eternal and inexorable test of time.'[257]

Although this sounds like a conservative opinion by Dooijes, the development of roman type over time seem to prove that he is correct. The technical developments since the introduction of the computer –especially that of the personal computer and the introduction of the page-description language PostScript– did not change the typography as such and the preference for the Renaissance archetypal models (and their derivatives) for text setting remained. The most recent development of e-books also shows that technology is adapted to reproduce the existing norm. The e-book revolution predicted by some type designers was a velvet one; the current development of rasterizers in combination with the rapidly increasing resolution of

---

[255] Johnston, *Formal Penmanship and Other Papers*, p.98.

[256] Ibid., p.47.

[257] Dick Dooijes, *Dossier A–Z 73: Association Typographique Internationale* (Belgium: Remy Magrermans, 1973), pp. 78–79 (p.79).

screens, will make the application of existing typefaces possible without adaptations and additional technology, such as (delta) hinting.

The simplification of letterforms that Crouwel applied in his New Alphabet was a way to circumvent the limitations of the Cathode Ray Tube technology. Later Crouwel stated that the New Alphabet was over-the-top and never meant to be really used.[258] In the early sixteenth century a partly comparable attempt to reform the graphemes of the alphabet was made in Thomas More's *Utopia* (1516). The Utopian alphabet (which was used to represent the Utopian language) shows a range of letters (from the n on) in which only horizontal and vertical lines are applied (Figure A1.3). The design of the Utopian alphabet (which is probably the work of More's colleague Peter Giles) did not have a technical background like Crouwel's New Alphabet, but an ideological one. A version of the Utopian alphabet is also shown in Geofroy Tory's *Champ Fleury* from 1529.

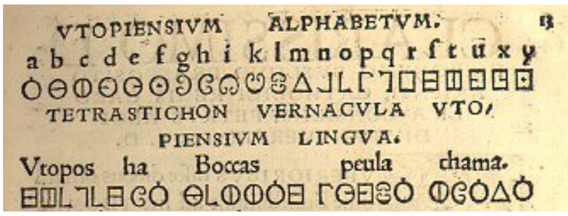


Figure A1.3 Thomas More's *Utopian alphabet.*

Crouwel's New Alphabet (and More's Utopian Alphabet) did not replace the archetypal model for roman type. Instead the Cathode Ray Tube technology was improved to support the model from Jenson and consorts.

A1.4 Typographical microcosm

Typographic conventions are inherent to the structure of the applied letters and not by definition exchangeable between scripts. In the typographical microcosm the parts of the letters are the smallest elements and as building blocks directly responsible for the hierarchical system of spacing, which respectively consists out of counters, letter space, word space, line space and margins. If a building block in one of the letters is changed, automatically all letters and subsequently the hierarchic system, i.e., the (rules for) typography will change. Everything in the typographical microcosm is interconnected and everything interacts.

258 <http://www.design.nl/item/wim_crouwel_on_his_80th_birthday>

AI.5 Conditioning

Every collection of graphemes representing an alphabet has its own rules, defined by their specific harmonics, patterns, and dynamics. The shapes of the graphemes can be the result of either a long or a short evolution; their dominance can be the result of a fixation at a certain moment in history. When the graphemes are commonly accepted they define the rules for the conditioning of their users, i.e., readers, and producers, i.e., designers.

One wonders whether Fournier was aware of the fact that what the eye sees is merely the result of conditioning when he mentioned that 'the eye, [is] the supreme judge' in his *Manuel Typographique*. A child's mind is blank before it is conditioned: 'The Reader converts characters into systematic phonemes; the child must learn to do so. The Reader knows the rules that relate one set of abstract entities to another; the child does not. The Reader is a decoder; the child must become one. [...] what is necessary for the child to learn to read is that he be provided with a set of pairs of messages known to be equivalent, one in ciphertext (writing) and one in plaintext (speech).'[259] This implies that a child can learn to combine any set of abstract entities, i.e., graphemes, with certain phonemes: it is just a matter of conditioning.

The mind of a starting graphic design student is basically as blank as a child's mind when it comes to the patterns of type. He has to be conditioned too before he understands the details of the abstract entities used in typography. Most of the freshmen I taught at the Graphic Design department of the Royal Academy of Art in The Hague over a period of almost 30 years did not see any difference between for instance Bembo and Baskerville, or Garamond and Spectrum. The very few who noticed differences had already completed a graphic-school education.

And even after a thorough study, a brief glance at certain typefaces by the students was not enough to recognize them. Most students looked for details, like the bending of the second stem of the n in Bembo, or the 'open' g of Baskerville. More subtle differences, like those between for instance Monotype Plantin and Times New Roman (the latter is based on proportions and fitting of the former) were still difficult to distinguish even by more trained students.[260]

Within the borders of the conventions there is room for different forms of conditioning; those who are trained to judge type against calligraphy will apply other

[259] Philip B. Gough 'One Second of Reading', *Visible Language*, Volume VI, Number 4 (Cleveland: the Journal, 1972), pp.291–320 (p.310).
[260] Tracy, *Letters of Credit*, p.197.

rules than those who see printed lettering as an aspect of epigraphy or chalcography. The followed doctrine determines the way graphic design students will look at type and how they will interpret details. In *Art and Illusion* Gombrich writes on the psychology of the artist's perception: 'The distinction between what we really see and what we infer through the intellect is as old as human thought on perception. Pliny had succinctly summed up the position in classical antiquity when he wrote that "the mind is the real instrument of sight and observation, the eyes act as a sort of vessel receiving and transmitting the visible portion of the consciousness."'[261] Although Gombrich was not referring to the arts of the typographer or the type designer, the parallel can be drawn here.

The same 'eye' used for judging roman type cannot be used for judging 'foreign' graphemes such as for instance those from Arabic or Indic scripts. These scripts have their own rules based on their specific harmonics, patterns and dynamics, which completely differ from the ones for roman type. Hence the conventions for Arabic and Indic scripts differ from these for Latin scripts, and the 'blank' mind of the child has to deal with different sets of abstract entities.

Conditioning is based on conventions and conditioning preserves conventions. Thus the snake bites its own tail; to be able to use one's 'eye' like Fournier advocated, one has to be educated to look at type in the same way. What is considered to be harmonic, rhythmic and æsthetic in type is largely the result of conditioning, i.e., cultural habituation. Familiarity is an important factor for the preservation of conventions; the appreciation of certain structures in for instance fine arts, architecture, typography or music partly depends on this. As Rameau states in his *Treatise on Harmony*: 'How, for example, could we prove that our music is more perfect than that of the Ancients, since it no longer appears to produce the same effects they attributed to theirs? Should we answer that the more things become familiar the less they cause surprise [...]?'

---

[261] Gombrich, *Art and Illusion*, p.12.

A2.1 Introduction

This appendix is supplemental to the third chapter and is referred to in Section 2 of Chapter 3. It provides additional information on Jenson's roman type and its relation to the typefaces of his Italian-Renaissance precursors, contemporaries, and successors.

A2.2 Roman type

The type Nicolas Jenson made in 1470 for the tractate *De Præparatione Evangelica* of the historian, exegete and polemicist Eusebius of Caesarea (ca.263–339) is generally accepted as the first highly refined roman type (Figure A2.1). The term 'roman type' as such is younger and it seems that the Italian calligrapher Giovanni Battista Palatino (ca.1515–ca.1575) was the first to use the term 'Lettere Romane', instead of 'antique' or 'antiqua', or 'antiche' employed by Pacioli and other writers.[262]

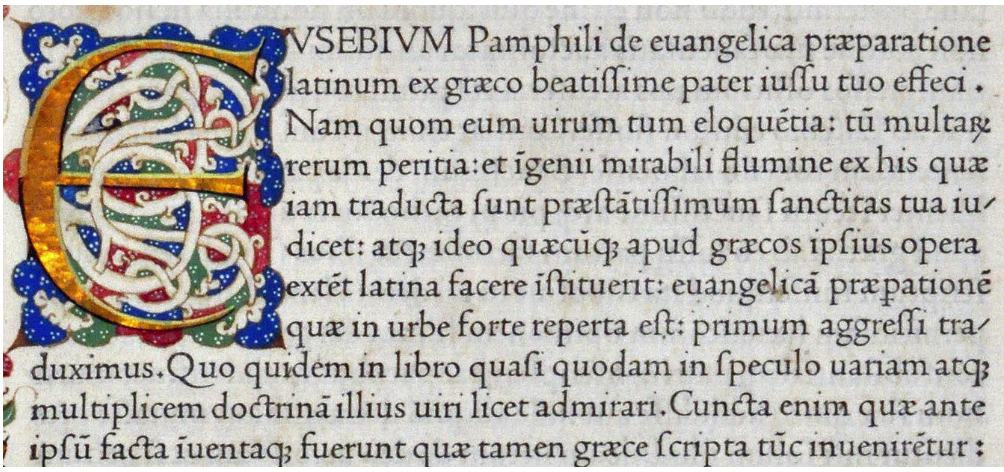

VSEBIVM Pamphili de euangelica præparatione
latinum ex græco beatiſſime pater iuſſu tuo effeci.
Nam quom eum uirum tum eloquētia: tū multaꝝ
rerum peritia: et īgenii mirabili flumine ex his quæ
iam traducta ſunt præſtātiſſimum ſanctitas tua iu-
dicet: atq; ideo quæcūq; apud græcos ipſius opera
extēt latina facere īſtituerit: euangelicā præpationē
quæ in urbe forte reperta eſt: primum aggreſſi tra-
duximus. Quo quidem in libro quaſi quodam in ſpeculo uariam atq;
multiplicem doctrinā illius uiri licet admirari. Cuncta enim quæ ante
ipſū facta īuentaq; fuerunt quæ tamen græce ſcripta tūc inueniētur:

Figure A2.1 Jenson's roman type in *De Evangelica Præparatione* from 1470 (Bridwell Library col.).[263]

A2.3 Jenson's ground plan and Griffo

The 'Eusebius' type is inspired by the best Humanist manuscripts of Jenson's time, as shown in Figure A2.2, but also largely deviates from handwriting due to standardisation required for the production of movable type.[264] Francesco da Bologna's (better known as Francesco Griffo) roman types were designed on the ground plan of Jenson's roman type. He made these 25 years after Jenson for the

---

[262] Morison, *Pacioli's Classic Roman Alphabet*, p.81.
[263] <http://www.codex99.com/typography/127.html>
[264] Updike, *Printing Types*, Vol.1, p.73.

books *De Aetna* and *Hypnerotomachia Poliphili*, which were published respectively in 1495 and 1499 by the Venetian printer Aldus Manutius. Because Griffo's roman types formed the basis for the French Renaissance ones, their details became dominant. It is possible that Griffo's types became familiar with Jenson's model because Manutius' father-in-law, the printer Andrea de Torresani of Asola, owned and applied Jenson's roman type.[265]

In *Four Centuries of Fine Printing* Morison mentions the importance of Griffo's *De Aetna* type, which centuries later formed the basis for Monotype Bembo. He notes that the type of the *De Aetna* equally marks the new epoch in typography, and that it was copied in France by Garamont, Colines, and others. Later Griffo's model made its reappearance in Venice cast from French punches, '[...] with an added note of conscious elegance and technical perfection.'[266]

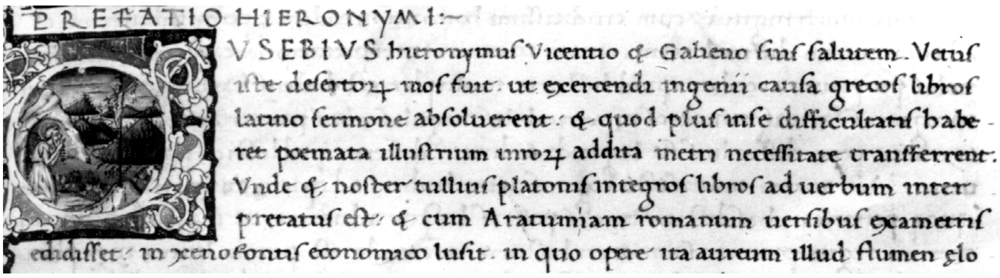

PREFATIO HIERONYMI:—
VSEBIVS hieronymus Vicentio et Galieno suis salutem. Vetus
iste disertorum mos fuit ut exercendi ingenii causa grecos libros
latino sermone absoluerent: et quod plus inse difficultatis habe-
ret poemata illustrium virorum addita metri necessitate transferrent.
Unde et noster tullius platonis integros libros ad uerbum inter-
pretatus est: et cum Aratum iam romanum uersibus exametris
edidisset: in xenofontis economico lusit. in quo opere ita aureum illud flumen elo

Figure A2.2 Humanistic minuscule (Italy, fifteenth century [Museum Meermanno col.]).

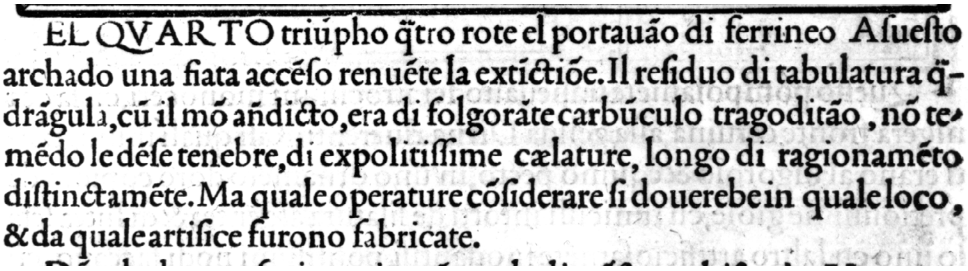
Both Jenson and Griffo cut their famous roman types for relatively small point sizes. As Morison stated, Griffo's type formed the basis for further development and refinement by his French and Dutch successors. The French and Dutch punchcutters copied the proportions of Griffo's roman, and this way Jenson's ground plan found its way through history.

Furthermore, the types Griffo made for *De Aetna* and *Hypnerotomachia Poliphili* (Figure A2.3) were revived in the first half of the twentieth century and are in full use in our digital and eclectic era, as are the (revived) types of Garamont, Granjon, Van Dijck, and Caslon. Jenson's and Griffo's roman types are the archetypal models, i.e., the prototypes; they form the basis and points of reference for any text typeface since the Renaissance.

---

265 Brown, *The Venetian Printing Press*, pp.33,46.

266 Morison, *Four Centuries of Fine Printing*, p.26.

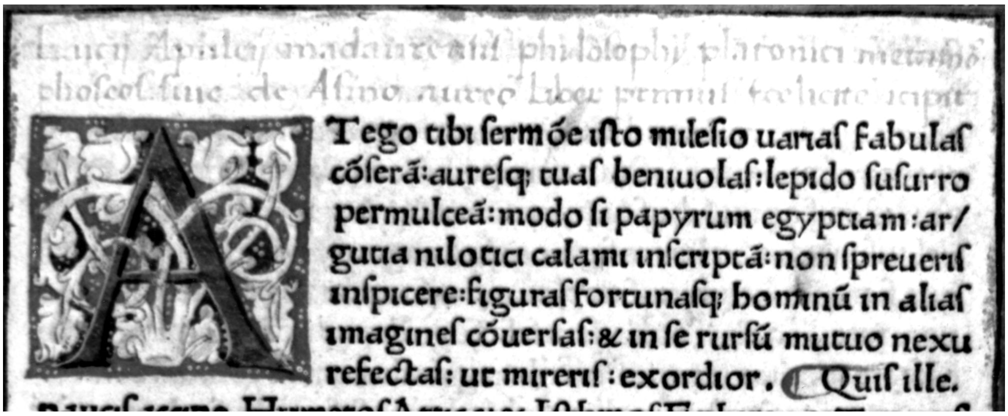


EL QVARTO triũpho q̃tro rote el portauão di ferrineo Aſueſto archado una fiata accēſo renuēte la extīctiōe. Il reſiduo di tabulatura q̃drāgula, cũ il mõ aňdicto, era di folgorāte carbũculo tragoditão, nõ temēdo le dēſe tenebre, di expolitiſſime cælature, longo di ragionamēto diſtinctamēte. Ma quale operature cõſiderare ſi douerebe in quale loco, & da quale artifice furono fabricate.

Figure A2.3 Griffo's type as applied in *Hypnerotomachia Poliphili* from 1499 (Museum Meermanno col.).

A2.4 Variants on a theme

Neither Jenson nor Manutius made use of display type in the aforenamed publications. There was one model and variants on this theme date from later times. For instance the title page of *Hypnerotomachia Poliphili* is typeset in the capitals of the type used for the text. The larger point sizes for display purposes cut by French-Renaissance successors were initially based on letterforms intended for small point sizes. However, at larger sizes optical rules differ, and adaptations of letterforms and spacing are often required.



A Tego tibi ſermõe iſto mileſio uariaſ fabulaſ cõſerã: aureſq; tuaſ beniuolaſ: lepido ſuſurro permulceã: modo ſi papyrum egyptiam: ar/gutia nilotici calami inſcriptã: non ſpreueriſ inſpicere: figuraſ fortunaſq; hominũ in aliaſ imagineſ cõuerſaſ: & in ſe rurſũ mutuo nexu refectaſ: ut mireriſ: exordior. Quiſ ille.

Figure A2.4 Sweynheym and Pannartz's type as used in *Opera* from 1469 (Museum Meermanno col.).

Neither Jenson nor any other Renaissance punchcutter made light, bold, condensed, or sans-serif variants of their roman types. These variants, which we are all used to nowadays, mainly all date from the nineteenth century. Making bold and condensed variants of roman type would have implied a lot of extra work for the punchcutters, but was most probably never considered. After all, there was a morphologically related bold and condensed model already in use: textura type.

Another reason for not cutting bold and condensed variants of roman type could be that the basis for roman type, the Humanistic minuscule, is supposed to be a reaction on the bold and condensed ones of the late Middle Ages that were called 'gothic', labeling them as barbarous.[267]

A2.5 Gothic details and weight reduction

The early development of Renaissance roman type, which culminated in the ones cut by Jenson and Griffo, show a relatively rapid decrease in weight and more and more a suppression of gothic details. Sweynheym and Pannartz's type as used in *Opera* from 1469 looks somewhat heavy still (Figure A2.4). Jenson seems to have reduced the weight in his roman type somewhat more than his colleagues; the colour of his design is lighter than that of contemporaries. Sweynheym and Pannartz in particular made type that is more transitional, i.e., in between gothic and roman type (Figure A2.5).

Although roman type eventually was stripped of gotic details, gothic type was still used during the Renaissance for liturgical works. Jenson cut more gothic type than roman type.

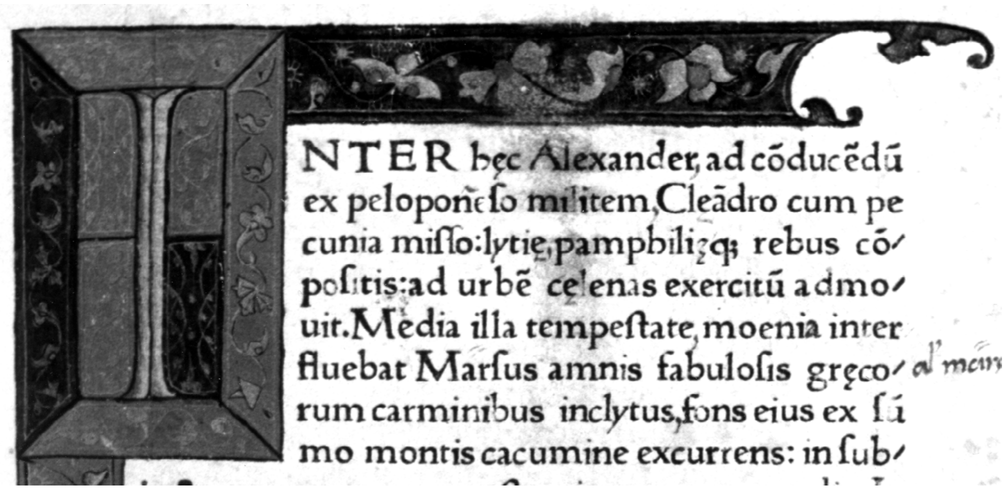

NTER hęc Alexander, ad cōducēdū
ex peloponēſo militem, Cleādro cum pe
cunia miſſo: lytię, pamphiliq; rebus cō-
poſitis: ad urbē celenas exercitū admo-
uit. Media illa tempeſtate, moenia inter
fluebat Marſus amnis fabuloſis gręco-
rum carminibus inclytus, fons eius ex ſū
mo montis cacumine excurrens: in ſub-

Figure A2.5 Da Spira's type as used in *Historia Alexandri Magni* from 1473 (Museum Meermanno col.).

The problems with emboldening, condensing, and contrast-reducing (or any combinations of these) of roman type, which type designers have encountered since the introduction of these variants in the nineteenth century, are caused by the fact that these effects are applied on a model that was not developed with the aforenamed deviations and derivatives in mind. As such, light, bold, condensed, and low-contrast variants (slab serifs and sans serifs), are anomalies. In line with this, 'regular' weights

[267] Leonard E. Boyle, 'The Emergence of Gothic Handwriting', *Visible Language*, Volume IV, Number 4 (Cleveland: the Journal, 1970), pp.307–316 (p.309).

are judged by readers as considerably more legible and more pleasing than bold weights'.[268]

A2.6 Standard

The archetypal model from Jenson and its variant from Griffo have set the standard for type, and in the Western world we are all conditioned with these, mainly via Garamont's variant. Rogers writes in an article titled *Progress of Modern Printing in the United States* that by a very general consent the types of the Italian Renaissance have been approved among modern printers as the most beautiful models upon which to base new attempts in letter design.[269] Not surprisingly Rogers based his Centaur type on Jenson's 'Eusebius' type, and this led Van Krimpen to comment in a letter to John Dreyfuss dated 1–2 February 1951: 'he has been so long and deeply imbued with the Jensonian Gospel that his final achievement –Monotype Centaur– is still a rendering of Jenson's type face.'[270]

---

[268] Miles Albert Tinker, *Bases for Effective Reading* (Minneapolis: University of Minnesota Press, 1966), p.121.

[269] Rogers, *Pi*, p.17. This article was first published in *The Times* in September 1912.

[270] Mathieu Lommen, *Jan van Krimpen & Bruce Rogers* ('s-Hertogenbosch: Dutch Type Library, 1994), p.10.

APPENDIX 3: BASIC INGREDIENTS OF LATIN TYPE

A3.1 Introduction

This appendix is supplemental to Chapters 3 and 8 and is referred to in the Sections 3.4 and 8.6. It provides additional information on what the handwritten originals of the ingredients of Latin roman and italic type are in the form of notes. It also shows how these ingredients interact. Knowledge of this is required to understand the basic principles of writing. Together with Appendix 4 this one forms a compact cookbook, which is a source of reference for designing Latin type. It also can be consulted for the parameterization of type-design processes.

A3.2 Alphabet

The Latin alphabet is derived from the Roman alphabet, which finds its origin from a local form of the Greek (the Ionic alphabet). The Greeks derived their alphabet from the Phoenicians.[271] The Greek did call letters 'phoinikeia' ('Phoenician things'): '[…] and the derivation of Greek letters from Phoenician is confirmed by similarities in their names, by the way in which they were written, and by their order from alpha to tau.'[272]

As mentioned in the former section, the graphemes used for representing a particular alphabet can differ from each other. For instance capital, roman and italic letters represent the Latin alphabet in type today. Although these grapheme systems mostly differ from each other, they also share a number of letterforms. Capital, roman and italic are directly related and connected via a historical development, which started with the Roman imperial capital letters (which found their origin in the Greek capitals) and eventually led via the Latin uncial (which found their origin in the Greek uncials) to the Carolingian minuscule and the latter formed the basis for the Humanistic minuscule and italic, which were formalised and standardised by the invention of movable type.

Within a grapheme system the letterforms can change in time. For instance the ancient Greeks made use of different variants of characters: 'Local variations in the forms and meanings of the characters lasted for centuries, but eventually the Ionic alphabet prevailed'.[273] At first the Greeks wrote from right to left like the Phoenicians, but the direction was reversed because of convenience. Some early Greek

---

[271] Thompson, *An Introduction to Greek and Latin Palaeography*, p.B.

[272] B.F. Cook, *Greek Inscriptions* (London: British Museum Publications, 1987), pp.8–9.

[273] Ibid., p.10.

inscriptions and vases show the 'boustrophedon' or 'ox-turning' method of writing: '[…] each line begins under the last letter of the previous line and runs in the opposite direction.'[274] In addition the letters were mirrored when written in the opposite direction.

A3.3 Scripts

Scripts often completely differ from each other; for example Latin, Indic and Arabic scripts have no graphemes at all in common. On the other hand, related scripts, such as Latin, Cyrillic, and Greek, can share graphemes to represent either identical or different letters. In digital type this results in having different glyph names and Unicode (an encoding system for currently more than 100.000 graphemes from 93 scripts) scalar values (code points).

Letter forms can be shared among scripts. For representing the Latin capital letter 'A', the Greek capital letter 'Alpha' and the Cyrillic capital letter 'A', in a digital typeface the same glyph normally will be used. The glyph (or 'PostScript') names (respectively 'A', 'Alpha' and 'afii10017') are different however, and different Unicode scalar values (respectively 0041, 0391 and 0410) are used for the identification of the glyphs. The glyph used to identify the Latin capital 'B' is in Greek used for the capital letter 'Beta' and in Cyrillic used for the capital letter 'Ve', and so on.

The shapes of the graphemes used to represent the different scripts are to a certain extent arbitrary. As Noordzij states in *De handen van de zeven zusters* ('The Hands of the Seven Sisters'): 'Script does not exist out of syllables, sounds or grammatical words, but of graphic symbols which we can give any meaning.'[275] And to make matters more complex: writing systems can combine elements of more than one script. The Japanese writing system, as an example, is unique in that it uses four different scripts: Hiragana, Katakana, ideographs (Kanji), and Latin.[276]

A3.4 Alphabet and letterforms

The graphemes used to represent the Latin script can be subdivided into three grapheme systems: Latin capital, Latin bookhand minuscule, and Latin cursive minuscule. Despite their differencing shapes, all three grapheme systems represent the same alphabet and alphabet-derived characters. The Latin bookhand minuscule and Latin cursive minuscule are descendants of the capitals, and are the result of a

[274] Ibid., p.11.
[275] Gerrit Noordzij, *De handen van de zeven zusters* (Amsterdam: G.A. van Oorschot, 2000), p.52.
[276] Ken Lunde, *CJKV Information Processing* (Sebastopol: O'Reilly, 2008), p.2.

mostly gradual transformation via uncial to Carolingian minuscule: '[...] we can still trace the ancestral capital form in the features of our small letters and there appears reason to suspect that the Roman capitals have always made their dominant influence felt by their wayward descendants.'[277]

A3.5 Form sorts

In an article on 'Pronunciation in Different Nations of Europe' an anonymous author of the nineteenth century describes the adaptations of the Latin alphabet to the modern European languages, which appeared 'after the establishment of the barbaric nations in the provinces of the Roman empire':

> When these new languages came to be spoken in the different countries, new vowels and new consonants were formed, entirely unknown to the Latin alphabet. In the infancy of writing, it would be vain to expect that ignorant monks who were alone the possessors of any knowledge at all should have been masters of a science so refined and subtle as that of grammar in its various elements; therefore, when these new sounds were to be represented, they applied themselves to the task of giving them as representatives certain combinations of letters, which we now discover to be incoherent and full of disorder. [...] Thus every European alphabet presents innumerable inconsistencies and absurdities, the necessary consequences of its unscientific and unphilosophical construction.[278]

By 'Latin alphabet' the anonymous author obviously meant the complete range of adapted and enhanced vowels and consonants, which are part of a writing system. This range can be considered inconvenient not only from the viewpoint of grammar; also the constructions of the graphemes, which represent the basic set of vowels and consonants, i.e., the Latin alphabet, are not at all homogeneous and contain inconsistencies.

In Latin bookhand minuscule and Latin cursive minuscule the diagonal letters k, s, v–z have as their basis a completely different construction than the other letters. The k has an ascender attached and the y a tail, but for the rest their construction is essentially identical to that of their equivalents in the grapheme system capital. The diagonal letters were directly taken from the capitals and calligraphers and type designers will adjust them in such a way that they do not obstruct the rhythmical pattern too much.

---

[277] Johnston, *Formal Penmanship and Other Papers*, p.39.

[278] Anonymus, 'Pronunciation in Different Nations of Europe', *The Museum of Foreign Literature and Science*, vol. XXVII (New York, 1836), pp.642–644 (p.643).

It is not new as such to make a subdivision of the alphabet into related groups of letters based on their forms or constructions, like I did above. It is interesting to note that this subdivision is made in different ways by authors on this subject, and that subsequently the resulting listings also differ from each other. For instance Eric Gill also made a distinction between the letterforms in roman type and hence their origin, although he clearly came to a different conclusion than I did about which letters are derived from the Roman capitals:

> The essential differences are obviously between the forms of the letters. The following letters, a b d e f g h k l m n q r s t u and y, are not Roman capitals & that is all about it. [...] The conclusion is obvious; there is a complete alphabet of capital letters, but the lower-case takes 10 letters from the capital alphabet, & the italic takes 10 from the capitals and 12 from the lower-case.[279]

The German type designer, typographer, and author on typography Albert Kapr (1918–1995) made groups of perpendicular, curvilinear and diagonal letters:

> The lowercase characters can also be divided into three groups according to their graphic character: the group of letters with mainly vertical basic strokes l, i, j, m, n, h, u, t, f, r, the group with curved strokes o, b, d, p, q, c, e, a, s, g, the group of characters with diagonal lines v, w, x, y, k, and z.[280]

Tracy used as basis a grouping on round and straight strokes. His division was somewhat complex and confusing because it results in a group of letters ('odd ones') that cannot be directly mapped using round and straight strokes:

> In the roman alphabets, capital and lowercase, most of the letters are formed of straight strokes or round strokes, or a combination of them; and the direction of emphasis is vertical. The letters can be grouped like this:
> letters with a straight upright stroke:
> B D E F H I J K L M N P R U b d h i j k l m n p q r u
> Letters with a round stroke:
> C D G O P Q b c d e o p q
> Triangular letters
> A V W X Y v w x y
> The odd ones:
> S T Z a f g s t z.[281]

[279] Gill, *An Essay on Typography*, p.61.
[280] Kapr, *The Art of Lettering*, p.308.
[281] Tracy, *Letters of Credit*, p.72.

A3.6 Contrast sorts

The historical development of the written letters of the Latin script shows that mainly three pen shapes have been used over time: the monolinear writing tools, such as the single line producing stilus and non-splitting pointed pen, the broad nib, and the flexible-pointed pen. From the Middle Ages until the eighteenth century the broad nib was the main writing tool, and from then on until the end of the nineteenth century the flexible-pointed pen was mostly used.[282] At the end of the nineteenth century the broad nib was rehabilitated by, amongst others, Johnston.

Traditionally, the typefaces that find their (main) origin in the writing with the broad nib are called in English 'Old Style' versus 'Modern' for letters based on the flexible-pointed pen. Noordzij came up with two descriptive terms 'translation' for letters that show the contrast flow of the broad nib (the width of the nib is a vector; the pen is translating the movement over a certain distance and over a certain angle) and 'expansion' for letters that show the contrast flow of the flexible-pointed pen as the result of pressure. Old Style (translation) and Modern (expansion) are contrast sorts. Noordzij uses a sorting based on translation and expansion in combination with contrast for classifying type. A cube (Figure A3.1) can represent his contrast sort and contrast universe. The latter comprises all variants from high to low:

> The ranges of sort of contrast and reduction of contrast can be set out on dimensions of a cube […]. My description of the cube is a mixture of technology, design, cultural history, and psychology with a flavor of cultural anthropology; a square kind of fortune-telling'.[283]

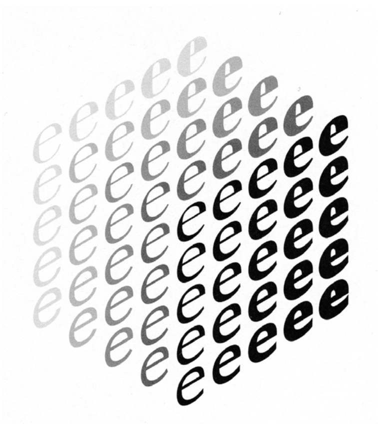


Figure A3.1 Noordzij's cube, showing his contrast-sort and contrast universe.

---

[282] Noordzij, *The Stroke,* p.72.

[283] Gerrit Noordzij, 'The Shape of the Stroke', *Raster Imaging and Digital Typography* 2 (New York: Cambridge University Press, 1991), pp. 34–42 (p.38).

The cube is an excision of a much larger universe. One can extrapolate in all directions, but the resulting forms will be outside the conventions. There is a corresponding aspect in both contrast sorts: for translation one needs a vector. This is fixed in case of the broad nib, and flexible in case of the pointed pen.

The transition from the broad nib to the pointed pen took place at a time in which the role of the counterpoint in music became less important. Counterpoint is the 'technique of combining musical lines. [...] This relationship is a two-fold one, in which vertical elements are contrasting yet interdependent'.[284] The term comes from the Latin punctus contra punctum: '[...] in earlier times, instead of our modern notes, dots or points were used. Thus one used to call a composition in which point was set against or counter to point, counterpoint [...].'[285]

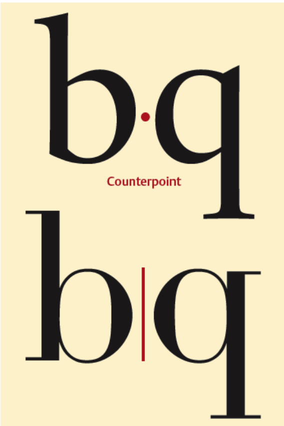


Figure A3.2 Counterpoint defined by point mirroring (top). The bowls of the letters below are line mirrored.

If a parallel with letters is drawn, the counterpoint can be seen as the mirroring point, which is the result of writing mirrored shapes, like the bowls of the b and the d, with a broad nib (Figure A3.2). The bowls are contrasting yet interdependent. The bowls are less contrasting, i.e., more identical, when written with a flexible-pointed pen, as the result of line mirroring. The transition in music from the Baroque into the Classic forms (via the Rococo) paralleled the transition from the broad nib into the flexible-pointed pen: in both cases the role of the counterpoint was diminished.

---

284 Alan Isaacs and Elizabeth Martin (ed.), Dictionary of Music (London: Hamlyn, 1982), p.86.

285 Johann Joseph Fux, ed. Alfred Mann, *The Study of Counterpoint: from Johann Joseph Fux's Gradus Ad Parnassum* (New York: W. W. Norton & Company, 1971), pp.22,23.

A3.7 Skeleton (heart) line

Monolinear letterforms do not have any contrast; all lines have an equal thickness. They preceded the ones written with a flat-ended reed pen. The Phoenician alphabet was monolinear and so were the letters made with a stilus in waxed tablets. The stone-engraved (lapidary) capitals of the ancient Greeks were constructed out of lines without any contrast. The Roman imperial capitals find their origin in the letters of the inscribed Greek capitals, which were treated as 'skeleton' or 'heart lines' when traced by a flat brush (Figure A3.3). The flat brush has the same shape as a broad nib, hence the Greek skeleton forms were vectored by the Romans.

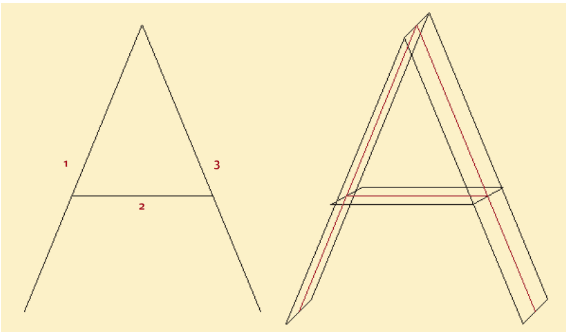


Figure A3.3 Roman imperial capitals found their origin in (Greek) skeleton lines, which were vectored.

There is a proportional relationship between the capitals and lowercase in Renaissance roman type. My conclusion is that the width of the capitals in the type from Jenson, Griffo and Garamont (and probably other punchcutters from that time) was standardised based on the width of the lowercase m, as shown in Figure A3.4.

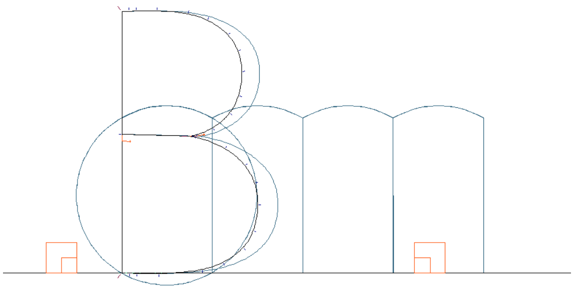


Figure A3.4 Adapting the proportions of the capital B to of the lowercase m (all skeleton lines).

If these capitals find their origin in skeleton lines and one wants to apply the same pen-effect as shows up in the lowercase letters, which find their origin in the broad nib (see next section), then it makes sense to translate the lowercase m to skeleton lines and to adapt the width of the capitals to this monolinear shape (figs.A3.4/5). This has been done with the skeleton-defined capitals in the LetterModeller application.

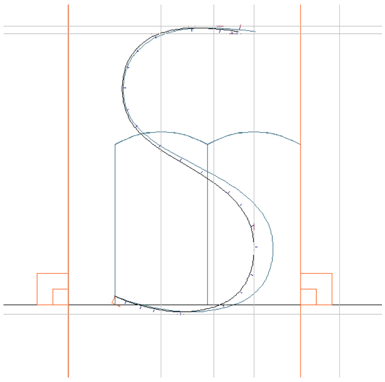


Figure A3.5 Adapting the proportions of the capital S to of the lowercase m (all skeleton lines).

As soon as the proportional relation between the capitals and the lowercase has been established, the capitals can be modified in relation with the lowercase (Figure A3.6).

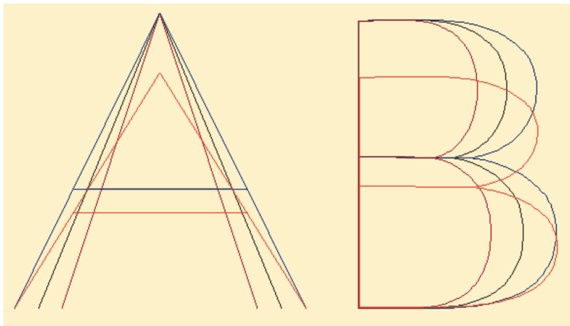


Figure A3.6 Modifying skeleton constructions of capitals.

A3.8 Broad nib

The use of the broad nib dates at least back to the Egyptians, who employed a flat-ended reed pen for writing on papyrus. The Greeks learned the use of the pen from the Egyptians: 'The Egyptians employed the reed, frayed at the end in fashion of a paint-brush; and the Greeks in Egypt no doubt imitated that method in the earliest times, adopting the pen-shaped reed perhaps in the third century B.C.'[286]

The flat-ended reed pen was used for formal writing in the Roman period, such as for the uncial book-hand. The shape of the broad nib added the factor contrast to the letterforms and the factor friction to the movements (the latter partly determined the pen angle). The broad nib translates the movement into a vectored shape , and

[286] Thompson, *An Introduction to Greek and Latin Palaeography*, p.39.

structures (partly because of the friction) and formalises letterforms. For instance the Latin cursive alphabets were formalised by the use of the broad nib in the Middle Ages.

The application of the broad nib using a certain pen angle, which is the angle of the nib (*not* the angle of the pen holder) in relation to the 'baseline', results in a fixation of the contrast flow; for instance the arches of the Humanistic minuscule are connected with their thinnest part (intersection point) to the stems. This standardisation automatically implies that the broad nib is not applied on a more or less arbitrary skeleton construction, but that the skeleton construction itself is the result of the movement made using a certain nib/vector angle. Commonly letters are treated as skeleton forms, on which a certain contrast flow is applied:

> It seems doubtful that Renaissance scribes thought of their letterforms as anything but organic units, but the abstractions to a skeleton form do capture the essence of the letters [...] The concept of an essential linear form is not unknown in the lettering pedagogy of this century. It is mentioned by Edward Johnston in Formal Penmanship, and was used extensively by the Austrian lettering teacher Rudolf Von Larisch and his student Friedrich Neugebauer. Father Catich also used it in his teaching of letterforms'.[287]

Figure A3.7 shows the application of vector angles of respectively fifteen and thirty degrees on a skeleton form of an n (left). The fifteen-degree angle results in a shift of the intersection point away from the stem. The resulting cluttered stem-arch connection has a destructive effect on the shape of the counter.

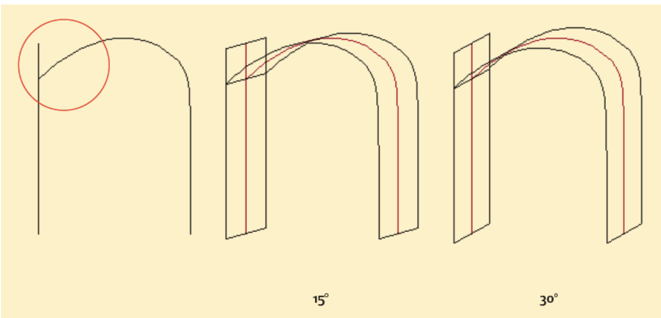


Figure A3.7 Application of a broad nib on a prefixed heart line, using two different vector-angles.

[287] Sumner Stone, 'Hans Eduard Meier's Syntax-Antiqua', *Fine Print on Type*, (London: Lund Humphries, 1989), pp.22–25 (p.22).

The derived heart lines in Figure A3.8 show that the shapes of the letters are the result of the applied vector angle and not vice versa. A change of the pen angle while maintaining the same construction results in different heart lines.

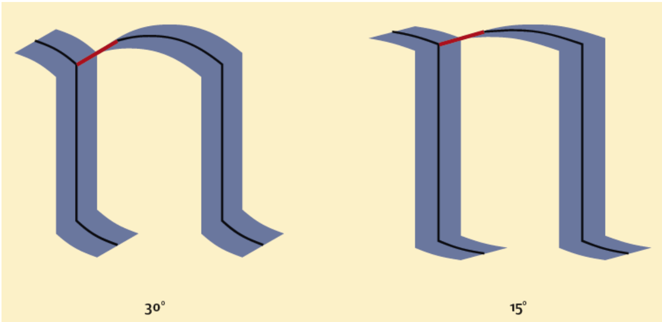


Figure A3.8 The skeleton or heart line is defined by the vector-angle.

A3.9 Flexible-pointed pen

The Romans also used flexible-pointed pens: 'A score of Roman bronze pens, shaped like our ordinary quill-pens, are in existence in various museums of Europe or in private hands'.[288] However, 'such pens [...] were not greatly used'.[289] The British palaeographer and librarian Edward Maunde Thompson (1840–1929) assumed that as soon as vellum came into general use the flexible-pointed pen was applied too, although there is no early mention of this: 'The hard surface of the new material could bear the flexible pressure of the pen which in heavy strokes might have proved too much for the fragile papyrus.'[290]

The flexible-pointed pen became the dominant writing tool in the eighteenth century especially, long after the Romans used it. The flexibility added an extra parameter to writing, namely pressure. Although pressure can be applied on a broad nib too, and was applied in some 'hands', the effect is limited in that case, because there is already a difference in contrast due to the form of the pen. Pressure on a pen also results in more friction, and normally a calligrapher will try to reduce that as much as possible. The Humanistic minuscule was in essence written without any pressure on the broad nib. If no pressure is applied on a flexible-pointed pen, the resulting line is monolinear. If pressure is applied, the line will expand, and this expansion is only possible perpendicular to the heart line, otherwise the pen will be ruined and the ink will spread in an uncontrollable and undesired way.

---

288 Ibid. p.40.

289 David Diringer, *The Book before Printing* (New York: Dover Publications, 1982), p.559.

290 Thompson, *Introduction to Greek and Latin Palaeography*, pp.40,41.

The flexible-pointed pen can be applied on any heart line and it does not have the structuring effect on the letterform like a broad nib. The letters written with the flexible-pointed pen in the eighteenth century faithfully followed the conventions, i.e., proportions and emphasis on strokes, of the preceding broad nib based letterforms. The heart lines distilled from the preceding broad-nib letters defined the shape of the flexible-pointed pen letters.

The emphasis in broad nib letters is optically mostly on the vertical strokes, despite the applied thirty-degree vector-angle. This emphasis on the vertical strokes is also the case with flexible-pointed pen letters. Because expansion is only possible perpendicularly to the heart line, for the diagonal letters the flexible-pointed pen has to be differently positioned in relation to the baseline. This is, of course, also the case with the cursive variants.

A3.10 Rotation

Rotation is a contrast sort-independent effect that changes the contrast flow. Basically there are two reasons to apply rotation: firstly to reduce the friction and secondly because of æsthetic preferences.

Figure A3.9 Title page of Jan van den Velde's *Spieghel der Schrijfkonste.*[291]

The application of rotation for the avoidance of friction is standard procedure for a calligrapher, as is releasing the broad nib from the paper when making upstrokes in cursive hands, which will be subsequently partly covered by downstrokes. With a flexible-pointed pen stroke, expansion is only possible perpendicularly to the heart line. If expansion has to be applied on (an abundance of) curvilinear forms, like in

[291] <http://www.wga.hu/frames-e.html?/html/v/velde2/jan1/spieghel.html>

Spiegel der Schrijfkonste by the Dutch writing master Jan van de Velde, rotation is a prerequisite. *Spiegel der Schrijfkonste* dates from 1605 and shows both broad nib and flexible-pointed pen letterforms (Figure A3.9).

Rotation as found in Van den Velde's work can be quite complex: 'This steep hold, with the fingertips quite close to the nib, allows the most complicated trick: changing the slant of the pen during the stroke by rolling the pen between the fingers'.[292]

[292] Noordzij, *The Stroke of the Pen*, p.41.

APPENDIX 4: DETAILS OF TYPE

A4.1 Introduction

This appendix is supplemental to Chapter 3 and is referred to in Section 3.4. It provides additional information in the form of notes on the details of Latin roman and italic type. Knowledge of this is required to understand the basic principles of type design. Together with Appendix 3 this one forms a compact cookbook for the design of Latin type and also for the parameterization of type-design processes.

A4.2 Sum of particles

Figure A4.1 shows the gradual modification from generic a from the letter model to a formalised variant for roman type.

Figure A4.1 Gradual transformation of the lowercase a, starting from a generic model (top left).

To come to the formalised variant, curves have been smoothened and the 'eye' of the a has clearly changed. These steps are the result of decisions that a type designer makes. Figure A4.2 shows what is involved in the creation of written letters, indicated by 'systems' here (rows 1–4).

By adding the factors 'formalisation' and 'idiom' the result is a formal group of graphemes, which may be a 'typeface'. Of course, the tweaking of the first four systems already creates personal structures and patterns, but type design offers more options for adding sophisticated and refined details, i.e., idiom, than writing with a prefixed or partly customizable tool, such as a broad nib or a flexible-pointed pen.

It must be noted that this mapping in systems and models is my personal one. I see this as a prerequisite for the understanding of the factors a type designer is dealing with. Appendix 9, *Systems and models in type* provides a detailed listing.

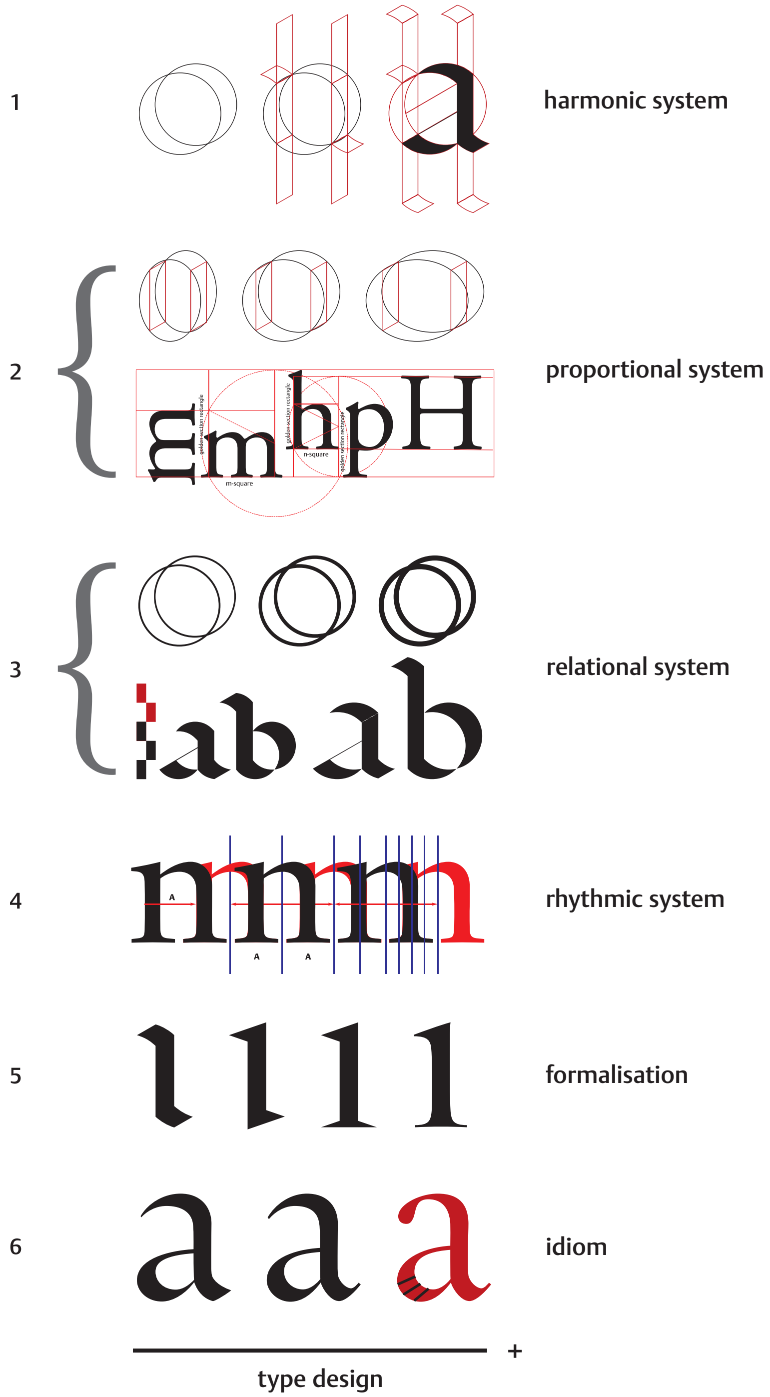


Figure A4.2 Sum of particles.

A4.3 Building blocks

When designing roman type everything is relative to underlying structures and patterns of the archetypal model. A type designer is stacking building blocks when he applies the systems presented in Figs.A4.2. When he makes a design for text setting, he makes variants on the theme fixed by the archetype from Jenson. Figs.A4.3/4 show the repetitive use of the same elements. All these elements contain the personal pattern of the designer and every repetition makes the pattern stronger.

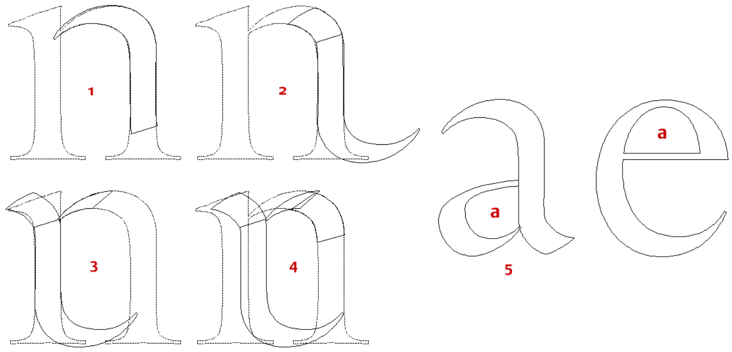


Figure A4.3 The design of the a from the n in five (assembly) steps.

Frederic Goudy describes in *The Alphabet* the personal pattern as follows:

> In the construction of a letter the artist should first determine just what the intrinsic shape of his model is—that is, in what degree are the lines, curves & angles, or the directions the lines take that compose it, fixed or absolutely necessary to that particular letter. His next thought must be for form, which includes proportion and beauty, and the particular form suitable to the place & purpose for which it is intended. His decision here will largely determine the measure of his ability and taste.[293]

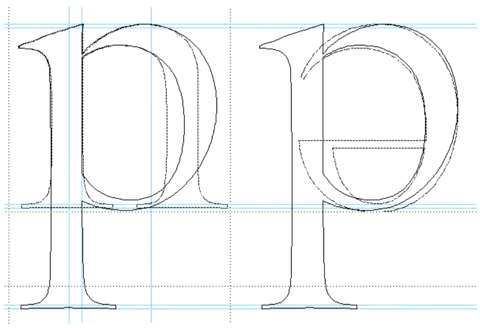


Figure A4.4 The correlation between the n, the p, and the e.

The development of type shows that the archetype of Jenson and especially Griffo model were used as a basis for new types by later punchcutters. These punchcutters, like Claude Garamont in the sixteenth century and Van Dijck in the seventeenth century, altered details; they made the letterforms more personal. Morison wrote about Van Dijck's letters: 'Though they are not as important to the historian as those of Garamond, they are certainly more beautiful. It is often the fact that the faces fashioned after the model of a certain historically important letter are noticeably superior in design to their prototype.'[294]

---

293 Frederic William Goudy, *The Alphabet: and Elements of Lettering* (London: Dover Publications, 1989), p.90.

294 Morison, *Type Designs of the Past and Present*, p.30.

The changes applied by Garamont on the models by Griffo and later by Van Dijck on the models by Garamont are relatively small and all within the same atmosphere. Details were altered but the overall image remained the same. The details Johann Michael Fleischmann introduced in the eighteenth century diverged much more. Fleischmann was perhaps more of what we nowadays consider to be a *type designer* than his predecessors, who were craftsmen first: 'As a whole, Fleischman's founts represent the first personal, individualist interpretation of Roman and Italic.'[295]

The development of the technologies used for producing type and text, like the introduction of Benton's pantograph in the second half of the nineteenth century never had a dominating lasting effect on the letter forms and hence did not alter the conventions. Nor had the development of the hot metal composing machines, the photo composers and digital type and typography. Over time the technology has always been adapted to represent the standards of the past. That was the case when movable type was invented and is still the case today when type has to be adjusted to for instance, screen resolutions. In *Typography as Vehicle of Science* Gerard Unger notes on the developments of type and typography in the era of desktop publishing: 'In the final decade of the twentieth century typography was subjected to wild and daring experiments. […] After 2000 such design is still done, but much less so, while traditionalism and conventionalism increasingly prevail in typography.'[296]

Type design is still anchored in the same rules, which were fixed by the invention of movable type, and the type designer tries to optimize the patterns and constructions with his idiom. In the foreword of Alan Hutt's *Fournier, the Compleat Typographer* James Moran notes:

> The design of types made by modern methods, therefore, is not inherent in the mode of manufacture. It comes from the nature of the written and hence the printed word, and some indefinable talent in the best punch-cutters and type designers who aimed and continue to aim at optical harmony.[297]

Deviating from 'the nature of the written and hence printed word' will place a type design outside the conventions for text setting.

---

[295] Morison, *Letter Forms*, p.34.

[296] Gerard Unger, *Typography as Vehicle of Science* (Amsterdam: De Buitenkant, 2007), p.28.

[297] Hutt, *Fournier*, pp.xi,xii.

A4.4 Consistency

Depending of the uniformity of the building blocks, the repetition of patterns will result in a more or less consistent type design. This consistency is measurable using the models to which the building blocks belong. Theoretically one could say that the more consistent the structure, the better the typeface. After all, as I aim to prove in this dissertation, everything is relative to underlying structures and patterns of the archetypal model.

However, we are dealing with human beings and this implies that what is perceived is subject to different opinions. A typeface, which is theoretically consistent, does not by definition appeal to its reviewer. The reviewer is seldom the reader, as most readers are unconscious of the vehicle used to pass on information. The eyes that are used to judge the quality and beauty of type belong to the type designer and the typographer. Type designers and typographers will always come up with theories, the purpose of which is to prove that there is more to typography than simply applying rules within the boundaries of the conventions in their attempts –if only to underline that their professions belong to the world of arts and not to that of craftsmen. The next section describes deliberate deviations from consistency in type: dissonances.

There is an ongoing discussion between type designers on how much the level of regularization of a type design influences the legibility factor. Peter Karow (1940), who invented the IKARUS system for the digitisation of contours in the 1970s, named this the 'roughness' of the design:

> With "Roughness" we want to approach tentatively an aspect of legibility. Typographers teach that text should color a page as evenly as possible; moreover, the characters of the text should form an even, rhythmically flowing succession of black and white areas. Therefore, it is a bit disturbing if the individual characters in a typeface are very different in blackness.[298]

[298] Peter Karow, *Typeface Statistics* (Hamburg: URW Verlag, 1993), p.297.

Figure A4.5 Inorganic geometric consistency in the Romain du Roi.

Consistency can for instance be achieved by applying artificial structures and patterns. With artificial I mean specific letterforms as the result of a contrast flow, which cannot be distilled from the handwritten broad-nib origin of roman type or from the application of the pointed flexible pen, like some of the letterforms (but not the proportions) of the Romain du Roi. Especially the bowls of the b, d, p and q of the Romain du Roi cannot be traced in handwritten models predating the type (Figure A4.5). Artificial letterforms can be inspired by (or combine) certain patterns from writing with aforementioned pens. Deviating from these patterns does not by definition imply that the resulting letters are incorrect as such, i.e., that these will not conform to the conventions anymore.

Artificially created letterforms will be compared with the (previous) standard for a specific application. The geometrically consistent Romain du Roi was a rigid construction on the foundation of Renaissance type on which patterns derived from Baroque handwriting were applied. Hence a comparison with the precursory letterforms is inevitable: 'The "Romain du Roi" is geometrical throughout. There is nothing personal about it. Designed to accord with the findings of a scientific commission, the face fully preserves the virtues of logic and consistency.'[299]

---

[299] Morison, *Letter Forms*, p.34.

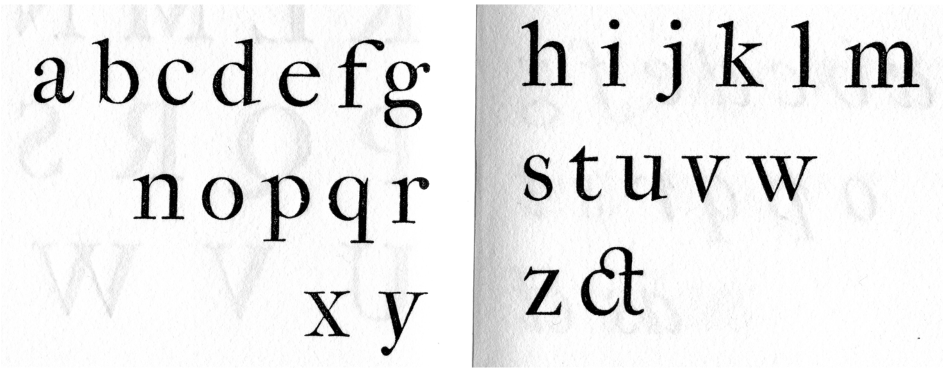


Figure A4.6 French Canon (roman) from the Fell types.[300]

The rather clumsy interpretations by Moxon of Van Dijck's roman type presented in his *Mechanick Exercises* show a different contrast flow than can be found in the 'reproduced' original type of the Dutch punchcutter. Burnhill noted that Moxon's '[…] outline characters and rule-and-compass way of describing the shape of a letter provides little sense of the structure of letterforms.'[301]

Either Moxon was not familiar with effects of the broad nib, or he just engraved what had become a common style in his time. Figure A4.6 shows the roman of the French Canon from the 1693 *Specimen of the Several Sorts of Letter Given to the University by Dr. John Felll*. Morison considered the origin of the larger type shown in the specimen to be of Dutch origin. He was not very positive about the quality: 'None of the faces is cut with any subtlety', and he dated them after 1650.[302] Especially the a, b, d, g, p, q, r, and s of the roman show the vertical stressing, which in later type is attributed to the application of the flexible-pointed pen.

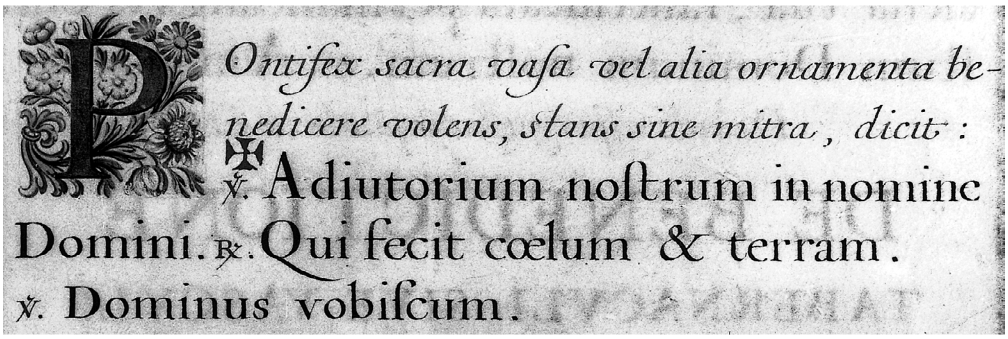


Figure A4.7 Example of Jarry's handwriting dating from 1653.

[300] Morison, *Letter Forms*, pp.24,25.

[301] Burnhill, *Type Spaces*, p.27.

[302] Stanley Morison, *The Fell Types: the Roman, Italic & Black Letter Bequeathed to the University of Oxford by Dr. John Fell* (Oxford: The Typophiles, 1951), p.6.

When it comes to the Romain du Roi there seems to be no complete agreement on what exactly formed the origin of the letterforms. Were the letterforms the result of the formalisation using ruler and compass, or were they a geometric reproduction of existing (handwritten) letters? Hutt called the idea that the design of the Romain du Roi was inspired by the engraver rather than the calligrapher (for instance Morison had this opinion) an over-simplification and he mentioned that 'there were great writing-masters in seventeenth-century France, like Nicolas Jarry and his successors […].'[303] The immovable calligraphy-oriented Noordzij seemed to have no doubts about the origin of the Romain du Roi:

> The minutes of the commission confirm what anyone can ascertain: the designs follow in detail the handwriting of Nicholas Jarry, who worked around 1650 as calligrapher for the Cabinet du Roi. This history leaves us no other choice than to view the 'romain du roi'–the type– in terms of handwriting of Jarry.'[304]

An example of Jarry's handwriting can be found in Figure A4.7.

Figure A4.8 Plate from George Shelley's *Natural Writing* (1709).[305]

The scientific approach by the Académie des Sciences left its marks in the typefounders' profession. Despite his objections against the application of geometric constructions of letter forms, '[…] Fournier was a profound believer in the application of scientific methods to the measurements of the body upon which type faces were cast', resulting in his standardisation of type bodies.[306]

[303] Hutt, *Fournier*, p.x10.

[304] Noordzij, *The Stroke*, p.17.

[305] Peter Jessen, *Masterpieces of Calligraphy: 261 Examples, 1500–1800* (New York: Dover Publications, 1981), p.92.

[306] Morison, *Letter Forms*, pp.39,40.

The use of the Romain du Roi was protected and restricted to the Imprimerie Royale; copying was not allowed.[307] The geometric construction methods for the royal type do not seem to have had much influence on later punchcutters, but the resulting letterforms did. Alexander Lawson commented on this:

> Some authorities have called the Romain du Roi the first modern types, but they seem closer to the transitional classification, which contains features of old style and modern in equal degrees. Whatever theory is followed, however, this French departure from old style greatly influenced designers of printing types during the eighteenth century. There is general agreement that the best-known of these designers, John Baskerville, an English amateur printer and typefounder, be credited with the creation of one of the earliest transitional types.[308]

On the other hand, John Baskerville made type that looked like handwritten letters from his time. In *A Tally of Types* Morison describes Baskerville's type as: '[…] the first appearance in print of the style of native letter common among contemporary English writing masters such as George Shelley […]. John Baskerville of Birmingham had himself been one of these professional writing masters.'[309] Figure A4.8 shows letters drawn by Shelley in the style we all know so well from Baskerville's type. The latter inspired Fournier, Didot and Bodoni, labelled by Morison as 'flattery without plagiary […]'.[310]

Fournier circumvented the copying limitations for the Romain du Roi by making his type less rigid and somewhat more oriented on the developments of earlier type as well as on contemporary type like Baskerville's.[311] James Moran notes about Fournier in the foreword of Alan Hutt's book on this French typefounder: '[…], his genius lay in his ability to modernise the traditional letter forms, and his types are the first of the "transitional" between "old face" and "modern".'[312]

---

[307] Gustav Bohadti, *Von der Romain du Roi zu den Schriften J.G. Justus Erich Walbaums* (Berlin/Stuttgart: H. Berthold AG, 1957), p.11,14.
[308] Lawson, *Anatomy of a Typeface*, p.184.
[309] Morison, *A Tally of Types*, p.65.
[310] Ibid., p.81.
[311] Bohadti, op. cit., p.14.
[312] Hutt, *Fournier*, p.XII.

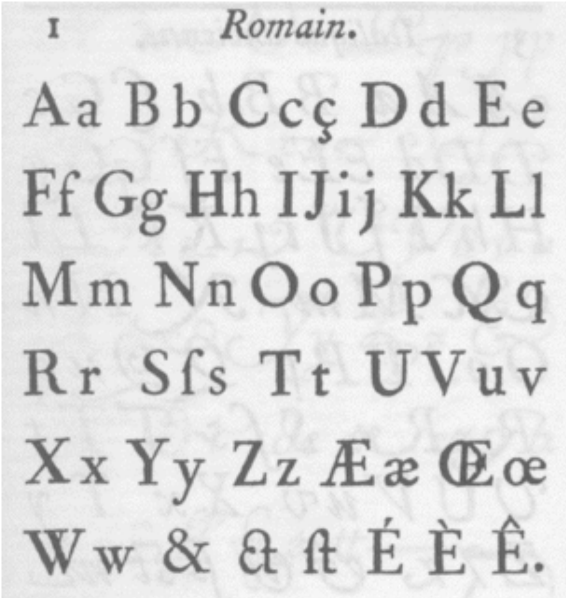


Figure A4.9 Fournier's roman type as shown in his *Manuel Typographique* (p. 187).[313]

The forms of the serifs of the Romain du Roi clearly differ from those applied on preceding type: 'The principal graphic novelty in the 'Romain du Roi' is the serif. Its horizontal and unbracketed structure symbolizes a complete break with the humanist calligraphic tradition.'[314] In Tracy's opinion a new feature in the Romain du Roi was the serif at the foot of the stem of the b, '[…] as though the letter was simply a reversal of the letter d. The style was adopted by many of the later punch-cutters who produced 'modern' faces. It is in Bulmer, but not in Scotch Roman; in Bodoni, but not in Walbaum.'[315] Updike considered the thin serif applied in the Romain du Roi 'dazzling to the eye' and in his opinion it rendered the type 'quite unlike anything that preceded it.'[316] De Vinne called the serifs a 'feminine fashion', which 'added nothing to the beauty of types, but it did largely diminish their legibility and durability.'[317]

A4.5 Dissonances

The development from foundry type via hot metal and photo typesetting to digital text composing has made possible that type can have perfect contours, that can be composed without any deviations from the baseline, and that can be perfectly printed. However, the opinions differ about the extent to which this can be considered an improvement. Rogers, who lived in the era of the hot metal composing

---

[313] <http://jacques-andre.fr/faqtypo/BiViTy/Manuel/f2c06.html>

[314] Morison, *Letter Forms*, p.29.

[315] Tracy, *Letters of Credit*, p.58.

[316] Updike, *Printing Types*, Vol.II, p.159.

[317] De Vinne, *The Practice of Typography*, p.87.

machines, did not appreciate too much regularity: 'A mechanically perfect letter is not the ideal letter; the reading eye does not demand cold regularity of execution; but it does gratefully recognize noble proportions combined with flexibility and variety of detail.'[318] Van Krimpen wrote in his famous letter to Philip Hofer dated November 1955: 'It seems likely that the slight irregularities, which the human eye and hand always leave in manual work, are an important element of the charm of handcut type.'[319] However, in the same letter Van Krimpen classified Rogers's attempts to reproduce the effects of foundry type in the Monotype version of *Centaur* as 'dishonest'.[320]

In *Counterpunch* the Dutch type designer and author on typography Fred Smeijers (1961) notes, more or less in line with Rogers and Van Krimpen (he does not specifically refer to hand-cut type, but to the printing):

> Most typefaces – certainly any belonging to the Garamond category – should have optical irregularity and variety if they are to function satisfactorily. [...] This quality cannot be explained merely by imperfect printing techniques. Rather it has to do with all the imperfections and irregularities that balance on the border of what can be perceived.[321]

One wonders how Smeijers wants to measure what can be perceived or not; when is it too much or not enough irregularity?

Because typography started with foundry type and the archetypes are still dominant (which Smeijers underlines with reference to his 'Garamond category'), contemporary printed –either in offset or inkjet (in the near future)– type will always be compared with letterpress printing. The best-printed pages in history may have an extra charm because of the impressions of the lead letters in the paper and the subsequent dispersion of ink at the edges, but many, many books were printed rather poorly and one feels pity for their readers.

It is in my opinion an overly romantic attitude to think that the irregularities of letterpress added to the legibility factor. I have yet to see any scientific proof for this assumption. I believe that in general the quality of offset printing is superior to the majority of the historical letterpress-printed counterparts. The contemporary typesetting and printing technologies make it possible to show the typefaces and

318 Rogers, *Pi*, p.17.

319 Jan van Krimpen, ed. John Dreyfus, *A Letter to Philip Hofer on Certain Problems Connected with the Mechanical Cutting of Punches* (Cambridge, Boston: Harvard College Library, 1972), p.17 of the letter.

320 Ibid., p.18 of the letter.

321 Fred Smeijers, *Counterpunch: Making Type in the Sixteenth Century, Designing Typefaces Now* (London: Hyphen Press, 1996), p.150.

their harmonics, patterns and dynamics as they really are. If monotony has a negative effect on the rhythmic structure, i.e., the proportional system(s), the designers should change the design. However, I do not think it makes sense to deliberately give stems uneven thicknesses, to make contours rough, or to make the x-height flexible. A purposely applied deviation from the rhythmic structure, a dissonance, may perhaps work for certain text sizes and can certainly be used as an extra gimmick for display.

A4.6 Serifs

Serifs are in general considered to be additional elements. For a while the Wikipedia page on serifs even mentioned 'non-structural': 'In typography, serifs are non-structural details on the ends of some of the strokes that make up letters and symbols' before this was replaced by 'semi-structural.' Figure A4.10 shows the accompanying image on Wikipedia with two different definitions of serifs: in the capitals A and C the complete endings of the strokes are indicated as serifs and in the rest of the letters only the parts that are sticking out are emphasized.

Figure A4.10 Serifs according to Wikipedia.

Serifs are structural elements which:

– emphasize the ending of a stroke,
– represent the contrast,
– indicate the contrast sort and contrast flow.

The way stroke endings are emphasized differs per typeface. The lower the contrast, the more the stroke-endings are emphasized. In case of a very low contrast the serifs become basically obsolete, because their thickness becomes equal to the stem thickness. Low-contrast variants with serifs are called 'slab serif' or 'egyptian'. The removal of the serifs results in a sans serif. In *De staart van de kat* Noordzij suggests that the ending of a stroke is by definition a serif, irrespective of whether elements are sticking out or not and he preferably wants to avoid the 'impossible' word 'sans serif'.[322]

[322] Gerrit Noordzij, *De staart van de kat: de vorm van het boek in opstellen.* (Leersum: GHMUitgeverij, 1988), p.99.

The interpolation (which calculates a new contour in between two existing ones) shown in Figure A4.11 seems to underline Noordzij's statement. The two poles were formed by the sans serif typeface DTL Argo designed by Gerard Unger and the serifed DTL Fleischmann, a revival based on type of the seventeenth-century German master. This isomorphic interpolation was made with the IKARUS V4 program, which makes 'intelligent' interpolation possible (the number of contour points is allowed to be different; glyphs will be interpolated as long as their morphology is corresponding). The resulting 'Arfleisch' type raises the question: if DTL Argo has no serifs what has been interpolated here?

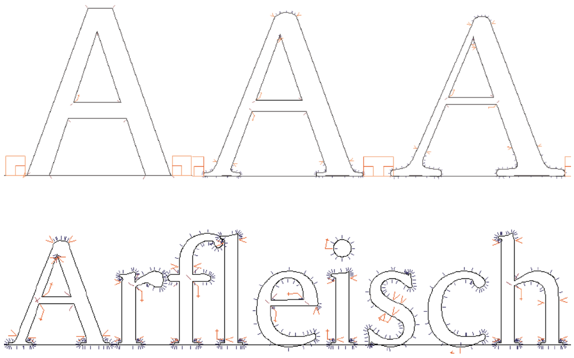


Figure A4.11 Interpolation of a sans serif typeface (DTL Argo) with a serifed one (DTL Fleischmann).

A4.7 Serif structures: broad nib

The types made by Jenson and Griffo were derived from letters written with a broad nib and subsequently had a similar high contrast. The bottom serifs of Jenson's 'Eusebius' type show what is essentially a backstroke. For the production of Centaur Rogers traced photographic enlargements of Jenson's letters with a broad nib and used backstrokes for the serifs, as shown in Figure A4.12. This way he did what Noordzij later described in the eleventh edition of *Letterletter*: 'Jenson interpreted handwriting. The example had lozenges as footings. Jenson could have copied this shape faithfully in his punches, but the extra work would not have paid. […] rectangular footings are cut more easily than lozenges.'[323] In Centaur also Rogers replaced the backstrokes by more chisel-based serifs, such as the ones that can be found in the Roman Imperial inscriptions.

[323] Gerrit Noordzij, *Letterletter* (Vancouver: Hartley & Marks, 2000), p.96.

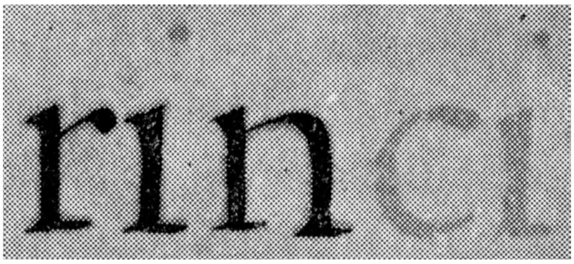


Figure A4.12 Rogers' broad-nib tracing of the 'Eusebius' type for Centaur (The Newberry Library col.).

In Adobe Jenson the backstroke in the bottom serifs of the lowercase is partly preserved. Obviously, Jenson treated the lowercase serifs somewhat differently from the capital serifs by preserving some details from writing. Griffo, however, seems to have copied to a greater extent the structure of the capital serifs to the lowercase letters.

Figure A4.13 Adobe Jenson (left) and Monotype Poliphilus, showing different treatment of the serifs.

Figure A4.14 shows the n's of Adobe Jenson, Monotype Poliphilus (Griffo) and Times New Roman, respectively. In Times New Roman the serifs mostly represent the serif shapes of the Roman imperial capitals.

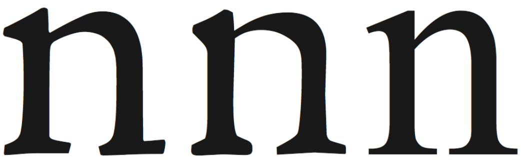


Figure A4.14 Adobe Jenson (left), Monotype Poliphilus (centre) and Times New Roman (right).

There is a direct relation between the weight and shapes of the top and bottom serifs of lowercase letters. The triangular top serif in roman type is a formal representation of the part of the arch, which is used to start and end a stroke (sometimes called 'foot'). Hence the weight of the top serif represents the weight of this curve part (Figure A4.15).

Figure A4.15 The top serif (right) represents the weight in the arches.

The formal triangular top serif is not specific for type; it can also be found in Carolingian minuscules (figs.A4.16/17) and subsequently in the Humanistic minuscules.

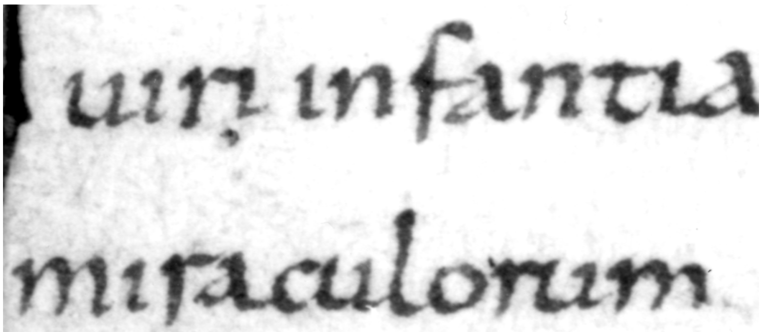


Figure A4.16 Top serifs in Carolingian minuscules (France, ninth/tenth century [National library of the Netherlands col.]).

The triangular top serif seems to have been applied only if a stroke was not followed by a second connected stroke at the same height. The m for instance has a sequence of connected arches, and here the triangular serif was not applied. In case of single stroke letters, like the i and the l, and also on top of the u, the triangular serif was applied, probably to make the letters sturdier.

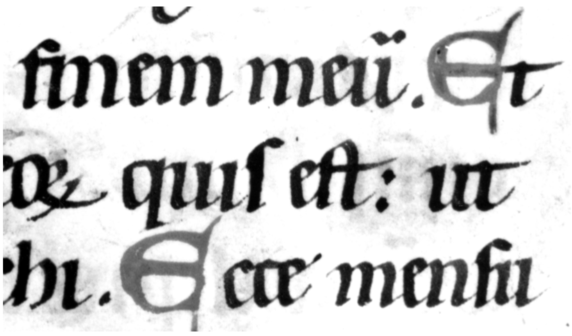


Figure A4.17 Top serifs in Carolingian minuscule letters ‘u’ (end of twelfth century, origin unknown [Museum Meermanno col.]).

Formal stroke endings, like the ones shown in Rogers's nib tracing of the Eusebius type, were also applied in medieval manuscripts. Figure A4.18 shows a formalised book hand from the twelfth century with subsequent stroke endings. The finest manuscripts from that century show a 'Perfect symmetry of letters, marvelous uniformity in their structure.'[324]

Such formalised Latin minuscule book hands are precursors of the fifteenth-century roman type and are in contrast with statements such as 'Pure, formal written romans are rare if not unknown before 1500'[325] and the allotment of the backstroke to the textura: 'After 400 years we have become accustomed to roman type, but we might yet do well to marvel at the fact that the reversal in the textura foot has been so emphatically adopted'.[326]

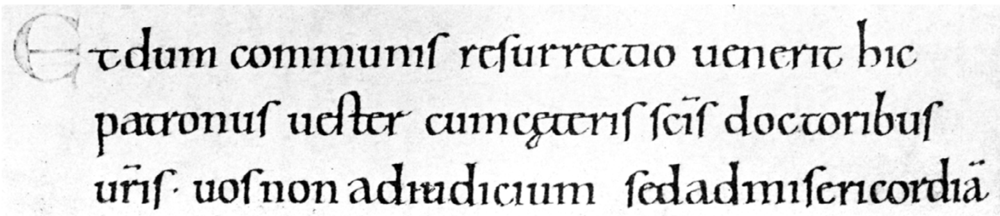


Figure A4.18 English book hand from the early twelfth century, showing formalised bottom serifs.[327]

Figure A4.19 shows how (theoretically) the pen angle is slightly changed to retain the width of the top serif (based on the width of the 'foot') in combination with lining the top with the arch. This way the total weight of the serif still resembles the related part of the arch. The top serifs represent the complete flow of contrast; i.e., from thick to thin.

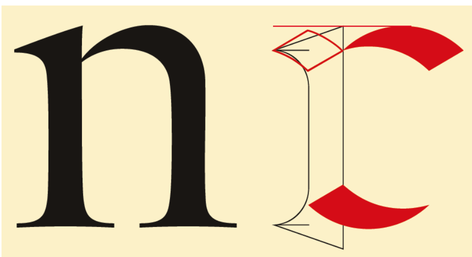


Figure A4.19 Formalisation of the top serif.

[324] Thompson, *An Introduction to Greek and Latin Palaeography*, p.436.
[325] Smeijers, *Counterpunch* p.49.
[326] Noordzij, *The Stroke*, pp.57,58.
[327] Thompson, op. cit., p.435.

There is a simple relation between the top and bottom serifs of the letters. Noordzij indicates that the triangular top serif of for instance the lowercase 'i' can theoretically be divided by a horizontal line into two identical parts.[328] This can be pushed a step further. The bottom serif is in theory made of half of the top serif. If the serifs are straight triangular shapes, the top half of the top serif is identical to the bottom serifs. If the bottom half of the top serif is curved, the bottom serif is a mirrored copy of this curved part (Figure A4.20). To maintain the total weight of the top serif, the top half can be copied to the right side of the stem bottom.

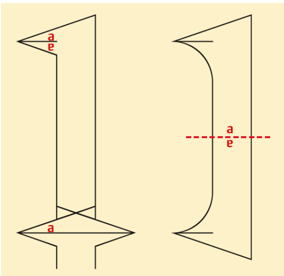


Figure A4.20 Relation between top and bottom serifs.

In case the pen (vector) angle changes, the serifs will change too. The steeper the pen angle, the more weight will consequently be in the arches and the more weight will be in the serifs. Figure A4.21 shows an increase in pen angle reflected in steeper serifs. Increment of the contrast is achieved by making the thick parts of a letter thicker. This can be done in an absolute way, but also in a relative way by decreasing the thickness of the thin parts. In both cases the vector and optical angle will become steeper. If the vector angle changes, the serif angle changes as well.

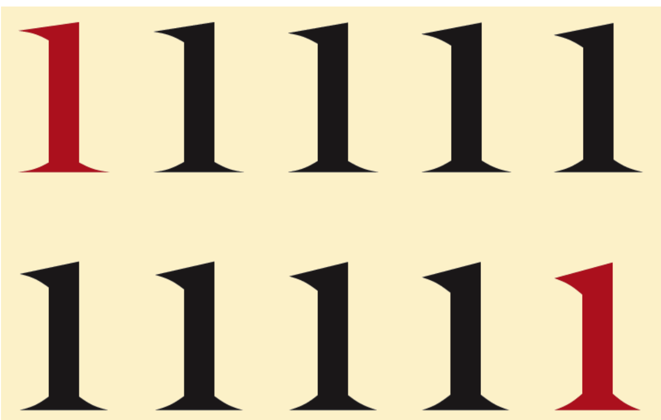


Figure A4.21 An increased pen angle leads to steeper and heavier serifs.

[328] Noordzij, *De staart van de kat*, p.103.

If the contrast is lowered, the angle of the serifs (the bracketing) will become less steep, because the additional weight will otherwise change the relation with the counter part in the arches, but also because the origin of the curved part, i.e., where it is placed against the stem, be widened and therefore this angle also changes. This angle, the optical angle, is by definition smaller than the angle used for the underlying vector. The vector angle can be considered as the factual angle. The optical angle could be represented by a line connecting the origin of the curve with its extreme.

If the contrast is lowered the bottom serif is represented by the triangular shape plus the weight of the thinner parts (Figure A4.22). This results in less steep brackets and the serifs become more horizontal. The level of contrast can be read from the serifs: if the angle is less than 90 degrees, there is by definition a certain amount of contrast.

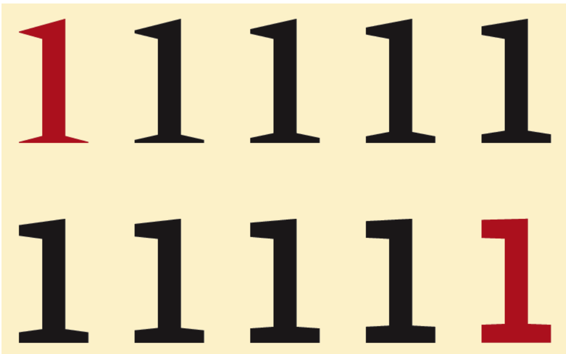


Figure A4.22 Lowering the contrast leads to heavier and more horizontal serifs.

Figure A4.23 shows the (theoretical) steps of the development of the formalised serif, starting from writing.

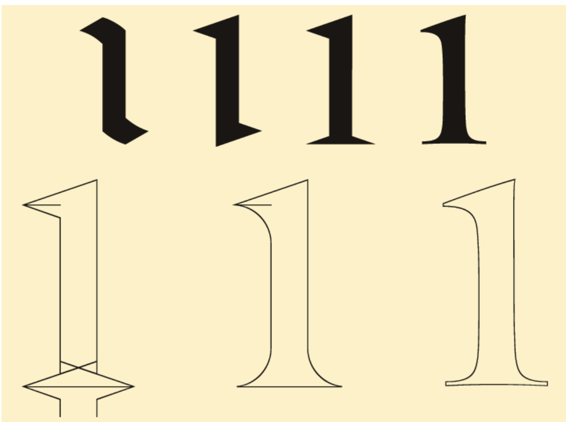


Figure A4.23 Schematic representation of the development of the serif.

The centre and right outlined i's on the bottom line show a different treatment of the stems. In the centred i the stems are defined by straight lines, which are connected to arcs (the taluses of the serifs). The connections of the arcs are quite abrupt and angulated. As a result the stem becomes optically convex, i.e., it bulges outwards and subsequently the serif-connections optically come inwards. The stem of the right i is biconcave and the serifs are fluently connected to the stems. The optical convexity is prevented this way.

Figure A4.24 Biconcavity in the stems of the right n prevents optical convexity as shown in the left n.

Figure A4.24 shows the n's of Times New Roman (left) and DTL Haarlemmer (right). The stems of the Times New Roman's n are straight and not only are the connections of the serifs optically imperfect, but the connection of the arch with the right stem does not look very smooth either. In the n of DTL Haarlemmer the stems are biconcave and the arc-connections more fluent.

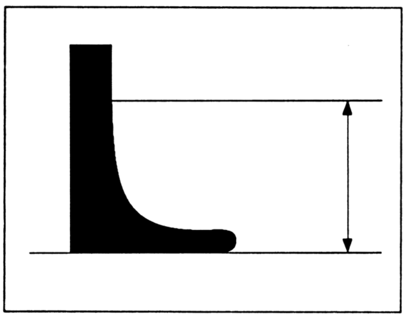


Figure A4.25 Defining the height ('serif leg') of the serif.[329]

In case of an abrupt connection the vertical origin (the height) of the serif can be easily defined. In case of a fluent transition of the stem into the serif, this is much more difficult. In case of biconcave stems one could theoretically state that the serif starts in the centre of the stem and that there actually is no stem, only serifs. In

[329] Karow, *Typeface Statistics*, p.56.

Typeface Statistics the height of serifs (called 'serif leg') is measured, but 'there is also a certain arbitrariness in the selection of the position to measure for the height of the serif leg.'[330] The starting point is defined by vertically descending the stem 'down to a height at which the vertical stem becomes a certain amount thicker.' This seems to be impossible with biconcave stems.

A4.8 Serif structures: flexible-pointed pen

Around the beginning of the eighteenth century the broad nib was generally replaced by the pointed pen. Because of the lack of weight in the horizontal parts of the letters, such as in the arches, the serifs were diminished to (almost) horizontal thin strokes. It is possible to put some weight in the arches by putting pressure on the pen at the top, as is shown in the types of for instance Baskerville. As a consequence the serifs still have an angle. In the types of Bodoni the weight disappeared from the arches, and the angle of the serifs became zero.

If the contrast is lowered in flexible-pointed pen letters like those of Bodoni, the angle of the serifs remains the same. The contrast can be lowered until the serifs become optically as thick as the stems, and the result will be a slab serif or Egyptian, just as is the case with broad-nib letters (Figure A4.22). In the case of slab serifs the contrast sort cannot be distilled anymore from the shape of the serifs because the serifs will be identical for letters that find their origin in broad-nib and flexible-pointed pen letters.

A4.9 Polyform and Monoform

In its simplest form a serif is a monoform, either a rectangle (flexible-pointed pen or slab serif) or a triangle (broad nib), as shown in Figure A4.25. As soon as the contrast of broad-nib letters is lowered, the serifs become polyform, because the lower contrast is represented by a rectangle on which the triangle is stacked. If the contrast is further decreased, at the end the serif always becomes a rectangle, i.e., monoform, irrespective of the contrast sort.

[330] Ibid., p.56.

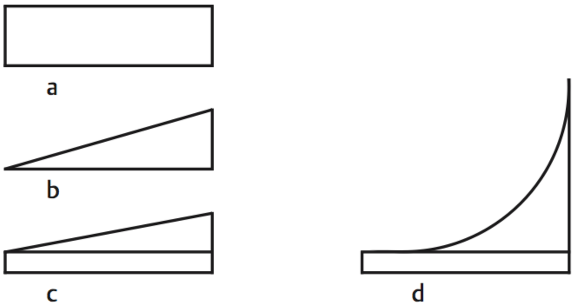


Figure A4.25 Variants a and b are monoform; c and d are polyform.

Serifs emphasize the ending of a stroke, represent the contrast and are an indication of the contrast-sort and contrast flow. Subsequently the shape, talus-angle, weight and contrast of a serif have a direct relation with the shape, applied pen-angle, weight and contrast in the other parts of letters. One could state that the DNA of a typeface can be distilled from the serifs and that subsequently a complete typeface can be built using the proportional system. This on the condition that the designer of the typeface applied serifs according to the structures described above, of course.

This may sound slightly abstract, but the serif-lengths are an indication of the size of the counters and from the applied angle in the top or bottom serif the pen-angle can be distilled. A horizontal serif will indicate that there is no weight difference between the arches and the stems; the only two possibilities are pointed pen-based letters with any possible contrast or slab-serif versions of broad nib-based letters. As soon as the brackets show an angle, the weight in the arches increases.

The stem thickness can be approximately distilled from the pen angle. The bolder the broad nib-based typeface, the steeper the angle will be. In case of flexible-pointed pen letters, the distilling of the stem thickness is more complex, because the horizontal serifs can be applied on both regular and bold letters (and everything in between).

As soon as there is a definition (distilled from a serif) of stems, arches, and counters, harmonic models can be used to define the proportions of the other letters, using the same contrast, contrast sort, and contrast flow.

A4.10 Serifs and spacing

The basic principle of an equal division of space between all letters is the result of the transition from an originally calligraphic system to a typographic mechanism. As lecturer at the KABK I have been in the position of experimenting with different approaches in educating rhythm and spacing. One of the things I have noticed is that explaining the fact that the space between the letters should be equal to the space within the letters does not help students very much when they start writing with a broad nib. One needs to provide a mechanism which forces the students in this rhythm, and in the case of the Latin bookhand minuscule the rhythm/spacing can be largely controlled by the length of the stroke-endings (feet).

The length of serifs is not an arbitrary matter, but a letter width-related factor. In other words, by defining the stem interval within the letters, the lengths of the serifs are a natural result of the stem interval. The stem interval between the letters is normally supposed to be (almost) equal to the width of the counters. Short serifs will cover less space and will result in a tighter spacing, which is basically an obstruction of the rhythm when the width of the counters exceeds the stem interval –a phenomenon that in my opinion makes sans serifs, for instance, by definition more irregular.

Goudy refers in *The Alphabet* to the relation between the lengths of the serifs and the stem intervals when he describes the harmonious quality of Jenson's pages:

> Every letter stands on solid serifs of unusual shape, so planned as to make each letter form coterminous with its type body while maintaining enough white space to set each letter off from its neighbor & preserve to the greatest degree the unity of the word formed by the separate characters. This permits close spacing of words and avoids loose composition.[331]

A4.11 Serif lengths, heights, and thickness

The length of the triangular top serif and hence the length of the bottom serifs of the lowercase of roman type are theoretically directly related to the weight and contrast flow of the arches. The length is a direct result of the applied vector and vector angle. In practice the type designer can deviate from this scheme, for instance because of spacing preferences. In addition for condensed, expanded, light or bold variants (or any combinations of these), which are essentially anomalies, type designers have to adapt the 'rules'. By definition, the clipping of serifs inside the counters or between the letters has to be prevented. There should be enough space dividing the serifs to leave a visible gap between them, especially on small point sizes.

[331] Goudy, *The Alphabet*, p.97.

Figure A4.26 Equal thickness of capital and lowercase serifs (DTL Haarlemmer).

The serifs for capitals in roman type are based on those for the lowercase, and although the counters of the capital letters are much larger than those of the lowercase, the serifs cannot be made longer because this would ruin the spacing with the lowercase. Although not a rule, capital serifs are usually made slightly longer than the lowercase serifs, as the distance to the lowercase is usually also made slightly greater than between the lowercase letters. Furthermore, the brackets of the capital serifs can be made steeper to give the serifs more weight. The capital serif-thickness is usually made the same as those of the lowercase serifs (Figure A4.26), to make the combinations with the lowercase serifs consistent. However, some type designers make the serif-endings of capital letters thicker (Figure A4.27), for instance because all the thin parts in capitals are by definition thicker too than those of the lowercase letters (as are the thick parts).

Figure A4.27 Different thickness of capital and lowercase serifs (Adobe Caslon Pro).

In *Typeface Statistics* the lengths, heights (called 'leg') and thickness (called 'foot') of measured 'roman typefaces' are brought together into statistics. According to the measurements the 'average' serif has the proportions in percentage of the cap height as shown in Figure A4.27. On the left the average capital serif is shown, and on the right the lowercase serif. Obviously the measured relation was unexpected: 'length and height of leg are not at all correlated! That is amazing. The height of the foot and leg are correlated of course, but by no means as strongly as we had expected.'[332]

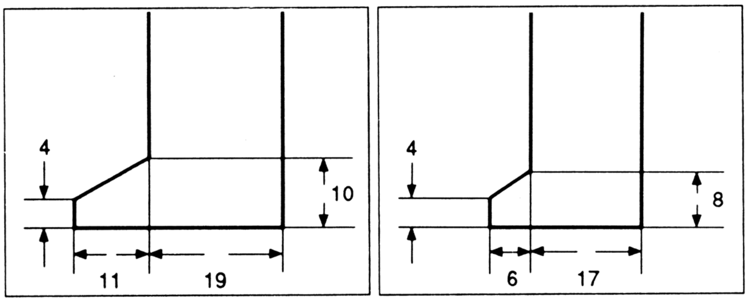


Figure A4.28 Serif proportions in relation to the cap height (in percentages).[333]

A4.12 Classifications

Size, details, weight, contrast and contrast flow are a number of elements in type that can be classified. Before standardised point systems (Didot, Pica) were used, the size of letters was indicated by regionally used names. In the Netherlands for instance 'Augustijn' stood for (what later became) twelve Didot points, 'Ascendonica' for eighteen Didot points, and 'Groot Canon' for thirty-six Didot points. The naming differed per country; for instance Ascendonica was named 'Ascendonica Romain' in France and 'Double Pica' in England.[334]

When there are only limited variants of type in use, such as roman, italic and gothic, there is not much need to classify type based on details. The name of the punchcutter was sometimes was used in addition to the size-name. For instance the Konrad Berner type specimen (Frankfurt, 1592) shows names like 'Romain Parangon de Garamond' and 'Cursiff Parangon de Granjon'. This sort of naming was also practised at Plantin's firm: 'The fact that the name of the French type-cutter Claude Garamond, who died in 1561, was given to one of the founts is another indication that the nomenclature was a recent innovation [...].'[335]

De Vinne explains the need for detailed classifications later on in history in *The practice of typography* as follows:

---

[332] Karow, *Typeface Statistics*, p.243.
[333] Ibid., p.243.
[334] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.16.
[335] Ibid., p55.

> When the faces of text-types were limited to roman, italic, and blackletter, one or two words described the size, or body, and another word defined the face. The multiplication of faces now compels founders to make names longer and more descriptive. The features are usually given in this order: (1) The body or size of the type, as "Pica." (2) The style or face of the type, as "Pica gothic." (3) The ornament or fashion of the type, as "Pica gothic ornamented." (4) The shape of the type, as "Pica gothic ornamented condensed."[336]

Type can be classified by its various details. These details are related to the time, i.e., style periods, in which type was produced. Certain stylistic details, like proportions, were considered to be specific for a country, such as the 'Dutch taste': 'The "Romain du Roi" was strictly reserved to the imprimerie Royale; Fleischman's Romans and Italics had Europe before them. The Paris trade, therefore, was bound to take notice of the "Goût Hollandais".'[337]

Since the early twentieth century several attempts have been made to come to a classification of type based on details. This has resulted, for example, in the German DIN 16518 classification (similar to the Eastern-German TGL 10-020 classification), one by Maximilian Vox and one by Aldo Novarese. According to Kapr, these classifications 'largely agree' [...] 'All four systems are organized to the graphic characteristics of the typeface, the form of the serifs, the contrast between main strokes and hairlines and the shadow axis of the curves.'[338] This results in vague descriptions such as for 'Old Face' (or named 'Humanes' in Vox's classification, 'Lapidary' in Novarese's, and 'Renaissance-Antiqua' in the German ones): '1. Contrasting strokes with oblique stress in the curves. 2. Less difference in thickness between the strokes. 3. Bracketed serifs.'[339] Such descriptions will help (not more) to categorize type, but they do not give any indication about for instance the style period. As Kapr remarks in *The Art of Lettering*: 'The drawback of the classification systems is that no distinction is made between the roman types of the Renaissance period and those of the twentieth century.'[340]

Noordzij, advocating handwriting as the underlying force for typedesign, made a classification based on the contrast and contrast flow originating from writing with the broad nib ('translation') and with the flexible-pointed pen ('expansion'): 'Contrast is governed by the techniques of handwriting, but it may be modified in design.

---

[336] De Vinne, *The Practice of Typography*, p.53.
[337] Morison, *Letter Forms*, p.35.
[338] Kapr, *The Art of Lettering*, p.325.
[339] Ibid., p.326.
[340] Ibid., p.325.

A range of drawings with gradually increased and reduced contrast reveals all the possibilities of typedesign.'[341] Noordzij's theories eventually culminated in his cube.

Noordzij's models also will not help to identify the style period in which the typeface was made. Like the aforementioned classifications by Kapr, Noordzij's will not help to describe the hand of a specific punchcutter or type designer either. In Appendix 9, *Systems and models in type* I describe a range of models deriving from the underlying structures and patterns of type, such as the harmonic system, harmonic model, proportional model and rhythmic model. The purpose of these systems and models is to describe all underlying structures and patterns of roman and italic type, which makes it possible to describe the details of a style period, together with the details of the punchcutter's hand on top of these. Hence, these will make classification easier.

A4.13 Rotating counter

In the former section Kapr's classification of 'Old Style': 'contrasting strokes with oblique stress in the curves' is quoted. This definition excludes the roman type from the seventeenth century, which in origin is broad-nib based like its precursors but in which the 'oblique stress in the curves' is suppressed. A vertically-stressed counter does not mean by definition that the letters are based on the flexible-pointed pen.

Figure A4.29 Erroneous approach of formalised broad-nib and flexible-pointed pen letters.[342]

Figure A4.29 shows 'two different styles of Roman minuscules', from a 'thorough, practical guide to the art of hand-lettering' by Helm Wotzkow, who is described in the publisher's note as a highly skilful letterer and designer. Wotzkow writes: 'The first (left) letter of each pair naturally belongs to the same alphabet – see the "plume"

[341] Noordzij, 'A Program for Teaching Letterforms', p.86.
[342] Helm Wotzkow, *The Art of Hand Lettering* (New York: Dover Publications, 1967), p.108.

form – and the second to the "drawn" form.'[343] A rotated circle with vertically expanding strokes mistakenly represents here the 'plume' (broad nib) form. The 'drawn' form actually shows a variant as can be written with a flexible-pointed pen, unexpectedly combined with curved brackets. Interestingly, Wotzkow correctly combined the lack of weight on top of the 'drawn' bowls with a horizontal serif. The overall wrong interpretation of the effects of the broad nib and flexible-pointed pen in Wotzkow's illustration are representative of many publications on type and lettering.

Figure A4.30 Correct approach of formalised broad-nib and flexible-pointed pen letters.

Figure A4.30 shows a correct representation I made of formalised broad nib and flexible-pointed pen letters. The top of the bowl of the p on the left clearly shows the vector, which results in much more weight in the arch than in Wotzkow's example. The right p shows a completely different construction of the bowl in comparison with the p on the left.

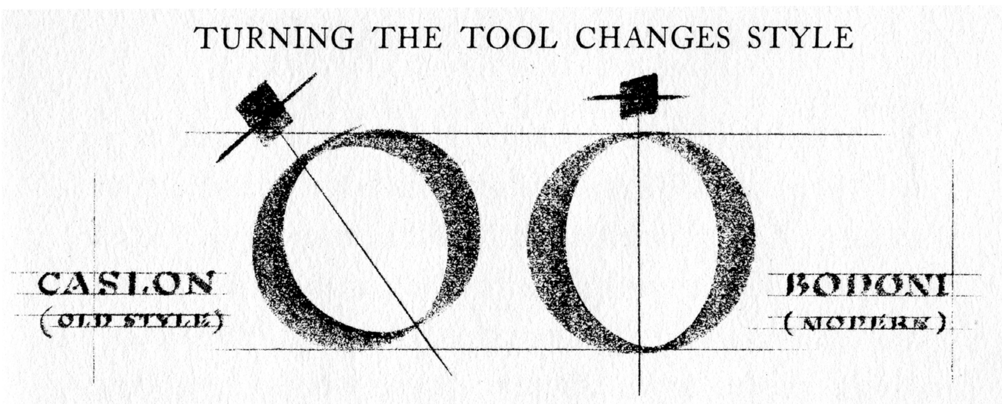


Figure A4.31 Erroneous explanation of contrast-flow in broad-nib and flexible-pointed pen letters.

---

343 Wotzkow, *The Art of Hand Lettering*, p.108.

Figure A4.31 shows 'the notable difference between a classic type and a modern type' according to Tommy Thompson in *How to Render Roman letter Forms*. Thompson erroneously explains the difference in contrast flow between the broad nib-based type of Caslon and the flexible-pointed pen-based type of Bodoni as 'the result of the tool being held in the different positions necessary to render them' and he subsequently draws the 'Bodoni' o with a broad nib. In Thompson's opinion, the rotation of the counter was the only difference between 'classic type', i.e., 'old style' and 'modern' type.

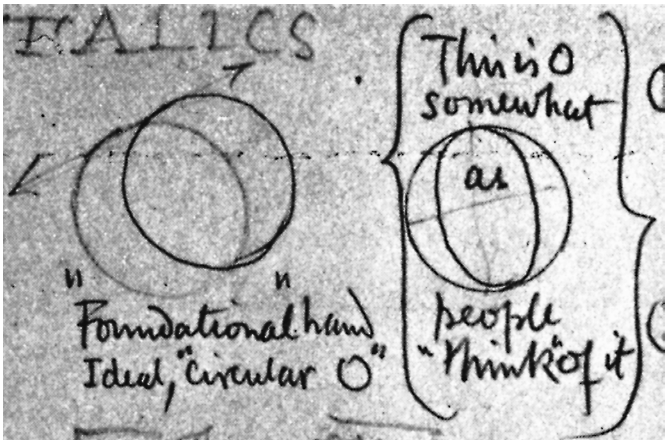


Figure A4.32 Notes from the early 1930s by Johnston on the shape of the o.[344]

The rotated o with vertically applied weight already appears in the roman type from the Renaissance and has nothing to do with the flexible-pointed pen (which became popular a couple of centuries later) as such. The written almond-shaped counter of the o as a result of translated circles (or ellipses) is difficult to retain in a drawn variant and was soon replaced by the Renaissance punchcutters and their followers by a circle (which is by definition smaller than the two translated circles) with a vertical stressing of the weight.

Johnston described the single-circled o as a (mis)interpretation of the 'circular O' (Figure A4.32). One can further read in his notes from the early 1930s: 'This is O somewhat as people "think" of it'. The explanation for the fact that the newly created o was still rotated to a certain extent like the written origin can be found in the rotated ('oblique') counters of the b, d, p and q and the related effect in the e.

[344] Johnston, *Formal Penmanship and Other Papers*, p.160.

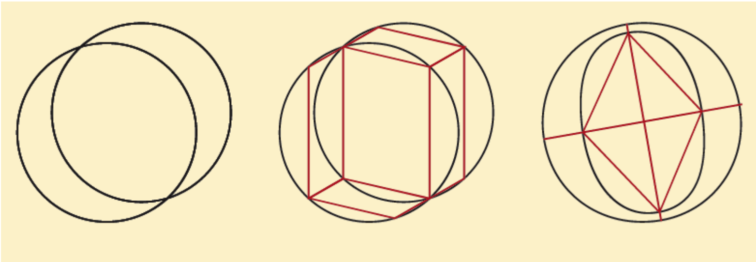


Figure A4.33 The construction of multiple-circled and single-circled o's differ.

The difference in construction between multiple-circled and single-circled o's is shown in Figure A4.33, which is an enhanced version I made based on Johnston's aforementioned drawing. The counter of the translated circular o can be schematically represented by a parallelogram (centre of the figure), and the counter of the single-circled o as a lozenge (right). The optical angle of the counter of the translated circular o is steeper that the one in the counter of the single-circled o. The more horizontal shorter sides of the parallelogram prevent the translated circular o from tumbling to the left. Especially in the seventeenth-century roman type appears in which the counter of the o is no longer rotated, like in the work of Van Dijck and Nicolas Kis.

Figure A4.34 Gradual rotation of the 'eye' of the e.

At a much earlier stage the small counter ('eye') of the e was rotated, which resulted in a horizontal bar. The design of the e in Jenson's type still sticks to the handwritten form as much as possible, but Griffo's type and that of his followers showed a counter as presented on the right in Figure A4.34.

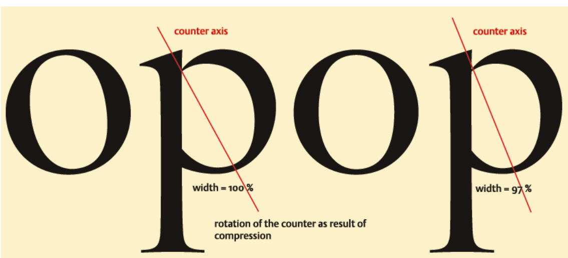


Figure A4.35 Counter rotation as an effect of compression.

Especially the curvilinear letters like b, c, d, e, o, p, and q became more condensed in relation to perpendicular ones in the roman type in the eighteenth century, as result of the 'Dutch style' ('Goût Hollandais'). The effect of this compression is that the counter angles rotate clockwise and as a result the counter looks more vertically stressed (Figure A4.35). The rotation of the counter was followed in the o, of course. This effect was even more applied in the capitals from the seventeenth century, anticipating the later transition from 'old style' to 'modern' type. The suppression of the 'backward tilt to the elliptical counters of curved letters like o' is described by Charles Bigelow as follows: 'As the roman typeface evolved, this virtual angle was flattened and the weights made more balanced.'[345]

According to the hierarchical relation between the space within the letters and the space between the lines, the compression of the 'Dutch style' letterforms in the eighteenth century resulted in shorter ascenders and descenders.

A4.14 Idiom

The signature or recognizable stylistic idiom in the work of type designers can be best described as a personalization of the conventional patterns and structures, or sometimes even as a deviation from the latter. To visually recognize these characteristic and often repetitive patterns, i.e., to identify the hand of a specific type designer, may not be too difficult for the trained eye, but to describe them is much more complex. One can compare the type designs from one hand with those of other type designers, but even then the result will not be much more than a description of deviations. During presentations in the 1980s Adrian Frutiger presented an average image of his typefaces by overlaying transparent sheets containing characters from a couple of his type designs (also shown in *While You're Reading*).[346] This average image showed Frutiger's personalized pattern.

In an article on typefaces by Frutiger, Charles Bigelow wrote: '[…] the interplay of created forms can reveal the personal style of an original designer, if not as an unvarying theme, then as a pattern of family resemblances.'[347] Bigelow also underlines the repetition of personalized patterns: 'Just as individual members of the human species may differ in musculature, proportion, clothing and complexion, but

345 Charles Bigelow, 'Philosophies of Form in Seriffed Typefaces of Adrian Frutiger', *Fine Print on Type*, (London: Lund Humphries, 1989), pp.140–143 (p.143)

346 Unger, *While You're Reading*, p.83.

347 Bigelow, 'Philosophies of Form in Seriffed Typefaces of Adrian Frutiger', p.140.

are alike in possessing a similarly articulated skeleton, so the type designs of Frutiger often share a similar internal architecture.'[348]

The first characteristic of a type designer's idiom is formed by the proportions of his letters. These proportions can be completely new, resulting in a unique framework in combination with one or more proportional models. In the world of book type the 'Garamond model' is mostly applied, which actually means that the proportions of Jenson's and Griffo's roman types are dominant still. Morison writes on Griffo's influence:

> Notwithstanding, it is obvious that the types of both the Aetna and the Polifilo are varieties of the same design. It was destined to have a lasting effect on the trade. Garamond and Granjon accepted it as their prototype; it was their romans, absolutely faithful to the Aldine, that set the style for Van Dijck, and were set by him for Caslon.[349]

Van Dijck for instance based his roman type on Garamont's, and type attributed to him formed the basis of Van Krimpen's Romanée from 1928, which was adapted in the last quarter of the twentieth century by Bram de Does for his Trinité. [350] The proportions of Dutch seventeenth-century type were also used by Gerard Unger for his Hollander type (1983); it 'was to some extent modeled on types attributed to Christoffel van Dijck or Dirk Voskens in that it adopts their generous proportions.'[351]

How difficult it is to describe differences within a certain idiom is proven by Vervliet's description of the details in Garamont's, Granjon's and Van den Keere's type: 'Few Romans are so nearly alike as those cut by these three men. [...] so far nobody has found a clear and constant criterion for telling the Romans of Garamont, Granjon and van den Keere apart.'[352] Vervliet proceeds with describing the differences, like 'Garamont's e finished lower than the others' and 'Van den Keere's b d p q have a slightly backward-tilted counter.'[353]

---

[348] Ibid., p.140.

[349] Morison, *A Tally of Types*, p.49.

[350] Jan van Krimpen, *On Designing and Devising Type* (New York: The Typophiles, 1957), p.41 and Huib van Krimpen, *Boek: over het maken van boeken* (Veenendaal: Gaade Uitgevers, 1986), p.284.

[351] <http://www.gerardunger.com/allmytypedesigns/allmytypedesigns06.html>

[352] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.65.

[353] Ibid., p.66.

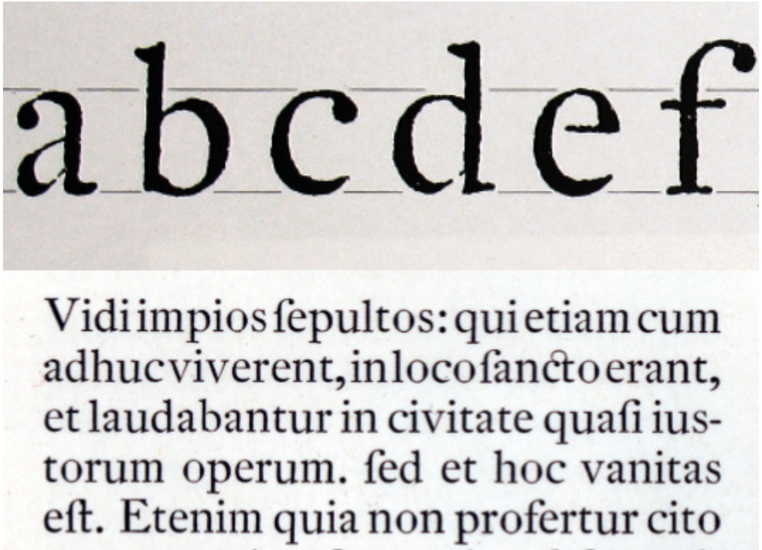


Figure A4.36 Type cut by Johann Michael Fleischmann.

The changes applied by Garamont on the models of Griffo, and by Van Dijck on the models of Garamont, and by William Caslon on the models of Van Dijck are relatively small. The details Johann Michael Fleischmann introduced in the eighteenth century deviated much more and were more abundant. Fleischmann was perhaps more of what we nowadays consider to be a type designer than his predecessors, who were craftsmen first. According to Morison, Fleischmann's designs represent 'the first personal, individualist interpretation of Roman and Italic.'[139]

Fleischmann's typefaces are transitional; they contain elements from writing with the broad nib and with the flexible-pointed pen. The letterforms are clearly late Baroque and predict the gallant style of the Rococo. With the emphasized serifs and teardropped terminals Fleischmann clearly personalized his type and he did this in such a controlled and delicate manner that at text sizes the details are not hampering the homogeneity. Large point sizes reveal Fleischmann's enriching display-like details and how the progression of the details results in a very harmonious grouping of the letters in words.

APPENDIX 5: DETAILS OF THE RENAISSANCE TYPE PRODUCTION

A5.1 Introduction

This appendix is supplemental to Chapter 6 and is referred to in the Sections 6.3 and 6.5. It provides additional information on the production of type in the sixteenth century, and the related standardisation and systematisation of matrices.

A5.2 Production of matrices

Standardisation of the parts of type production is inevitable when the production becomes more professional. In the early days of typography the punchcutters also produced the matrices and even cast type. However,

> By the end of the fifteenth century [...] specialization had begun to develop and professional punch-cutters and type-founders appeared. [...] there were already type-founders in the sixteenth century who hardly ever created their own type designs but were content to work with matrices prepared by their more skilful colleagues.[354]

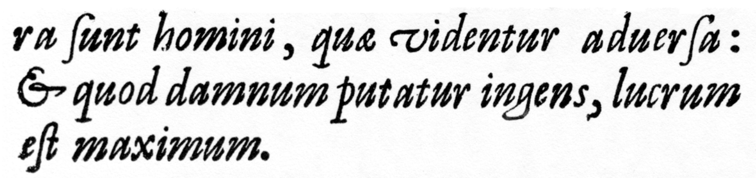

ra ſunt homini, quæ videntur aduerſa:
& quod damnum putatur ingens, lucrum
eſt maximum.

Figure A5.1 Granjon's Ascendonica Cursive in print.[355]

One can imagine that the placement of the punches on the matrices was done empirically. In his *Manuel Typographique* Fournier explains that, after polishing the matrix, the place where the punch should be struck is marked: the exact place of the strike is empirically and gradually found.[356] In *Counterpunch* Smeijers suggests that in the sixteenth century the punch was struck in '[...] a lump of copper with one or two flat sides. Somewhere in this lump there floats a character. Justification in all directions was necessary.'[357] This looks to me much more complex than Fournier's method, in which the *exact place* of the strike is determined, and the statement is in contradiction with the standardisations I found in Garamont's matrices, as described in Chapter 6.

---

354 Voet, *The Golden Compasses*, Vol.2, p.64.

355 Vervliet and Carter, *Type Specimen Facsimiles* 2, Plantin's Folio Specimen, no.10.

356 Carter, *Fournier on Typefounding*, pp.82,83.

357 Fred Smeijers, *Counterpunch* (London, 1996) p.120

Figure A5.2 Unjustified matrices of Granjon's Ascendonica Cursive.

The collection of the Museum Plantin-Moretus also contains punches, unjustified matrices (or 'raw strikes'), and justified matrices of Robert Granjon's Ascendonica Cursive (approximately 18 Didot points). This makes it possible to check not only the justified matrices for possible standardisations of widths, but also the unjustified ones. The Ascendonica Cursive was cut in 1570 to Plantin's order and the type seems to have been exclusively used at Plantin's press.[358] Perhaps Plantin purchased these matrices for commercial reasons and maybe he planned to sell them in Frankfurt, but apparently he did not.

Granjon lived from 1513–ca.1590 and was a punchcutter, typefounder and publisher. Like his French countryman and coeval Garamont he ranks amongst the most skilful punchcutters in history. The Ascendonica Cursive has become widely known in our time, because it formed the basis for the italic of ITC Galliard, which was designed by the American type designer Matthew Carter (1937) and released in 1978.

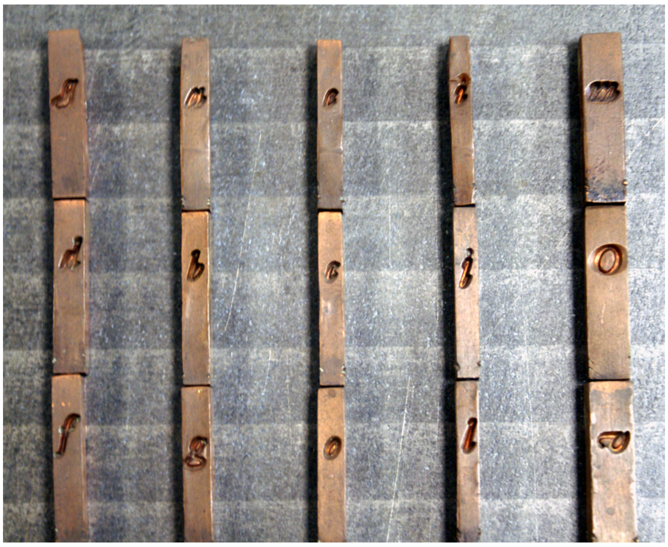


Figure A5.3 Rows of justified matrices of Granjon's Ascendonic Cursive.

[358] Voet, *Inventory of the Plantin-Moretus Museum*, p.56.

Before I measured the widths of the justified matrices, I made rows of matrices to see if I could find the same sort of standardisation of widths that I found in the matrices for Garamont's Gros Canon Romain (Figure A5.3). This was indeed possible. Next I made rows of the unjustified matrices to see if these would also show the same systematisation as the justified ones (Figure A5.4). If so, this would mean that the 'lumps of copper', mentioned by Smeijers in *Counterpunch*, would be easier to justify.

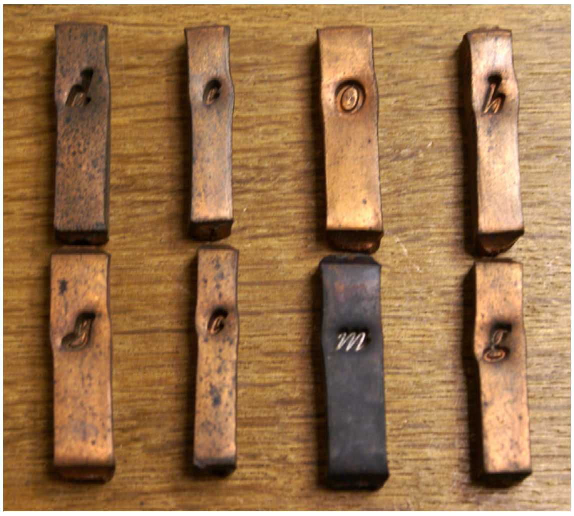


Figure A5.4 Rows of unjustified matrices of Granjon's Ascendonic Cursive.

In his *Manuel Typographique* Fournier writes about the matrices:

> They are small pieces of red copper, from an inch thick, but varying in width according to the nature of the letters [...]. The dealer cuts these plates [red copper] into strips with large shears and the founder beats them out into an equal thickness, but making some wider than others for matrices of different widths.[359]

The endings of the unjustified matrices of the Ascendonica Cursive look as these have been prepared with chisel cuts for separation by hand (Figure A5.5). The strings of copper were precut like chocolate bars. Different letters that shared the same character widths could be struck into the standardised strings and the matrices could be disjointed afterwards.

Figure A5.5 Raw matrices that look like the strikes were made in pre-cut copper bars.

[359] Carter, *Fournier on Typefounding*, p.81.

The standardisation of character widths in combination with the standardisation of the widths of the copper strings must have made the justification of the matrices easier when the strikes were exactly positioned. In *Fournier on Type Founding* Carter mentions the later use of '"a striking", in which the punch is held firmly and upright whilst a screw, acting upon the top, presses it gradually into the copper. A vernier scale shows the depth to which the punch has been driven. This puts less strain on the punch than a hammer.'[360] One can imagine that a striking press makes the exact placement of the punch of the matrix easier. When exactly the use of the striking press for the production of matrices started seems to be unclear. In the catalogue of the 1963 exhibition *Printing and the Mind of Man* at the British Museum one can read in a short note on the striking press that 'Until recent times punches were struck into copper with a hammer.'[361] Therefore it is unlikely that the Renaissance punchcutters used such a tool.

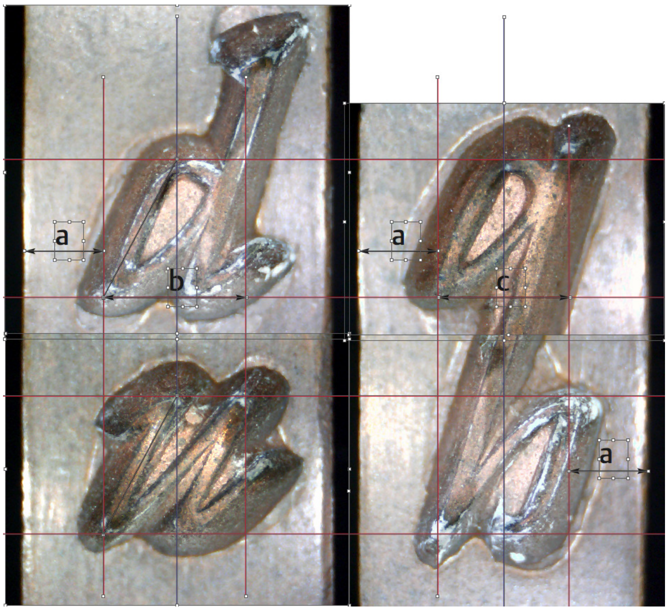


Figure A5.6 Positioning of the strikes on the matrices of the Ascendonica Cursive.

The positioning of the strikes on the matrices of the Ascendonica Cursive (Figure A5.6) is as perfect as that of the matrices of the twice as large Gros Canon Romain of Garamont.

[360] Ibid., p.84.

[361] Nicolas Barker et al., *Printing and the Mind of Man* (London: F. W. Bridges & Sons, 1963), p.20.

Figure A5.7 Excrescences on the sides of the matrices of the Ascendonica Cursive.

Small cuts can be found on the sides of the justified matrices of Garamont, Van den Keere, and Granjon (Figure A5.7). The matrices are not always equally wide everywhere, but placed in the mould they seem to be perfectly perpendicular. The excrescences were used to correct the widths of the matrices to make standardised casting possible. When too much was removed from the side of a matrix, a little sharp chisel was driven into it to raise small excrescences in the copper.[362]

A5.3 Tricks and trade secrets

The placement of the strikes on the matrices from Garamont, Granjon, and Van den Keere, is remarkably precise. Furthermore, the letters seem to fit perfectly on the derived cadence-units, as described in chapter 6. The Renaissance punchcutters were probably technically more advanced than has been assumed so far. Unfortunately here is no documentation on this subject dating from the times of Jenson, Griffo and Garamont.

[362] Carter, *Fournier on Typefounding*, p.94.

Figure A5.8 Rädisch cutting punches at Joh. Enschedé en Zonen in 1951.[363]

Craftsmen use tricks to ease their tasks and often also keep these tricks secret. Paul Helmuth Rädisch (1891–1976), the punchcutter who worked closely together with Van Krimpen at Joh. Enschedé en Zonen (Figure A5.8), revealed in his autobiography a 'trick' he used to transfer the drawings by Van Krimpen to his punches. This is probably generally unknown because only 135 copies of the book *A tot Z* were produced (in Dutch) He describes that first a photo in the right size was made of Van Krimpen's drawings. He used etching on red copper (first he used zinc, but this was not precise enough) to get a good image to subsequently make a soot impression from. This impression was used to transfer the letter to a punch using transparant plastic.[364] Rädisch suggests that this technique was his idea, but it is likely that photographic gravure (probably autotype or heliogravure) was already applied in the same way for the production of type in Germany. In 1952 in Germany a film on how movable type was produced at that time was released together with a small booklet.[365] Film and booklet show exactly the process described by Rädisch (Figure A5.9).

[363] Dreyfus, *The Work of Jan van Krimpen*, p.143.

[364] Paul Helmuth Rädisch, *A tot Z: een autobiografie van P.H. Rädisch, staalstempelsnijder* (Haarlem: De Priegelboekerij, 1979), p.46.

[365] Martin Hermersdorf, *Wie ein Druckbuchstabe entsteht* (Seebruck am Chiemsee: Heering-Verlag, 1952).

Figure A5.9 Frame from *Wie ein Druckbuchstabe entsteht.*

In an article in *Fine Print on Type* Stan Nelson describes a related method that he used for the production process of punches for Anglo-Saxon characters to be used with Van Krimpen's Romanée: 'One letter was transferred from a sample Romanée type to the polished face of the punch by offsetting a soot impression onto a thin coating of slightly tacky varnish. After the soot transfer the character was outlined on the steel punch with the scribe and it was ready for cutting.'[366] In September 2009 a YouTube video was uploaded in which Stan Nelson demonstrates this process using the capital R from ATF Garamond (Figures A.10–11). [367]

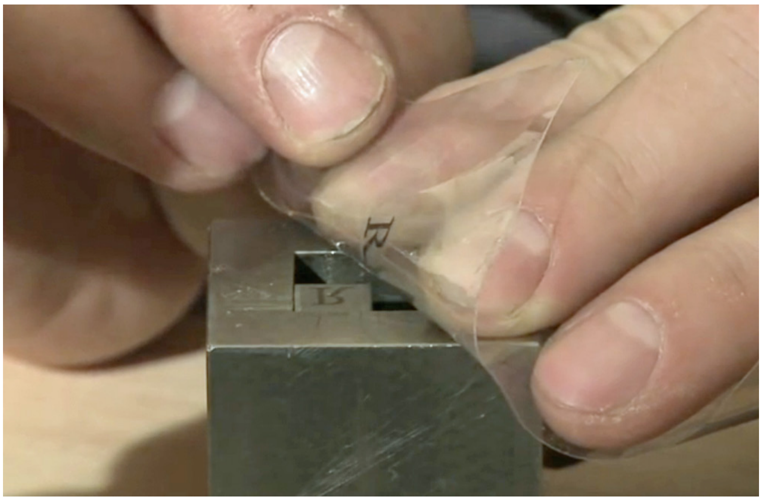


Figure A5.10 The soot transfer to the polished face of the punch by Nelson.

[366] Stan Nelson, 'Cutting Anglo-Saxon Sorts', *Fine Print on Type*, (London: Humphries, 1989), pp. 117–118 (p.118).

[367] <https://www.youtube.com/watch?v=eExllUeGtvc>

Figure A5.11 Magnified image of the newly cut capital R from ATF Garamond by Nelson.

Proportions and details of different historical foundry type, like those of Garamont's and Van den Keere's Parangon Roman, can be so much alike that one expects that special methods were used to transfer the image of existing type to punches, like the one Nelson describes and demonstrates. Initial standardisations required to control the early Renaissance production can in this way simply be copied without knowledge of (the basis for) the standardisation. Vellum can be made transparent for this purpose and in later times there was even a patent granted for a method to acquire the transparency.[368]

A5.4 Emperical testing

At the Museum Plantin-Moretus in Antwerp (December 2010 and January/February 2011) I measured the Gros Canon Romain from Garamont and its sibling the Moyen Canon Romain from Van den Keere using a digital calliper
(Figure A5.12). From both typefaces printed material, original movable type, and matrices are present in the inventory of the museum. I also measured the Ascendonica Cursive cut by Granjon. In May 2012 I investigated standardisations in matrices of Van den Keere's Canon Flamande and Parangonne Flamande.

[368] <http://cool.conservation-us.org/don/dt/dt2487.html>

Figure A5.12 Digital calliper with Renaissance foundry type.

The best way to test my theory on the need of one set letter per group of letters with the same width, like I found in the Renaissance Gros Canon Romain type, was to cast a number of letters using the original matrices from Garamont and Van den Keere.

On Tuesday 11 January 2011, Hutsebaut, the technical expert at the Museum Plantin-Moretus, and I cast type directly from Garamont's matrices for his Gros Canon Romain, and from Van den Keere's matrices for his related Moyen Canon Romain at the Museum Plantin-Moretus in Antwerp. Type was cast with a limited number of register settings adjusting to groups of matrices.[369] Hutsebaut used one of the 200 moulds from the inventory of the Brussels' type foundry Vanderborght (Figure A5.13), which were acquired by the museum in 1956. The mould in question probably dates from the nineteenth century and was perfectly suitable for the Moyen Canon Romain from Van den Keere; therefore the body was slightly too small (approximately six Didot points) for Garamont's larger type. To test the (standardisation of the) width of the letters, however, this mould was perfectly suitable.

On Wednesday 28 August 2013 Hutsebaut and I tested (again) my theory on the systematisation of the Renaissance font production, culminating in the standardisation of character widths in matrices. This time type was cast from Garamont's Gros Canon Romain lowercase using one fixed setting for the mould's registers using a sixteenth-century mould from Van den Keere.[370]

369 <http://www.youtube.com/watch?v=81ZrfbratSc>

370 <http://www.youtube.com/watch?v=tZKQslge32Y>

On Wednesday 17 June 2015 my Expert class Type design lesson was dedicated to measurements and casting from the matrices of Van den Keere's Gros Canon Romain (1573), which is presented as Canon Romain in the *Folio Specimen* from ca.1580, and Van den Keere's Canon d'Espaigne (1574), which is also shown in aforenamed specimen.

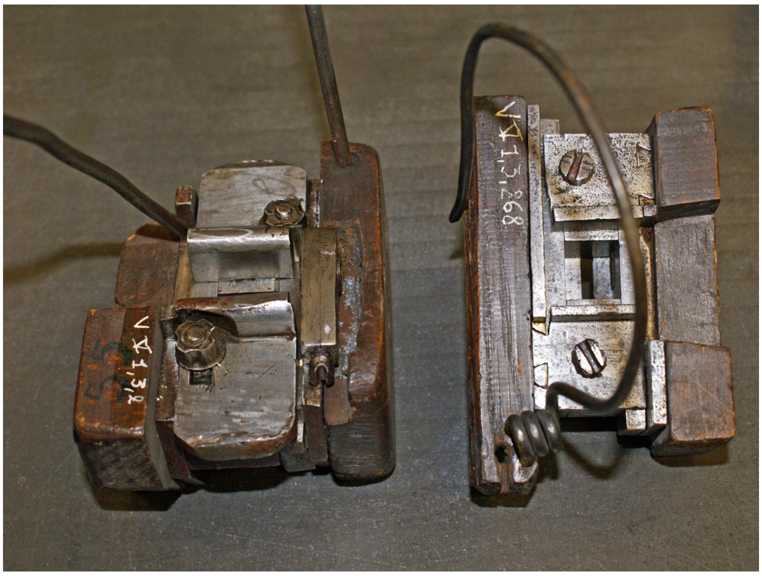


Figure A5.13 Nineteenth-century moulds from the VanderBorght foundry.

During the three sessions Hutsebaut used an alloy named MCP 37, which consists of 54% bismuth and 46% tin (this alloy is stable with 48–55% bismuth; below these percentages the metal shrinks and above it expands. The melting point is 137 degrees and Hutsebaut cast the type at 220–240 degrees. Bismuth has been known since antiquity and was until the eighteenth century often confused with lead and tin, which have more or less the same physical properties. However, bismuth is a heavy metal, which is less toxic than lead and tin.

At Plantin's printing office in about 1580 an alloy was used that contained 82% lead, 9% tin, 6% antimony, and for the rest copper. In the twentieth century a different alloy was used for foundry type: 60% lead, 15% tin, 25% antimony, and a trace of copper.[371]

[371] Lawson, *Anatomy of a Typeface*, p.389.

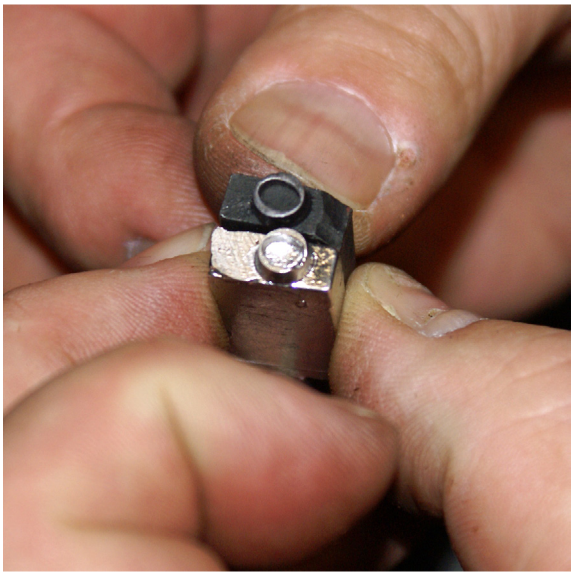


Figure A5.14 Newly cast o of the Gros Canon Romain compared with original foundry (top).

A sixteenth-century cast o of the Gros Canon Romain was used as set pattern and a range of letters from the same width-group (Garamont: g, n, o, q, and Van den Keere: d) were cast. The newly produced type seems indeed to prove that standardised matrices make casting easy.

A5.5 Measurement results

In this section the resulting values of the measurements of Renaissance matrices and foundry type are presented. The measurements were made with a digital calliper.

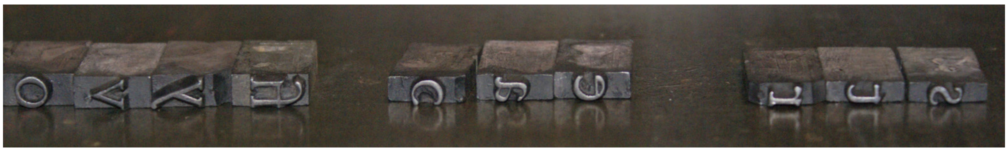


Figure A5.15 Historic foundry type: Garamont's / Van den Keere's Moyen Canon Romain.

Foundry type (sixteenth-century): Moyen Canon Romain (Garamont / Van den Keere) from the inventory of the Museum Plantin-Moretus (Figure A5.15):

(measurements in millimetres)

A	–	a	4,43	Æ	–
B	–	b	5,03	Œ	–
C	–	c	4,38	æ	–
D	8,58	d	4,9	œ	–
E	–	e	4,43	fi	5,19
F	–	f	2,24	fl	–
G	–	g	5.46/5.2	1	3,37
H	–	h	5,45	2	4,1
I	–	i	2,29	3	3,67
J	–	j	2.35/2.29	4	4,37
K	–	k	5,9	5	3,58
L	–	l	2.26/7	6	4,62
M	–	m	8,85	7	5,53
N	–	n	5,45	8	4,32
O	8,66	o	5.32/5.27	9	4,22
P	–	p	5,24	0	5,03
Q	–	q	–	!	–
R	–	r	3,75	?	–
S	–	s	3,4	-	–
T	–	t	3,52	.	–
U	–	u	5,29	,	–
V	–	v	5,27	:	–
W	–	w	–	;	–
X	–	x	–	(	–
Y	–	y	5,25	[	–
Z	–	z	4,92	{	–

The widths of the old foundry type show deviations of approximately 0.2–0.4 mm if letters are measured that can be placed in rows, as shown in Figure A5.15.Taking this tolerance into account, the letters can be sorted in a limited number of groups, like [a, c, e] [b, d, g, h, n, o, p, q, v, fi] [I, j, l] and [r, s, t].

Figure A5.15 Granjon's Ascendonica Romain MA7 matrices.

Matrices: Ascendonica Cursive (Granjon) from the inventory of the Museum Plantin-Moretus, cat. nr. MA7 (Figure A5.15):

(measurements in millimetres)

A	8.09	a	5.53	Æ	–
B	7.25	b	5.07	Œ	–
C	8.01	c	4.60	æ	–
D	8.51	d	5.74	œ	5.92
E	7.32	e	4.72	as	7.42
F	6.40	f	5.24	ct	6.50
G	7.35	g_spec	5.28	fi	5.28
		g_ita	6.00	fl	5.34
H	8.36	h	5.51	ff	5.38
I	5.51	i	4.21	fr	6.21
J	5.34	j	4.28	ffi	6.62
K	7.94	k	5.25	ffl	6.38
L	7.14	l	4.20	ij	5.37
M	matrix is missing	m	7.47	is	5.96
N	8.35	n	5.78	ll	5.36
O	7.48	o	5.05	lgs_lgs	5.96
P	7.39	p	5.03	lgs_i	5.48
Q	13.60	q	5.52	lgs_l	5.61
R	7.86	r	5.06	lgs_p	6.32
S	5.72	s	4.90	lgs_t	5.72
		long_s	4.71	sp	7.46
T	7.63	t	4.75	st	6.82
U	no matrix made	u	5.71	us	7.21
V	6.91	v	8.00	leave	10.33
W	no matrix made	w	no matrix made	1	5.08
X	8.12	x	5.99	2	5.80
Y	6.45	y	4.81	3	5.01
Z	8.08	z	5.95	4	5.97
Z_swa	6.30	z_swa	5.90	5	5.05
&	9.31	ß	5.62	6	5.56
				7	5.58
				8	5.22
				9	5.64
				0	4.89

The tolerances within the groups of matrices with optically identical widths is comparable with the tolerances measured in the foundry type. In case of the foundry type it is plausible that oxidation processes influenced the widths, but in case of the copper matrices this is less likely. What certainly influenced the measurements, is the way the foundry type and matrices were placed between the jaws of the digital calliper. The Renaissance punchcutter did not use such equipment, of course: the matrices were empirically tested between the registers of the mould. Excrescences, as showed in Figure A5.7, were used to adjust the widths of the matrices. Although theoretically the positioning between the registers and the jaws of the calliper is comparable, the pinching by the registers was definitely more fierce –if only because the measurements were made with the utmost care for the precious matrices.

A6.1 Introduction

This appendix is supplemental to Chapter 7 and is specifically referred to in Section 7.2. It provides additional information on historic grids and unitisations, like those for the Romain du Roi and even earlier by Moxon.

A6.2 Em-and en-square

In the early days of typography the leading was incorporated into the body. In digital type ascenders and descenders can exceed the body without any (physical) problem. Parts are likely to stick outside the em-square in any case, as we see for instance with the diacritics on capitals (there are several entries in digital fonts to preserve the rasterizing of parts outside the em on a screen, or that prevent clipping in some circumstances). Nevertheless, some designers copy the structure of foundry type, just to prevent clipping when zero line spacing is applied.

Present-day digital units are scalable and their size is relative to the bodysize of the type. For example, 10 and 100 point type bodies are both defined by the same number of units, but the units are smaller in case of 10 point. However, when defining the letter contours, the size of the units can be translated into absolute values. In the IKARUS system the units measure 1/100 of a millimetre when an analogue character is either manually digitised or imported via a scanner.

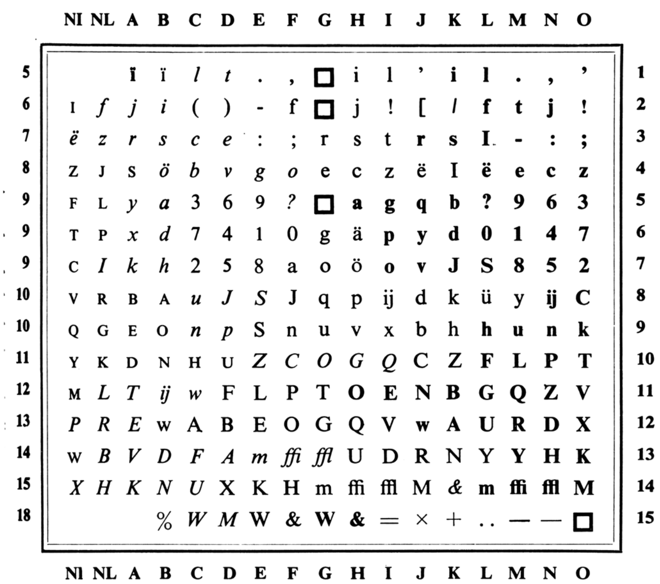


Figure A6.1 Monotype matrix-case arrangement.

In the times of the hot metal and photographic composing machines, the em-square was a rectangle that could be a square, depending on the type design. The proportions were vertically defined by the body size and in horizontal direction by the width of the widest character (normally the M and/or the W). This character width was divided in a certain number of units depending of the system.

The term em-square is especially often connected to the character width of the capital M, which provided the standard for the (division into units of the) em for composing machines. In a manual for operators of the Monotype 'hot metal' composing machines from 1912 one can read that: 'The designer of Monotype faces divides the basic character of the font (the cap M) into eighteen equal parts, using one of these parts as his unit of measurement in determining the width of all the other characters in this font.'[372] However, in Monotype fonts the M is not always the widest letter; in a type family, for instance, the roman M could be placed on fifteen units and the italic M on eighteen units (Figure A6.1). The capital W seems to have been placed by definition on eighteen units and that was obviously part of the original idea: '[…] it was decided that the lower case i, l, full point, etc., could be commonly allotted a thickness of five units, the figures and average letter-thickness nine units, and the capital W, em dash and em quad eighteen units.'[373] The W of for instance Monotype Poliphilus is much wider than the M.

Moxon mentions in *Mechanick Exercises* the 'm Quadrat': '[…] by m thick is meant m Quadrat thick; which is just so thick as the Body is high […]' and mentions n Quadrat as '[…] half as thick as the body is high […].'[374] In *The history and art of printing* from 1771, m and n quadrats and related variants as 'Three to an m' and 'five to an m' are described as blanks used for indenting and spacing.[375] In *An introduction to the study of bibliography* from 1814, the function of the m and n quadrats is described accordingly and further as 'the square of the letter to whatever fount it belong […] n quadrat, is half that size.'[376] Later terms for aforenamed space units are 'em quad' or 'mutton' and 'en quad' or 'nut' space.

For a complete control of the justification of lines, the widths of all characters have to be a multiplication of a standardised unit, like in the Monotype system. This implies that the widths of the spaces should also be part of the same unit

---

[372] *The Monotype System* (Philadelphia: Lanston Monotype Machine Company, 1912), p.22.

[373] R.C. Elliot, 'The "Monotype" from infancy to maturity' *the Monotype Recorder*, No. 243 Vol. XXXI (London: The Monotype Corporation Ltd., 1931), pp.21,24.

[374] Moxon, *Mechanick Exercises*, p.103.

[375] P. Luckombe, *The History and Art of Printing* (London: J. Johnson, 1771), p.278.

[376] Thomas Hartwell Horne, *An Introduction to the Study of Bibliography* (London: T. Cadell and W. Davies, 1814), p.265.

arrangement system: ‘Monotype justification is perfection; the spacing is mathematically accurate and the length of line exact; hand justification can never be perfect […].’[377] However, one can accomplish the same control by applying a unit arrangement system on foundry type, such as cadence-units.

If m and n stood and today em and en stand for the full and half size of the body respectively, where does the term originally come from? In Monotype fonts the M is not always the widest letter, but in Moxon’s engraving in which he ‘[…] exhibited to the World the true Shape of Christophel Van Dijcks […] Letters […]’[378] the width of the capital M equalizes the height of the body. The N, however, has not been drawn on half the width of the M. Moxon notes ‘[…] that some few among the Capitals are more than m thick […]’ and he lists Æ, Œ, Q ‘[…] and most of the Swash Letters […]’[379] as examples.

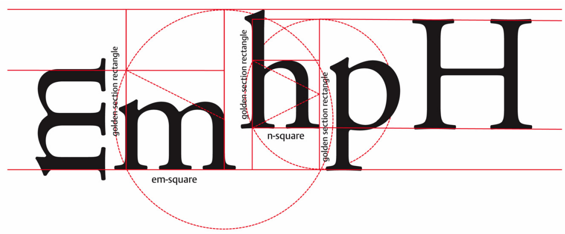


Figure A6.2 Framework for Renaissance type applied on Adobe Garamond.

If the size of the (e)m-square is based on the width of the capital M, why is it not labelled ‘M-square’ or ‘EM-square’ by Moxon and the other aforenamed authors? Is it possible that the terms ‘m’ or ‘em’ have a different historical background?
A hypothesis: let us assume for a moment that the origin of the (e)m-square lies in the lowercase m. The relation with the n-square seems to make more sense then, because the width of the capital N is never half the width of the M. As stated above, the proportions of the m (and the n) seem to have been the measure of all –or at least many– things in Renaissance type and in addition, Fournier used the M and m as references for the design of all other letters. Figure A6.2 shows an em and en-based framework for Adobe Garamond, which is based on Garamont’s Parangon Romain. This framework is discussed in Section 7.3.

377 *The Monotype System*, p.30.
378 Moxon, *Mechanick Exercises*, p.124.
379 Ibid. p.104.

A6.3 Grids

'Ever since the sixteenth century, elaborate diagrams have been published to show how letters should be drawn [...]. Generally a diagram of minute squares was first made, and on this the design and dimension of each letter was determined', according to Updike in *Printing Types*.[380] The application of grids for constructing letter shapes can be found in instruction books on calligraphy and lettering, as Fournier in his *Manuel Typographique* from 1764–1766 states:

> Several scholars and artists, such as Lucas Pacioli, Albert Dürer, J.B. Palatino, Pierre le Bé, the writing master, and many others have left various treatises upon the formation and shape of letters with an eye to the perfection of the art of writing rather than that of typography.[381]

When it comes to punchcutting, the patterns for the construction of a new series of types for exclusive use by the Imprimerie Royale, and which were developed by the Académie des Sciences in eighteenth-century France, are generally considered a unique case. Updike writes about this:

> [...] every Roman capital was to be designed on a framework of 2304 little squares. Grandjean, the first type-cutter who attempted to follow them, is said to have observed sarcastically, that he should certainly accept Jaugeon's dictum that "the eye is the sovereign ruler of taste" and accepting this, should throw the rest of his rules overboard![382]

The Romain du Roi is merely treated as an isolated attempt to regularize and standardise type, and is often disliked. For instance Smeijers notes in *Counterpunch*: 'The best known case of the separation of design from execution is the 'romain du roi'. Here in France at the end of the seventeenth century, intellectual reason struggled in a dialogue with practice and human limitations.'[383] Kapr writes in *The Art of Lettering*:

> A commission was appointed in 1692 to fix the proportions of the romain du roi. Under the chairmanship of the Abbé Nicolas Jaugeon, it went even further in determining the design of typefaces by mathematical rules and diagrams. We need not overrate all these attempts, for artistic success is scarcely achieved through geometric or scientific means.[384]

---

[380] Updike, *Printing Types*, Vol.1, p.7.

[381] Carter, *Fournier on Typefounding*, p.4.

[382] Updike, *Printing Types*, Vol.1, p.7.

[383] Smeijers, *Counterpunch*, p.70.

[384] Kapr, *The Art of Lettering*, p.300.

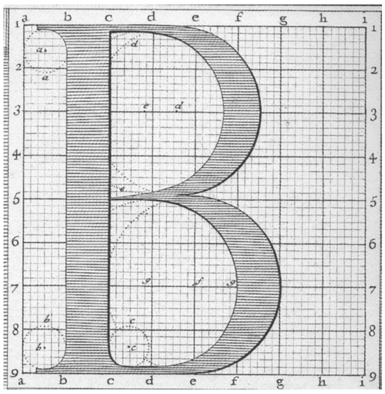


Figure A6.2 For the Romain du Roi a refined grid was defined.

The grid of 2304 little squares for the Romain du Roi (Figure A6.2) was perhaps not as unique as many authors on type want us to believe. The relation between the lowercase letterforms in Moxon's engravings and the plates for the Romain du Roi can be coincidental, but it seems that the Académie des Sciences thoroughly researched publications on type. This makes it is quite possible that Moxon's *Mechanick Exercises* was consulted as well.

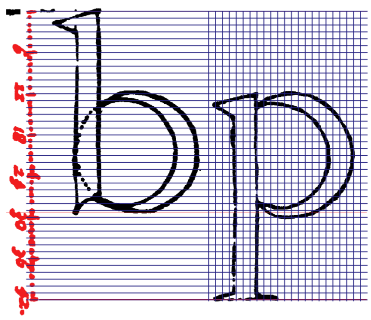


Figure A6.3 Moxon's 42-units grid from *Mechanick Exercises* actually drawn.

Moxon actually shows in his plates a 42-unit grid (Figure A6.3) and this results in a framework of 1764 units, which is also a large number. Moxon remarks on the origin of the grid:

> We shall imagine (for in Practice it cannot well be perform'd, unless in very large Bodies) that the Length of the whole Body is divided into forty and two equal Parts.', and: 'It may indeed be thought impossible to divide a Body into seven equal Parts, and much more difficult to divide each of those seven equal parts into six equal Parts, which are Forty two, […], especially if the Body be but small; but yet it is possible with curious Working […].[385] [386]

[385] Moxon, *Mechanick Exercises*, p.91.
[386] Ibid. p.92.

Just like Moxon, Fournier divided the body into seven parts, but apparently without the subdivision that Moxon mentions: 'I divide the body of the letter which I am to cut into seven equal parts, three for the short, five for the ascending and descending, and seven or the whole for the long letters.'[387]

One wonders why Moxon's grid seems to be overlooked in literature; is it because he did not actually draw the grid lines, like I have done in Figure A6.3? Could it be that the conclusion of Robin Kinross (1949), a British publisher and author on typography, in *Modern Typography* (2004) that the Romain du Roi can be seen as an innocent anticipation of the conditions of type design and text composition in the later twentieth century is incorrect and that unitisations derived from older processes were adapted for the Romain du Roi?[388]

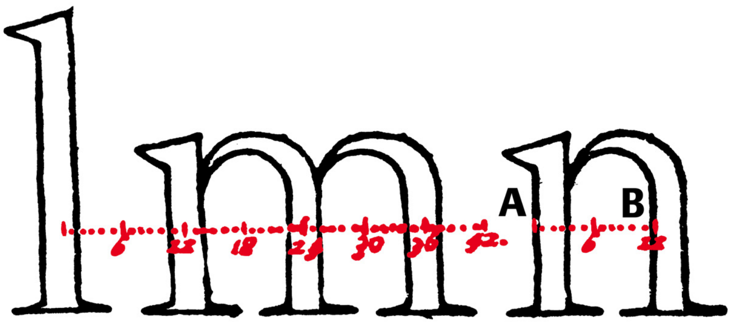


Figure A6.4 Moxon's division into 42 units positioned on the stem-interval.

Moxon's grid does not seem to have been arbitrary; the size of the units can be distilled from the stem interval (Figure A6.4) and hence the units are what I baptised 'cadence units'. Moxon was not trained as punchcutter or caster: 'He himself said that he had never been properly taught the art of type-founding, but had taken it up solely through his interest in the subject—as was the case with many celebrated type-cutters before and since.'[389] This fact suggests that it is not unlikely that Moxon got the idea for his grid from other sources. It is for instance not difficult to define a 42 (square) cadence-units grid for Van den Keere's Gros Canon, of which the lowercase dates from 1573 (Figure A6.5).

[387] Carter, *Fournier on Typefounding*, p.23.
[388] Robin Kinross, *Modern Typography* (London: Hyphen Press, 2004), p.26.
[389] Updike, *Printing types*, Vol.1, p.9.

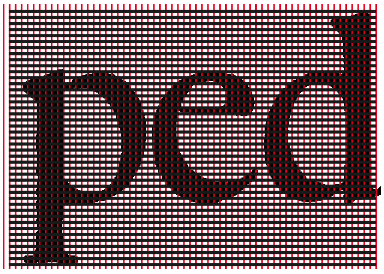


Figure A6.5 Van den Keere's Gros Canon on a 42 cadence-units grid.

A horizontal grid of cadence units for the textura type from Gutenberg's 42-line bible (Figure A6.6), can also be used in the vertical direction (Figure A6.7) and this raises the question of whether grids were not already applied at the cradle of typography.

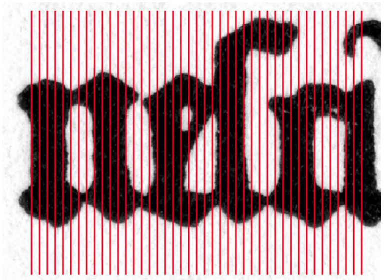


Figure A6.6 Refined cadence-units grid applied on Gutenberg's textura type from his 42-line bible.

Van den Keere's Gros Canon and Gutenberg's textura are both large types, so technically the application of a relatively refined grid should have been possible – taking into account Moxon's consideration that with 'curious Working' the application of a refined grid should be possible on relatively large bodies.

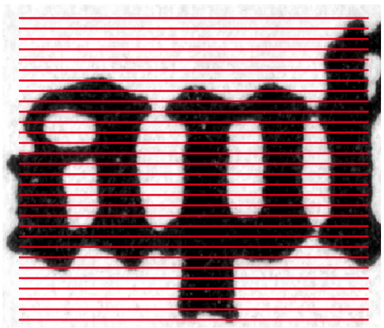


Figure A6.7 The cadence units grid from Figure A6.5 applied in vertical direction.

A6.4 Artificial units

The division into a grid based on the width of the n into 36 units and resulting in an m-square of 48 units at first sight resembles the unit arrangement systems used by Monotype for their hot metal (18 units), photo (48 units) and laser composing (96 units) machines. However the size of the cadence-units is only related to the typeface, whereas for instance the Monotype units were always part of a standardised system, despite the differences of 'set' width:

> Mr. Lanston's early conception of a machine-composed fount was that of characters being designed to some definite thickness, multiples of a thinnest unit dimension. This was essential, as he had, by means of his proposed mechanism, to register the unit-thickness of every character composed, so that all complete lines should contain the same total number of "units". [...] Thus was established the unit and em of a one-point "Monotype" fount, and the unit of all larger sizes was to be a multiple of the unit of the one-point fount.[390]

This unit was 1/18 of 1 pica point (1 set), which is 0,0007716 of an inch, which could in turn be subdivided into quarters. The character widths of all other characters in a font were translated into the closest range of units. This adapting process was restricted by the maximum of fifteen rows in a matrix case, each row containing characters of the same number of units, which inevitably resulted in the redrawing of some of the characters. Therefore, this standardisation came with a price:

> In comparing fonts cast according to the old system of irregular sets and those cast on the point-set system, we find that the older font had more than ninety different sets, while the latter has but from thirty to twenty. Something suffers when ninety different adjustments are reduced to from thirteen to twenty [...].[391]

It is not impossible that Renaissance punchcutters applied unit-arrangement systems on their type. There are no records from that period that prove this and I had to distil the evidence from historic type and matrices. However, there are records that prove that a unit arrangement system was already being applied on type before the development of the hot metal machines in the second half of the nineteenth century. In Vienna in 1840 a test was made with a unit arrangement system developed by Alois Auer. All the characters of a foundry type were placed on eight, twelve or sixteen units. The purpose of this system was to make the justification of text easier. Because of the restrictions for the type design and the questionable time savings, the project was eventually abandoned.[392] The idea was applied on the hot metal machine type in following decades.

---

[390] Elliot, 'The "Monotype" from Infancy to Maturity', pp.21,24.
[391] Updike, *Printing types*, Vol.1, p.35.
[392] Willi Mengel, *Die Linotype erreichte das Ziel* (Berlin/Frankfurt: Linotype GmBH, 1955), p.37.

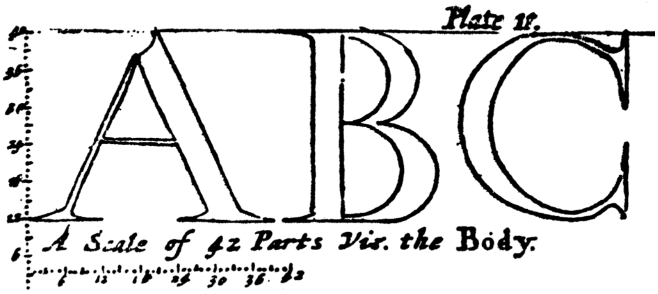


Figure A6.8 Moxon's divison of the 'm Quadrat into 42 units.

Moxon shows in *Mechanick Exercises* a proprietary unit arrangement system in which the em-square was divided into 42 units (Figure A6.8). His previously mentioned engraving of the 'true Shape' of Christoffel van Dijk's letters shows this division on an em that measures an inch. In his notes to the 1896 facsimile of *Mechanick Exercises*, Theodore De Vinne comments on Moxon's measuring rules:

> These nicer subdivisions had to be determined and marked by himself on measuring-rules of his own construction, and he must have done this work very well. To divide the body of English in forty-two equal parts is to make each part equal to about 46/10000 of an inch. One forty-second part of long-primer body would make each part about 33/10000 of an inch.

De Vinne proceeds to mention the division by Moxon of the 'em quadrat' into seven thin spaces: 'The full point or period was one and one sixth of this thin space; the colon, one and two sixths; the comma, one and three sixths; the hyphen, one and four sixths; the semicolon, one and five sixths.'[393]

A6.8 Unitisation and design

There is no documentation about how handwriting was transformed into type by the Renaissance punchcutters. It is not unlikely that there was to some extent an exchange of knowledge between Renaissance calligraphers and punchcutters. The production of type has always been a technically challenging matter, because characters have to be adapted to limitations of the medium. That was the case for movable type, for which originally freely-written characters had to be squeezed into rectangles. More than four centuries later that was also the case for the Monotype 'hot-metal' machines, for which characters had to placed on a limited number of widths, due to the unit-arrangement system.

[393] Joseph Moxon *Mechanick Exercises: or the Doctrine of Handy-Works Applied to the Art of Printing*, ed. Theodore Low De Vinne, (New York: The Typothetæ of the City of New York, 1896), pp.413,414.

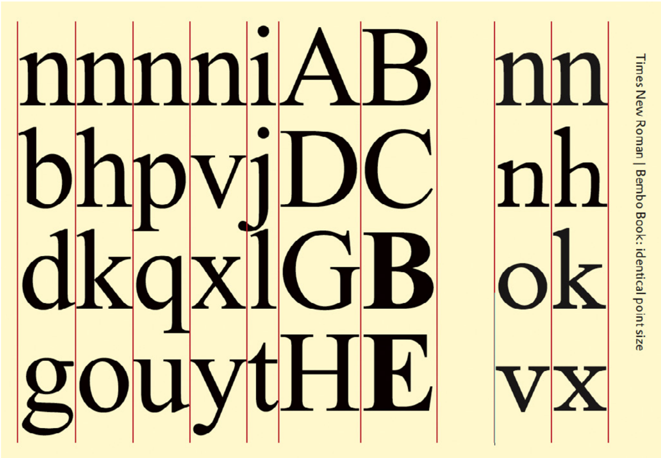


Figure A6.9 Hot-metal standardisation in digital versions of Times New Roman and Bembo Book.

The unitisation of characters for the Monotype 'hot-metal' composing machines was a clear deviation from the nineteenth-century foundry practice, but obviously did not have a notable negative effect on the quality of the designs. In fact, the majority of the fonts produced at the Monotype Works under supervision of the American engineer and type designer Frank Hinman Pierpoint (1860–1937) and with the guidance of Morison in the first half of the twentieth century have always been considered excellent. Pierpoint has been praised for his technical merits and Monotype's Type Drawing Office (TDO) was obviously capable to satisfactorily adapt the designs to the limited widths. Even today the Monotype fonts show their limited widths in digital format (Figure A6.9). The exact number of units depended on the layout of the matrix case, but most likely the range for the top row of Figure A6.9 must have looked like this: n on 10, I on 5, A on 14, and B on 12 units. That this adaptation did not lead to distorted designs could be explained by the fact that similar standardisations were part of the early Renaissance font production.

Monotype's 18-unit arrangement system was applied after the type design was made. A layout was chosen that would require minimal adaptations of the design. In the case of the typefaces from the always highly critical Van Krimpen, Monotype's TDO went to considerable lengths to adjust these. But this inevitably required compromises and in his *Memorandum* to Monotype Van Krimpen described the problems that accompanied this kind of production. He declared himself in favour of designing a typeface directly within a unit arrangement system, but with the proviso that no designer should try to make a design on an existing unit arrangement that does not correspond with his own particular rhythm.[394]

[394] Jan van Krimpen, 'Memorandum', *The Monotype Recorder*, New series/Volume 9 ('s-Hertogenbosch: Dutch Type Library, 1996), p.8.

APPENDIX 7: GEOMETRY IN THE RENAISSANCE

A7.1 Introduction

This appendix is supplemental to the Chapter 7 and is referred to in Section 2.7. It provides additional information about the systematisation by the early punchcutters. The required standardisation for the Renaissance type production in addition to the fact that geometry was used by scholars and artists makes it plausible that the early punchcutters used frameworks like the golden section-based em-square.

A7.2 Theory and practice

In the Quattrocento there was a growing interest in (ancient Greek) geometry. Euclid's description of the golden ratio in his *Elements* is the oldest one known. Euclid's *Elements* was copied in Greek (Figure A7.1) during the Carolingian Renaissance and has been of influence ever since.

Figure A7.1 Ninth-century copy of Euclid's *Elements* in Greek.[395]

[395] <https://www.ibiblio.org/expo/vatican.exhibit/exhibit/d-mathematics/images/math01.jpg>

In Euclid's *Elements* (ca.300 BC) the construction of a golden section rectangle (Figure A7.2) –although not named as such– is explained as follows:

> Let AB be the given straight line. It is required to cut AB so that the rectangle contained by the whole and one of the segments equals the square on the remaining segment.
>
> Describe the square ABDC on AB. Bisect AC at the point E, and join BE. Draw CA through to F, and make EF equal to BE. Describe the square FH on AF, and draw GH through to K. I say that AB has been cut at H so that the rectangle AB by BH equals the square on AH. Since the straight line AC has been bisected at E, and FA is added to it, the rectangle CF by FA together with the square on AE equals the square on EF. But EF equals EB, therefore the rectangle CF by FA together with the square on AE equals the square on EB. But the sum of the squares on BA and AE equals the square on EB, for the angle at A is right, therefore the rectangle CF by FA together with the square on AE equals the sum of the squares on BA and AE. Subtract the square on AE from each.
>
> Therefore the remaining rectangle CF by FA equals the square on AB. Now the rectangle CF by FA is FK, for AF equals FG, and the square on AB is AD, therefore FK equals AD. Subtract AK from each. Therefore FH, which remains, equals HD. And HD is the rectangle AB by BH, for AB equals BD, and FH is the square on AH, therefore the rectangle AB by BH equals the square on HA. Therefore the given straight line AB has been cut at H so that the rectangle AB by BH equals the square on HA.[396]

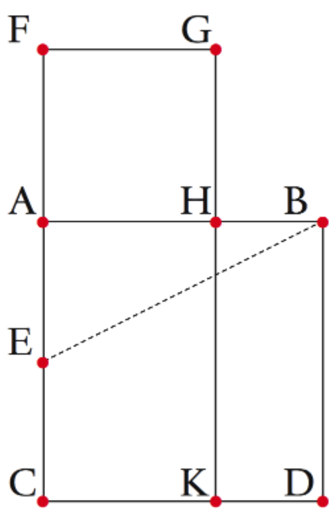


Figure A7.2 Euclid's 'golden-section' rectangle.

Euclid's description of the quadrature of the circle found its application, for example, in the 'Vitruvian man' by Leonardo da Vinci: 'No doubt that a central part of the holy

[396] <http://alepho.clarku.edu/~djoyce/java/elements/bookII/propII11.html>

science of Vitruvius in the Renaissance times derived from Euclid, in the concept of the square inscribed in a circle and the circle inscribed in the square.'[397]

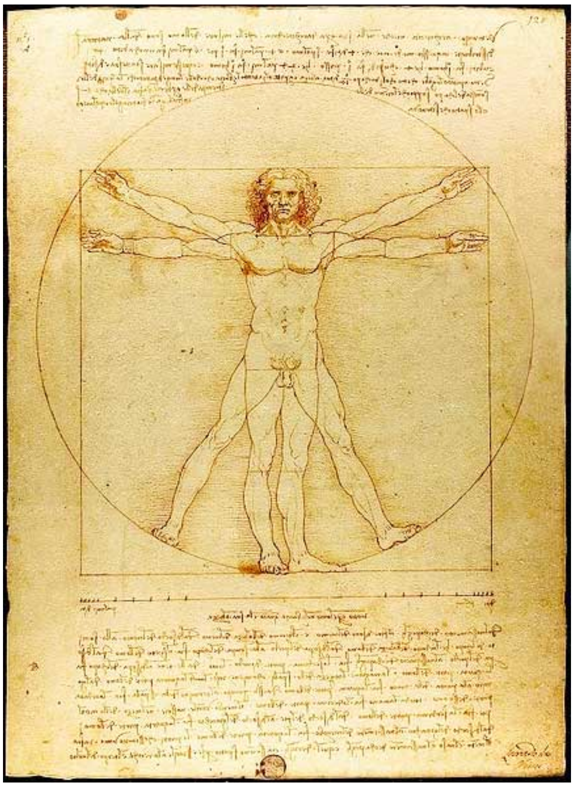


Figure A.7.3 Leonardo da Vinci's 'Vitruvian man'.

One should note here that the famous 'Vitruvian man' drawing (Figure A7.3), which Leonardo da Vinci created around 1487, is often associated with the golden ratio. However, bisecting the rectangle both vertically and horizontally through the navel of the 'Vitruvian man', results in four rectangles and the height of the two lower rectangles is 1 to 0.656 of the two top rectangles. The totalling 1.656 is not the expected 1.618, which means that the outcome is close, but not close enough to consider a deliberate application of the golden section here by Da Vinci.[398]

Vitruvius's ideas about the proportions of the human body found their application in the Renaissance reconstruction of Roman imperial capitals:

> Tory followed the Vitruvius-Leonardo line of thought in relating the human figure to the square and inscribed circle. [...] Tory not only attempted to relate ancient capital letters with Vitruvius but threw in generous portions of classical mythology and any other idea that came to hand'.[399]

---

[397] Anderson, 'Cresci and His Alphabets', p.337.

[398] <http://www.world-mysteries.com/sci_17_vm.htm>

[399] Anderson, 'Cresci and His Alphabets', pp. 331–352 (p.343).

Morison described Geoffroy Tory's attempts in the *Champs-Fleury* (1529) as 'cabalistic abracadabra'.[400] Besides on Vitruvius and the Kabbalah, Tory's reconstructions of the capitals were based on squares and circles, like the ones made by his predecessors: 'He habitually uses the Compass and the Rule because he is convinced that they are the King and Queen respectively of instruments.'[401]

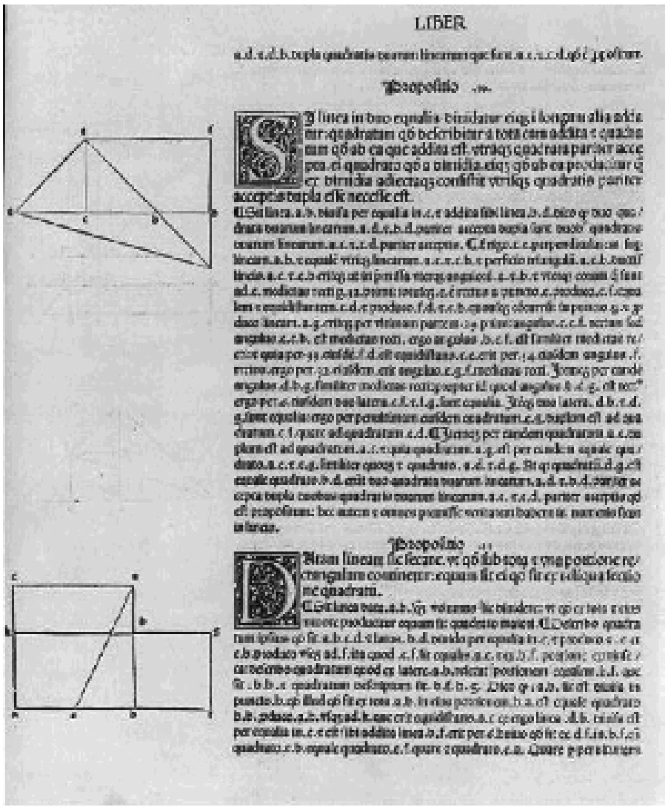

LIBER

Figure A7.4 Page from the Latin translation of *Elements*, published by Ratdolt in 1482.

A printed edition of Euclid's *Elements* was published during the Renaissance. Erhardus Ratdolt (1442–1528) was a German printer working in Venice from 1476 to 1486. In May of 1482, he published the first printed edition of *Elements, Euclid Liber Elementorum in Artem Geometrie* (Figure A7.4). Its contents were based on the medieval translation of the work from Greek to Latin by Campanus (circa 1220–1296).[402]

400 Morison, *Pacioli's Classic Roman Alphabet*, p.24.

401 Ibid., p.25.

402 <http://www.maa.org/publications/periodicals/convergence/mathematical-treasure-ratdolts-euclids-ielementsi>

A7.3 Geometry and type

Is it really conceivable that the early punchcutters, who were engravers or goldsmiths by origin, only used their eyes in a profession that requires standardisation? Why would they ignore conventions, such as the golden section, that were applied everywhere else in the Renaissance world of arts? Was it because of technical limitations, or did Jenson, Griffo, Garamont, and Granjon have such trained eyes that they applied 'divine' proportions almost instinctively? The measurements I made of the Renaissance matrices and foundry type at the Museum Plantin-Moretus seem to contradict the idea that technical limitations played a role, and the models I applied and which are presented in Chapter 7, seem to refute the 'rely on the eye' dogma.

'Since this [Geometry] is in very truth the foundation of the whole graphic art, it seems to me a good thing to set down for studious beginners a few rudiments', writes Albrecht Dürer in the third book of his *Underweysung der Messung mit dem Zirckel und Richtscheyt* from 1525, which also focuses on the shapes of letters. Dürer's attempt did not stand on its own, but was part of a development that found its origin in the Italian Renaissance:

> A new form of didactic and theoretical writing appeared in the early Renaissance: treatises on the design of the alphabet, which is to say, of course, the roman alphabet. The first of these texts known to us was written by none other than Felice Feliciano, a friend of the painter Andrea Mantegna who recorded the chief events in a famous archeological trip they made together to the Lago di Garda. Feliciano's treatise on the alphabet was followed by similar "trattati delle lettere antiche", one by Damiano Moille, printed at Parma ca. 1480, another by Luca Pacioli, printed in Venice in 1509, and still another by Sigismondo de' Fanti, printed in Venice in 1514. This species of literature was then adopted north of the Alps, appearing first as a section of Dürer's Underweysung der Messung, printed in 1525.[403]

The geometric descriptions of letters by the Renaissance artists and scholars were not a novelty. In an article on the revival of the Roman capital letter Giovanni Mardersteig mentions the existence of '[...] patterns for writing and for making gothic initials', which 'were set to one side at the introduction of the humanistic script and the spread of roman inscriptional capitals.'[404] The earliest specimen that he knows of can be found in the collection of the Bibliotheca Comunale of Mantua: '[...] Each initial is drawn in a large square divided into 16 smaller squares. The four central

[403] Millard Meiss, 'The First Alphabetical Treatises in the Renaissance', *Visible Language,* Volume III, Number I (Cleveland: the Journal 1969), pp.3–30 (p.3).

[404] Giovanni Mardersteig, 'Alberti and the Revival of the Roman Letter', *Typography Papers 6* (London: Hyphen Press, 2005), pp.49-65 (p.58).

squares contain the design for the letter. Its construction is made with the assistance of many circles and segments'.[405]

Feliciano's aforementioned treatise on the alphabet mentioned is *Alphabetum Romanum* from around 1463, in which he put the emphasis on the theoretical side without becoming too dogmatic: 'Although Feliciano's concern with proportion and geometry is essentially theoretical, it is occasionally bound up with practical and didactic purposes. [...] Geometry had, however, only a proximate meaning. Feliciano, for instance, preferred a narrow H and he produced it, even though it does not come near to filling the square with which he began.'[406] Feliciano's publication preceded Jenson's roman type and Moille's *Trattati delle lettere antich* also preceded the type Griffo made for the *Hypnerotomachia Poliphili* and *De Aetna*. The other previously listed books on reconstructions of the Roman imperial capitals are from a later date, but they were all the result of the Renaissance interest in geometry, which in my opinion can hardly have been unnoticed by the punchcutters of that time. The geometric reconstructions of the 'em' and 'en' squares I present in chapter 7 support this theory.

The attempts to capture the construction of the Roman imperial capitals with ruler and compass were followed in history by many others, including Giovan Francesco Cresci, Luca Orfei, Marc' Antonio Rossi, Cesare Domenichi, Leopardo Antonozzi and Frabrizio Badesio.[407] A contemporary of Dürer was Johann Neudörffer (1497–1563), who was a calligrapher and mathematician, and who showed relatively complex construction methods for Roman imperial capitals in his book *Gründlicher Bericht der alten lateinischen Buchstaben; Handschrift unter Benützung van Schablonen* (ca.1538).[408]

---

405 Ibid., p.58.

406 Meiss, op. cit., p.15.

407 James Mosley, 'Giovan Francesco Cresci and the Baroque Letter in Rome', *Typography Papers 6* (London: Hyphen Press, 2005), pp.115–155 (p.145).

408 Werner Doede, *Schön schreiben, eine Kunst: Johann Neudörffer und die Kalligraphie des Barock* (München: Prestel Verlag, 1988), pp.48–50.

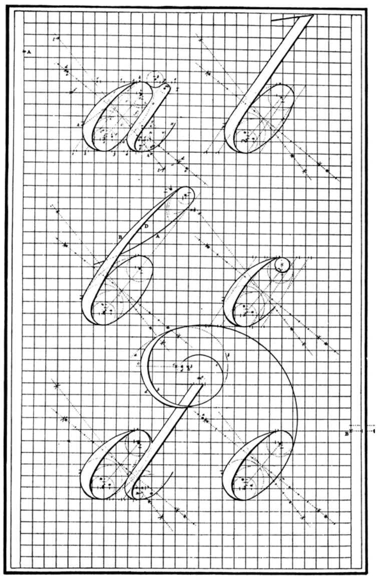


Figure A7.5 Plate from *Mathematische of Wiskundige behandeling der Schrijfkunst, […]* (1773).[409]

Later in history, geometry was also used to (re-)construct letterforms and these attempts were not restricted to the Roman imperial capitals. Mathematical constructions can be found in eighteenth- and nineteenth-century instruction books for calligraphy, such as, for instance, the Dutch publication *Mathematische of Wiskundige behandeling der Schrijfkunst, […] by Jan Pas* from 1773 (Figure A7.5). These geometric rules were criticized, like in *Handleiding tot de Schrijfkunst* ('Manual for the Art of Writing') from 1830 in which the need for perfect uniformity in writing by different people is questioned.[410]

A7.4 Geometry and quality

In *Mechanick Exercises on the Whole Art of Printing* Moxon complains about the fact that there were no quality rules for type designs: '[…] neither the Ancients whom we received the knowledge of these letters from, nor any other authentick Authority have delivered us Rules […].'[411] Moxon developed with a sort of standard for judging the quality of type:

---

[409] M.R. Groenewege and W.C. de Man, *Schrift Schrijven Schrijfonderwijs: Handleiding voor aanstaande onderwijzers* (Leiden: Spruyt, Van Mantgen & De Does, 1975), p.20.

[410] p.3: 'Het is waar, indien niet iedere trek eener letter zich naar eenen Meetkundige vasten regel schikt, kan men nimmer tusschen verschillende schrijvers eene volmaakte gelijkvormigheid in de zamenstelling hunner letters verwachten. Doch waartoe is ook juist eene naauwgezette gelijkvormigheid in dezen zin noodig?'

[411] Moxon, *Mechanick Exercises*, p.21.

> […] we must conclude that the *Romain Letters* were Originally invented and contrived to be made and consist of Circles, Arches of Circles, and straight Lines; and therefore those *Letters* that have these figures; either entire, or else properly mixt, so as the Course and Progress of the Pen may best admit, may deserve the name of true Shape, rather than those that have not. Besides, Since the late made *Dutch-Letters* are so generally, and indeed most deservedly accounted the best, as for their Shape, consisting so exactly of Mathematical Regular figures as aforesaid, […] therefore I think we may account the rules they were made by, to be the Rules of true shap'd *Letters*.[412]

In *The Alphabet* Frederic W. Goudy quotes the same part from *Mechanick Exercises* and he comments:

> Such an analysis can, at best, only fix and permit the reproduction of the same form at another time; and even then the quality of life and freedom in the original will be in large part lost in reproduction. The mere blending together of geometrical elements common to all letter forms, good or bad, is not enough; 'true shape' is something more subtle than geometry'.[413]

In line with this statement Goudy does not seem to have used any geometric reconstructions for his rendition of the Trajan capitals, known as Goudy Trajan.

A7.5 Divine proportion

The attempts to capture the construction and proportions of the inscribed Roman imperial capitals from the first century into geometric models were made by artists, scholars, and calligraphers. For instance Dürer (1471–1528) was an artist; Fra Luca de Pacioli (1446/7–1517), who published a section on the 'true' shapes and proportions of classical Roman letters in his *De Divina Proportione* from 1509, was a mathematical scholar; and Giambattista Palatino, who was a calligrapher, also made geometric representations of the Roman imperial capitals: 'All these are faithful versions of the letters that symbolized the authority of Augustus and Trajan' writes Morison in *Letter Forms*.[414]

The geometric descriptions of the Roman imperial capitals were relatively crude. According to Catich the geometric approach was a mistake by definition:

> There were even attempts to contrive foolproof geometric formulae for letter making by Fleury, Tory, Moille, Serlio, de' Fanti, Ruano, Dürer, and others– schemes which today are, at most, of interest to typographic

[412] Ibid., pp.22,23.

[413] Goudy, *The Alphabet*, p.31.

[414] Morison, *Letter Forms*, p.156.

> researchers and calligraphic historians. […] Had there been a vital practice of brush writing in the Renaissance surely these gifted artist-authors would not have submitted such compass-and-square lettering schemes.[415]

However, modern research on the Roman imperial capitals by Richard Grasby and Tom Perkins show complex construction methods (possibly) applied by the Romans on their imperial capitals, such as different root rectangles, golden section rectangles and extended variants of these.[416] The proportions of, for example, capitals like B, E, F and P generally don't seem to be based on split squares anymore, as is shown in the work of the Renaissance researchers, but on root-five rectangles, and the squares are subsequently replaced by doubled root-five rectangles. Perkins emphasizes that the Roman stone carvers were probably more versatile than the approaches from the Renaissance suggest: 'It is quite different from Renaissance theories of constructed classical letters where the rulers and compasses are allowed to dictate every detail of the finished form leading to over-elaborate schemes far removed from any practical application.'[417]

Pacioli's mainstrokes had a thickness of one ninths of the square. The mentioned crudeness of the illustrations probably explains the deviation. Feliciano, Dürer and Tory dictated one tenth of the square, but according to Morison the difference between one-ninth and one-tenth of a square '[…] does not affect the essentials of the design […].'[418] Grasby measured a larger range: 'The ratio 1:10, one stem width to ten of height, is commonly found in capitals from the Augustan period, but ratios of 1:8 and 1:12 are also used.'[419] The 1:10 ratio goes back to Marcus Vitruvius Pollo:

> The Roman engineer-architect […] stated the geometric and numerical canon that "man's anatomical proportions are reducible to the ratio 1 to 10, the circle, and square." In the Renaissance, Felice Feliciano, one of the first "circle-and-square" calligraphers who influenced subsequent letter design, extended this Vitruvian canon […] to capital roman letters.[420]

The geometric translation of the letter shapes and proportions was not followed by everyone; the renowned calligrapher Giovan Francesco Cresci included Roman imperial capitals in his first writing book *Essemplare di pìu sorti lettere* in 1560 and 'he made it clear that it was drawn freehand, without the underlying and (in his view)

---

415 Catich, *The Origin of the Serif*, p.270.

416 Tom Perkins, 'The Geometry of Roman lettering', *Font* (Ditchling: Ditchling Museum & the Edward Johnston Foundation, 2000), pp.35–52.

417 Ibid., p.51.

418 Morison, *Pacioli's Classic Roman Alphabet*, p.24.

419 Grasby, *Processes in the Making of Roman Inscriptions*, p.9.

420 Catich, *The Origin of the Serif*, p.112.

restricting geometric construction that had been applied to nearly every alphabet of 'antique' capital letters, manuscript and printed, in Italy since that of Feliciano.'[421] Recent studies however seem to prove that the 'antique capital letters' themselves had a geometric basis: '[…] geometrically constructed and brush-formed letters are found to exist in parallel from the first century onwards […]'[422] and '[…] the structural precision of letter forms derived from a signwriter's brush and their spacing could not be attributed to skills of hand and eye alone […].'[423]

In the professions of the calligrapher and type designer, geometric (re)constructions are also not always welcome in our time. For instance Käch wrote about the geometric reconstructions of the Roman imperial capitals by Feliciano and consorts in *Rhythm and Proportion in Lettering*: 'There began the unhappy measuring of things on the basis of technical science.'[424] In *The Art of Calligraphy* (1980) a page from Ferdinando Ruano's *Sette alphabeti di varie lettere, formati con ragion geometrica* from 1554 has the following caption: '[…] he tried, not very successfully, to give Renaissance hands a geometric basis, for which the cancellaresca is especially unsuited.'[425] The question is whether this acclaimed unsuitedness is really true; if the Humanistic minuscule can be captured in a model, then this should also be possible with the derived italic, from which the cancelleresca was developed: '[…] this increased slope combined with a certain suppleness of form gradually transformed the original plain humanistic cursive into an intricate cursive that was, in terms of currency, comparable with the gothic cursive it had superseded.'[426]

In *Counterpunch* Smeijers comments on the fifteenth-century geometric attempts: 'In the climate of Italian humanism it was possible to come up with strange, super rational creations. […] These letters were rationalized by the geometrical schemes of Felice Feliciano, Luca Pacioli, and others we are familiar with […]. Such schemes tell us more about humanism than they tell us about designing usable letters.'[427]

---

421 Mosley, 'Giovan Francesco Cresci and the Baroque Letter in Rome', p.153.

422 Grasby, *Processes in the Making of Roman Inscriptions*, p.3.

423 Ibid., p.5.

424 Walter Käch, *Rhythm and Proportion in Lettering [Rhythmus und Proportion in der Schrift]* (Olten: Otto Walter Ltd., 1956), p.33.

425 Joyce Irene Whalley, *The Art of Calligraphy* (London: Bloomsbury Books, 1980), p.159.

426 Morison, *Letter Forms*, p.143.

427 Smeijers, *Counterpunch*, p.51.

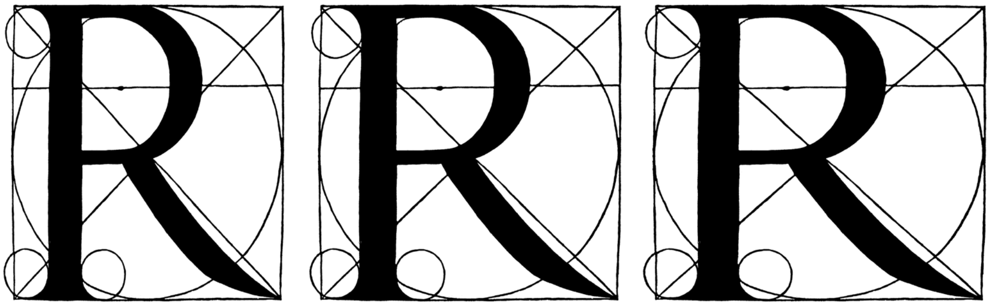


Figure A7.6 Picioli's Roman imperial capital R (centre), flanked by computerized horizontal modifications (90 and 110 percent).

Interestingly, the proportions of the Roman imperial capitals seem to be considered so 'true' that mathematical scholars like Pacioli did not use the square and circle based constructions as a basis for modifications. Although stretching in both directions (condensing and expanding), like I did in Figure A7.6, would have been relatively easy, this was clearly not considered by the scholars. Obviously, geometry was more a way of explaining and reproducing the 'true' and divine classical shapes. Consequently, the outcomes, such as Dürer's capitals, should not be considered type designs.

The fact that Moxon referred to geometry as a sort of standard for the judgment of type does not come as a surprise knowing that he was, besides punchcutter and typefounder, a hydrographer, instrument maker, lexicographer, and printer. Moxon was definitely not an expert on type, as his engravings '[…] to the World the true Shape of Christophel Van Dijcks aforesaid Letters […]' clearly prove.[428] Moxon reproduced the broad nib effect in Van Dijck's letters using two circles different in size, in this way in fact generating a more or less similar effect as the one found in the more elaborate Romain du Roi, which was developed in the following decades (Figure A7.7).

[428] Moxon, *Mechanick Exercises*, pp.124–128.

Figure A7.7 Moxon's engraved interpretation (detail) of Van Dijck's 'true' shapes (top/red) compared with engravings for the Romain du Roi.

A7.6 Golden section/ratio/mean controversy

The golden section/ratio/mean is assumed to be present in many expressions of art, such as fine arts, sculpture, and architecture –either applied deliberately or unconsciously by the artists. Measurements of the dimensions of the Parthenon in Athens, for example, show the influence of the golden rectangle on Greek architecture. The golden ratio can also be found in the works of Renaissance painters like Leonardo da Vinci, Michelangelo, and Rafael. A well-known example of the application of geometry in fine arts is the painting 'The Flagellation of Christ' from ca.1460 (Figure A7.8), which shows an underlying construction based on a root-two rectangle (Figure A7.9).

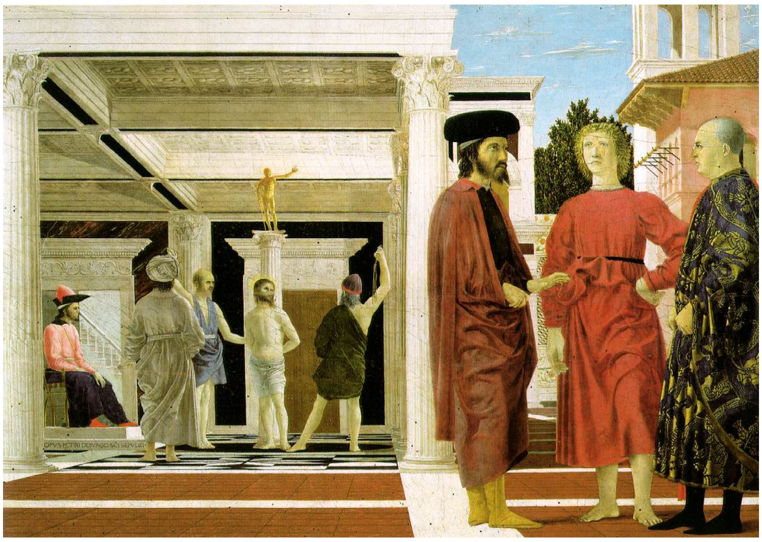


Figure A7.8 Pierro della Francesca's The Flagellation of Christ (ca.1460).

The artist Pierro della Francesca was also a mathematician and geometer, so the application of geometry in 'The Flagellation of Christ' is most likely not a coincidence. The accuracy of the applied geometry in this painting is remarkable: 'This painting has been analyzed to death, and I even have a computer analysis locating the vanishing point to the nearest millimetre […].'[429]

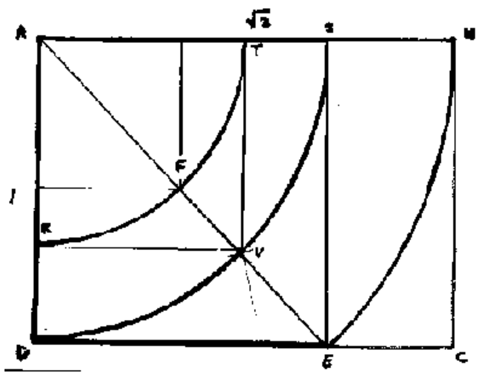


Figure A7.9 Underlying geometry of The Flagellation of Christ, showing a root-two rectangle.

In *The Elements of Typographic Style* Bringhurst dedicates up to six pages to utilizations of the golden section in typography, focusing especially on the sizes of pages and text blocks. And, of course, he describes Fibonacci's related spiral of increase, based on integers which are (after the first two) the sum of the two preceding.[430] The golden rectangle has been applied in incunabula and was used by Pacioli for reconstructing Roman imperial capitals, as mentioned in the previous sections.

The Penguin Dictionary of Art and Artists describes the golden section as follows: '[…] the name given to an irrational proportion, known at least since Euclid, which has often been thought to possess some æsthetic virtue in itself, some hidden harmonic proportion in tune with the universe'.[431] The description ends with 'In practice it works out at about 8:13 and may easily be discovered in most works of art.' The last part of this sentence in particular provides those who question the existence of the golden section in the arts with ammunition.

The golden section may be easily discovered in works of art, but does this provide proof for the argument that the golden ratio has been deliberately applied, or rather for the fact that this ratio can always be distilled one way or another if one is

429 <http://www.dartmouth.edu/~matc/math5.geometry/unit13/unit13.html>

430 Bringhurst, *The Elements of Typographic Style*, p.155.

431 Peter and Linda Murray, *The Penguin Dictionary of Art and Artists* (London: Penguin Books, 1989), p.172.

determined to find it? Huntley mentions the sceptical approach in *The Divine Proportion* and he considers this attitude by some individuals an unfortunate one: 'One of these measured the heights of 65 women and compared the results with heights of their respective navels, obtaining an average of 1.618.'[432] The Vitruvian man may have inspired the focus on the navel (the centre of the circle) in this mockery. Vitruvius's idea that the human body was the principal source of proportion is and was not endorsed by everyone. For example Edmund Burke could not believe that the human figure supplied the architect with any ideas. After ridiculing the posture of the Vitruvian man: '[…] men are very rarely seen in this strained posture; it is not natural to them' he proceeds: '[…] certainly nothing could be more unaccountably whimsical, than for an architect to model his performance by the human figure, since no two things can have less resemblance or analogy […].'[433]

Pacioli applied geometric proportions even on human heads in his *De Divina Proportione* (Figure A7.10).

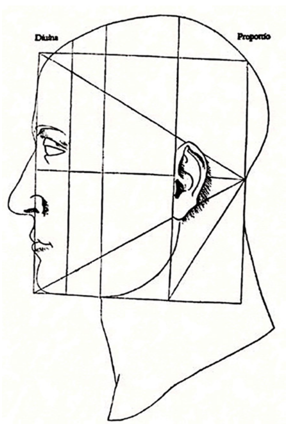


Figure A7.10 Illustration from Pacioli's *De Divina Proportione*, showing geometric proportions projected on a human head.

The golden section seems to be an important factor when it comes to the approval of art, architecture, books or any other objects –including type:

> Curious about the golden section a German psychologist, Gustav Fechner, in the late nineteenth century, investigated the human response to the special æsthetic qualities of the golden section rectangle. Fechner's curiousity was due to the documented evidence of a cross-cultural archetypal æsthetic preference for golden section proportions. Fechner limited his experiment to the man-made world and began by taking measures of thousands of rectangular objects, such as books, boxes,

[432] H.E. Huntley, *The Divine Proportion* (New York: Dover Publications, 1970), p.62.

[433] Edmund Burke, ed. Adam Phillips, *A Philosophical Enquiry into the Origin of our Ideas of the Sublime and Beautiful* (Oxford: Oxford University Press, 2008), p.91.

> buildings, matchbooks, newspapers, etc. He found that the average rectangle ratio was close to a ratio known as the golden section, 1:1.618, and that the majority of people prefer a rectangle whose proportions are close to the golden section. Fechner's thorough yet casual experiments were repeated later in a more scientific manner by Lalo in 1908 and still later by others, and the results were remarkably similar.[434]

But even if one wants to question the deliberate application of the golden ratio in art, the related structures found in for instance paintings, architecture and type can explain why some of the works are considered to be optically appealing. In *The Psychology of Art Appreciation* the author Bjarne Sode Funch mentions a study by Calvin F. Nodine which shows:

> [...] an interesting correspondence between eye movement and the golden section. He compared the pattern of eye movements in work of art with an underlying compositional structure based on the golden section with the eye movements in altered versions of the original works of art where the structure was not ruled by the golden section. He found that seventy-five percent of the subjects preferred the original work of art over the altered versions, and the record of their eye fixations revealed that the arrangement of visual elements directly influences the way a composition is analyzed.[435]

In *Rhythm and Proportion in Lettering* Käch notes that the application of the golden ratio is by definition not an artificial but a natural phenomenon:

> '[...] it must be said that the phenomena of proportion exist in nature without the help of æsthetic research. The artist acts above all emotionally, and when he finds the harmonious effect of the proportion of the golden mean, while correcting his work, he does not take the result as being a scientific perception. For the rhythmic law lives in him, since he too is a part of nature.'[436]

---

[434] Kimberly Elam, *Geometry of Design: Studies in Proportion and Composition* (New York: Princeton Architectural Press, 2001), pp.6,7.

[435] Bjarne Sode Funch, *The Psychology of Art Appreciation* (Copenhagen: Museum Tusculanum Press, 1997), p.21.

[436] Käch, *Rhythm and Proportion in Lettering*, p.64.

APPENDIX 8. PROPORTIONS OF CAPITALS IN ROMAN TYPE

A8.1 Introduction

This appendix is supplemental to Chapter 7 and is referred to in Section 7.3. It provides additional information on the relation between the horizontal proportions of the lowercase letters and capitals in Renaissance roman type. Although the letterforms in roman and italic type find their origin in calligraphy, the handwritten letters did not have, nor did they need, the consistency required for the engraving, casting, and setting of letters. For roman type capitals were added and adapted to the lower case that found its origin in the Humanistic minuscule. This required a systematisation of the capitals in line with the standardisation of the lower-case letters.

A8.2 Optical harmony

'Roman capitals, as now made by type-founders, are imitations of the lapidary letters used by the Romans', Theodore Low De Vinne, printer, and author on typography, wrote in *The Practise of Typography* over 100 years ago.[437] 'Roman type consists of two quite different basic parts. The upper case, which does indeed come from Rome, is based on Roman imperial inscriptions', according to Bringhurst in the more recent publication *The Elements of Typographic Style*.[438]

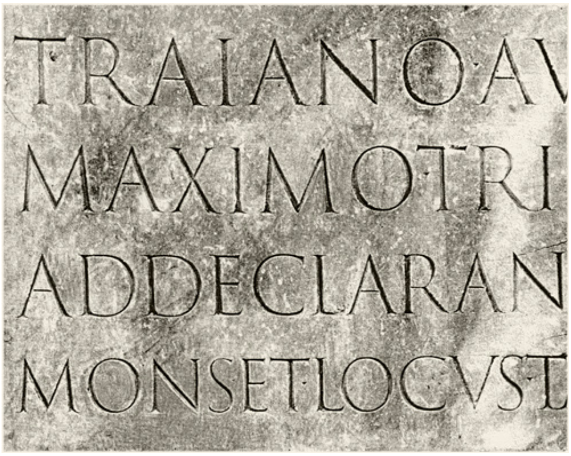


Figure A8.1 Capitalis monumentalis on the Trajan column (AD 113).

[437] De Vinne, *The Practice of Typography*, p.186.
[438] Bringhurst, *The Elements of Typographic Style*, p.124.

These are a generally accepted explanation for the origin of the capitals in roman type, but a comparison of the imperial Roman capitals, like for instance those in the Trajan column (Figure A8.1) with the capitals Jenson made for the type used in *Vitae et Sententiæ Philosophorum* (Figure A8.2), show many differences in proportions and contrast. Jenson's capitals are in general wider and the square-based relations in the Roman inscriptions between small (half-square) letters like B, E, F, L, P and S and square letters like H, N and O, for instance, are not preserved in Renaissance type. The contrast is lower in the archetypes. Jenson clearly did not consider it a good idea to preserve the 'divine' proportions of the Roman imperial capitals and nor, in fact, did Griffo.

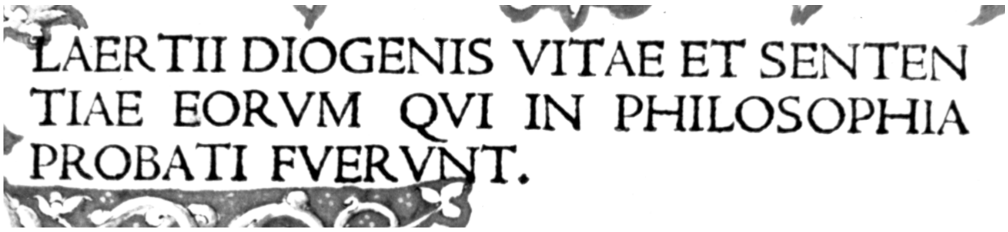

LAERTII DIOGENIS VITAE ET SENTEN
TIAE EORVM QVI IN PHILOSOPHIA
PROBATI FVERVNT.

Figure A8.2 Jenson's capitals in *Vitae et Sententiæ Philosophorum* from 1474 (Museum Meermanno col.).

The combination of the capitals with the roman lowercase letters forced Jenson and Griffo to change their proportions accordingly. In addition the fact that the capitals had to be suitable for usage at small point sizes (Jenson's type was around sixteen 'digital' pica points large), forced them to lower the contrast and subsequently to thicken the serifs. The Roman imperial capitals were not developed for typesetting, but for making inscriptions in stone: 'The most conspicuous difference between the lettering derived from the old roman scriptura monumentalis and the uppercase used by present-day printers is the extension of several characters which, according to the classical letter-cutters and their disciples of the Renaissance, occupied half a square', and: 'This was a natural development, for the necessities of architects and sculptors, though analogues, are not identical with those of punch-cutters and printers. Having learned and memorised the true proportions of roman letter as taught in the manuals of Moille, Pacioli and others, the goldsmiths, punchcutters and printers relied on their eyes and not upon their measuring tools.'[439]

Did the goldsmiths, punchcutters, and printers really purely rely on their eyes as Morison suggested, or did they actually use different, regularised, measuring

[439] Morison, *Pacioli's Classic Roman Alphabet*, pp.77,78.

methods, perhaps inspired by the manuals of Moille, Pacioli and others? Morison's statement seems to mystify the qualities required for type design, which are described by Allen Hutt as '[...] some indefinable talent in the best punch-cutters and type designers who aimed and continue to aim at optical harmony.'[440]

According to Morison the proportions of the Renaissance printers' capitals were derived from eighth-century publications:

> Although not always very literally, the bulk of the roman capitals used by fifteenth-century printers derive from titles employed in the books of that earlier Renaissance which Charlemagne had directed in the eight century. Thus, Jenson's capitals are by no means immediately classical; they descend from Caroline models.[441]

But exactly how were these Carolingian capitals, that were 'not always literally' taken, adjusted to the proportions of the roman lowercase by Jenson? The enlarged widths of a couple of the capitals, like B, E, F, K, L, P and S, was explained by Morison as '[...] in order to avoid a contrast between wide and narrow letters', but he provides no clues concerning the measures of things.[442] Catich held the view that the capitals in Latin bookhands had no relation at all to the lapidary capitals of the Romans: 'There seems to be no basis for this assumption. On the contrary it is disproved by the use of thin strokes in the bookhand which do not occur in the monumental letters.'[443]

Goudy points out in *The Alphabet* that although Jenson's '[...] individual forms are in perfect symmetry and accord in combination', 'Jenson had an instinctive sense of exact harmony in types, and he was so intent on legibility that he disregarded conformity to any standard [...].'[444] Or did Jenson actually provide the standards for roman type, because it formed the basis '[...] which has been the inspiration for all fine roman types since 1470 [...]?'[445]

A8.3 Fence-posting

In *The Psychology of Art Appreciation* Funch refers to Gombrich's claims that the idea of 'the innocent eye' in art is a myth: 'The mind tends to classify and register the seen in terms of what we already know and visual details may be left unnoticed because of

---

440 Hutt, *Fournier*, p.XII.
441 Morison, *Pacioli's Classic Roman Alphabet*, p.79.
442 Ibid., p.80.
443 Catich, *The Origin of the Serif*, p.112.
444 Goudy, *The Alphabet*, p.77.
445 Ibid., p.77.

the viewer's lack of knowledge.'[446] One of the visual details that seem to be left unnoticed in the types from the early Renaissance punchcutters is the adjusting of the horizontal proportions of the capitals in roman type to the lowercase. As mentioned in the previous section, Morison's claim that the fifteenth-century printers' capitals were based on Carolingian ones was not accompanied by any information on the adjustment of their proportions.

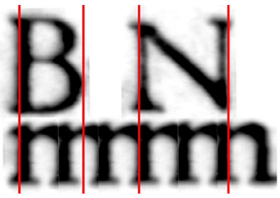


Figure A8.3 Jenson's capitals horizontally measured using an n-based fence.

Figure A8.3 shows the horizontal proportions of a couple of Jenson's capitals against a rhythmic 'fence' construction of lowercase n's. It looks as if the widths of Jenson's capitals are based on (a repetition of) the width of the n. Morison considered the capitals of Jenson to be too large: '[…] it is in his capitals that Jenson is perhaps most open to criticism; they are too large for the lower case […].'[447] The remaining question is: what are these proportions based on?

Figure A8.4 shows capitals of Adobe Jenson, a fairly faithful rendition (although perhaps somewhat light to accommodate the taste of the twentieth-century typographer) on an n-based fence. Like many other capitals, the C, D, H, and N fit within a doubled n. The B fits within one and a half n, like the E, the F, and the P also, for example, do. The subdivision of the lowercase n in smaller parts may have played a major role in defining the letter spaces too.

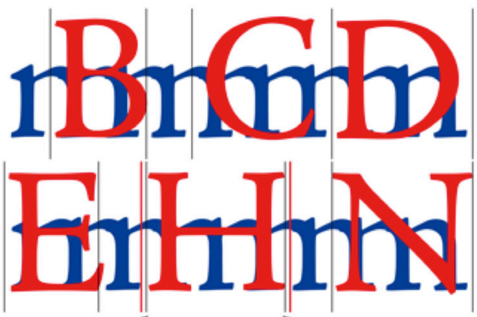


Figure A8.4 Adobe Jenson capitals on an n-based fence.

446 Funch, *The Psychology of Art Appreciation*, p.82.
447 Morison, *Type Designs of the Past and Present*, p.19.

Jenson was not the first to cut roman type but he set the standard for quality: 'The general calligraphic scheme of the letter does not differ from that of Da Spira. It is the technical excellence, such as might be expected from an engraver of Jenson's experience, that confers distinction upon his types.'[448] It should be noted that it is not certain that Jenson himself engraved the archetypal roman type model of which he is considered the architect: 'It is not to be assumed as certain that the types of Jenson, either gothic or roman, were cut by his own hand, though he may have brought his own punch-cutter with him.'[449]

If Jenson used n-based proportions, did Griffo follow this scheme? The capitals of Monotype Bembo in Figure A8.5 show the same n-based proportions as the ones in Figure A8.4. The B and C have an identical relation to the n as in Jenson's type, but the H and N deviate somewhat from Jenson's versions, which seems to æsthetically improve the proportions of Griffo's capitals.

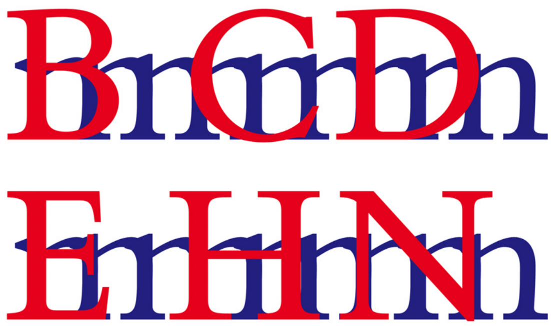


FIGURE A8.5 *Monotype Bembo* capitals on an n-based fence.

The capitals used in the *Hypnerotomachia Poliphili* seem to diverge even more from Jenson's n-based scheme for the capitals. To illustrate this, Monotype's Poliphilus, which is a precise rendition of the historical type, is used in Figure A8.6. Poliphilus was '[…] was recreated, as it stood, from the original […]. The printed letters were one by one reproduced with their outlines as impressed on the paper'[450] in Francesco Colonna's *Hypnerotomachia Poliphili* uit 1499.

[448] Morison, *Type Designs of the Past and Present*, p.28.
[449] Morison and Day, *The Typographic Book 1450–1935*, p.28.
[450] Morison, *A Tally of Types*, p.54.

Figure A8.6 Monotype Poliphilus capitals on an n-based fence.

The proportions of Garamont's capitals, represented in Figure A8.7 by Garamond Premier, seem to be a mix of the proportions found in Griffo's capitals for the *Hypnerotomachia Poliphili* and *De Aetna*.

Figure A8.7 Capitals of Garamond Premier on an n-based fence.

Because of their different morphology, capitals have their own rhythmic system and hence spacing requirements. For the lowercase the n defines the rhythmic system, while for capitals this is the H. Figure A8.8 shows fence-posting based on the H and the related treatment of the overshoot of the O.

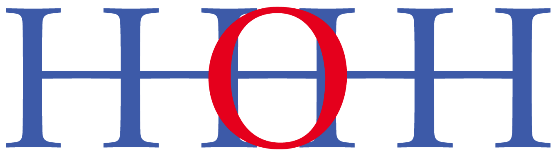


Figure A8.8 Capitals have their own rhythm and hence spacing.

The differences in proportions of the Roman imperial capitals can be explained geometrically using squares and rectangles, something that both Pacioli and Dürer, among others, did, as described in Appendix 7. The adaptation of the capitals to the lowercase of roman type seems to have been influenced by capitals applied in Carolingian books and the proportions of the m. If the standard for the width of the capitals has been defined, the other capitals can be designed within a related rhythm. Figure A8.9 shows a fence of H's using a shift of half the letterform. The other capitals fit in this rhythm and the spacing for the capitals is a direct result of this rhythm; no optical corrections are made.

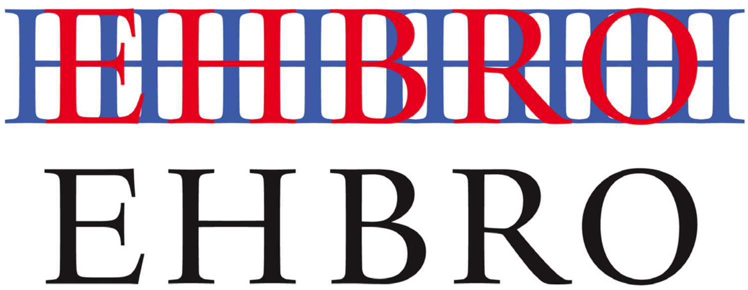


Figure A8.9 Capitals spaced on their rhythmic system.

The capitals Jenson developed for his 'Eusebius' type seem to have been based on the fencing rhythm of the n. Griffo and his followers deviated somewhat from this scheme. Despite the deviation, the spacing of the capitals was in all of these cases based on the stem interval of the lowercase, with which the capitals had to be combined. In roman type capitals are forced in the rhythm of the lowercase (Figure A8.10). After all, there only two cases in foundry type: upper- and lower case: there is not a third case for capitals on adjusted widths. If required, for instance for a capitalized title, the typesetter had to properly space the capitals by eye. This was not different for the 'hot metal' Monotype composing machine or for phototypesetting, although in this case the typographer usually instructed the typesetter. However, in present-day digital type it is possible to put additional information in the fonts for the spacing of capitals relatively to each other.

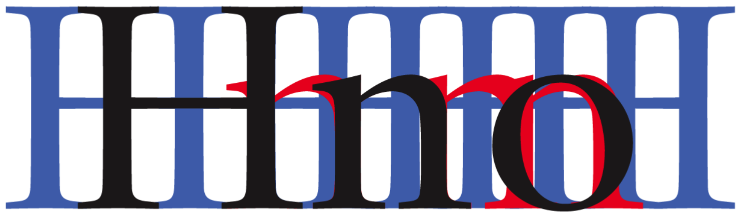


Figure A8.10 In roman type capitals are forced into the rhythmic system of the lowercase.

Figure A8.11 shows a translation of the fence posting rhythm applied on Adobe Jenson into a unit arrangement system. This cadence-unit system is based on the division of the stem interval on the lowercase letter n. The distance from a side bearing to the centre of the letter equals the stem interval. The resulting character width (twice the stem interval) can be divided into smaller units by either bisecting the stem interval or by dividing into in an arbitrary number of units.

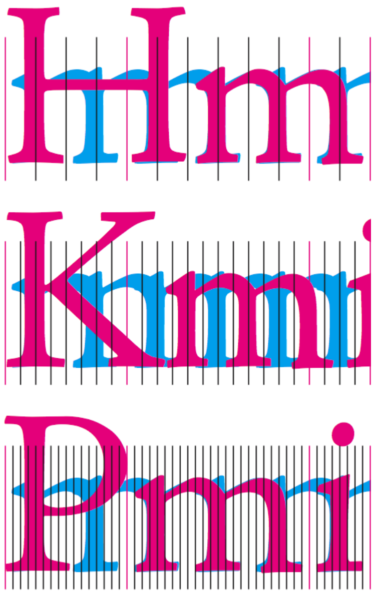


Figure A8.11 Fitting of capitals on n-based spaces.

Please note that in all of these examples digital renditions have been used. However, the initial Italian Renaissance type was made for small point sizes (around sixteen digital pica points) and by definition the deviations in the original printed letters leave some room for interpretation.

APPENDIX 9: SYSTEMS AND MODELS IN TYPE

A9.1 Introduction

This appendix is supplemental to Chapter 4 and is referred to in Section 4.2. It provides additional information on the script-related structures that form the basis of writing and type. To understand the fundamentals of type design all these aspects have to be mapped. This mapping is also a prerequisite for the artificial (re)production of type design processes.

A9.2 Systems and models

The purpose of the systems and models I defined during my research is to map the aspects and elements that together determine the shapes and consistency of the graphemes in use for representing the Latin script, i.e., the letters and characters, and the way they interact. So, the subdivision of scripts into the systems and models, as shown in the diagram in Figure A9.1, is specifically meant to illustrate the Latin script, although (parts of) the subdivision might be applicable for other scripts too. However, this is beyond the scope of my research.

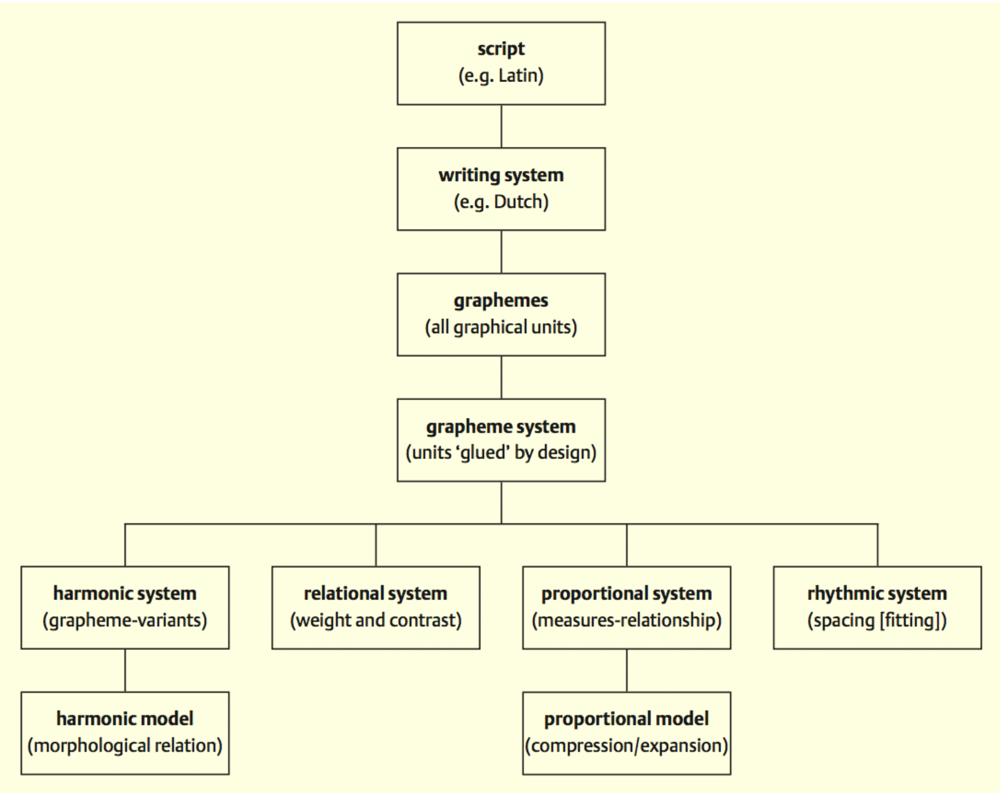


Figure A9.1 Scripts and derived systems and models.

Scripts form the apex of a system that comprises writing systems, graphemes, grapheme systems, harmonic systems (which can be subdivided in harmonic models), relational systems, proportional systems (which can be subdivided in proportional models), and rhythmic systems. Scripts can be related: for example the Cyrillic script shares elements of the Latin and Greek scripts.

Writing system is the orthographic term for a collection of graphemes, and the subsequent rules required to represent one or more (by definition related) languages. Translated into typographic terms, a writing system contains glyphs, which are formalised and fixed (as synonym for incised or engraved) language(s)-specific graphemes.

Graphemes are the units that make up a writing system. They are essentially the graphical equivalents of phonemes, i.e., the basic units of spoken language. Graphemes comprise letters, syllables, characters, numerals, and punctuation marks (of which there are no equivalents in speech). One can consider this collection as a container with all variants of all informal and formal grapheme variants, i.e., grapheme systems, used or in use for a writing system such as for instance capital, uncial, textura, rotunda, Humanistic minuscule, roman type, italic type, fraktur, et cetera.

Graphemes in their written form are by definition modular, because they are the results of the recurrent application of relatively restricted movements made with a certain writing tool. In their typographic form graphemes show the same modularity as a result of the transformation of the handwritten forms to formal variants. The extent to which graphemes form coherent groups depends on how consistent these movements are. For instance some graphemes can be made (unintentionally) smaller or wider than others, which will result to some extent in an obstruction of the rhythm.

Grapheme systems are collections of graphemes which share general constructional aspects. The combined graphemes do not necessarily have to share the same morphological background; they can be 'glued' together by design, i.e., the tweaking of details (see: harmonic models below). The combination of graphemes with different morphologic origins in a grapheme system can for instance be the result of an evolutionary process, but also of the direct interference by scholars, like Alcuin of York's influence on the shaping of the Carolingian minuscule. In the Greek and Latin scripts the core of every grapheme system is formed by the alphabet.

The grapheme systems, either calligraphic or typographic, in use for representing the Latin script since the invention of movable type are capital, uncial, book-hand minuscule, and cursive minuscule. Each grapheme system comprises variants, i.e., harmonic systems, which are often the result of evolutionary processes. These variants share the same overall morphology, but their details are different: for example, inscribed, written, and typographical variants mutually differ.

It has to be noted here that the role of the grapheme system uncial has been relatively small, and its present-day use is restricted to Gaelic, the Celtic language of which Irish and Scottish variants exist.

Harmonic systems are formed by specific variants of grapheme systems. As subdivisions of grapheme systems, harmonic systems by definition share the same basic structure, but differ in proportions and/or details. For instance the grapheme system Latin capital comprises the harmonic systems Roman imperial capitals and roman type capitals. These two harmonic systems differ in proportions and details, like the form of the serifs, but they share the same basic structure. The written Renaissance capitals incorporated in the Humanistic minuscule form a separate harmonic system within the grapheme system capital, because they differ in details from for instance the lapidary and typographic capitals. Still, the written capitals share the same morphology as the regularized and formalised variants. Greek capitals are part of a different grapheme system, due to their different forms.

The same subdivision as for the grapheme system capitals can be made for the grapheme system book-hand minuscules. The minuscules of textura (type), rotunda (type), Humanistic minuscule, and the lowercase part of roman type are harmonic systems within this grapheme system. The minuscules of bastarda, schwabacher, fractur, Humanistic cursive, and cursive type form different harmonic systems, which are all part of the grapheme system cursive minuscule.

Harmonic models are subdivisions of harmonic systems based on the morphological origin of the graphemes combined. The consistency of a harmonic system depends on the number of harmonic models it comprises. For instance the lowercase of roman type contains two harmonic models. There is a primary, i.e., dominant, one for all letters with exception of the k, s, and the v–z range. The letters that are part of the primary harmonic model are all constructed with the same basic elements. The exceptions form the secondary harmonic model; these letters have a different morphological background, because they find their origin in the grapheme system capitals.

Relational systems comprise the (relative) boldness or weight, and the amount of contrast in the graphemes. In terms of the broad nib it describes the relation between the nib-width and the x-height, and the relation between the nib-width and nib-thickness.

Proportional systems describe the relationship between the x-height and the width of the graphemes. It also describes the relationship between the size of the x-height and the lengths of the ascenders and descenders. These aspects are captured in the proportional models (see below). Proportional systems can also comprise cross-grapheme system information, such as the relation between the proportions of the minuscules of a book-hand and the accompanying capitals (or majuscules, if applicable). These aspects are captured in dynamic em-squares (see also Chapter 8).

Proportional models define the degree of compression or expansion in the primary harmonic models. There can be more than one proportional model in a harmonic model, which in theory indicates that there is an inconsistency in the construction (read: design). In that case there is a usually a primary, i.e., dominant, proportional model and a secondary one.

Rhythmic systems define the intervals of stems and the relation between the counters and the space between the graphemes, i.e., the spacing (fitting). This implies for instance that a change in the proportional system will lead to an increase or decrease of the spacing because it will change the rhythmic system. Irrespective of the number of proportional systems there can only be one rhythmic system in a harmonic system, otherwise the spacing will result in separated, i.e., isolated, groups of graphemes.

All systems directly interact with and influence each other. A change in the proportional system will lead to an increase or decrease of the spacing because it will change the rhythmic system. The application of multiple proportional systems will result in different sized counters and will, by definition, consequently obstruct the rhythmic system. Irrespective of the number of proportional systems there can be only one rhythmic system, otherwise the spacing (fitting) will result in separate groups of graphemes.

A9.3 Grapheme system

The graphemes in use for the Latin script can be grouped into four grapheme systems:

- capital;
- uncial;
- Latin bookhand minuscule;
- Latin cursive minuscule.

Each grapheme system comprises variants that share the same morphology, such as for instance inscribed, written, or typographical forms. If the variants contain the same harmonic models and only differ in proportions or details, they belong to the same harmonic system. For instance, the grapheme system 'capital' comprises one harmonic system for both the Roman imperial capitals and the capitals used in roman type, despite the differences in the proportions and details, like the form of the serifs, because they share the same basic structure. The written Renaissance capitals incorporated in the Humanistic minuscule belong to the same harmonic system, although they differ in details from the lapidary and typographic capitals. Still, they share the same morphology as the regularized and formalised variants.

Greek capitals form another harmonic system, because they differ too much from their Roman counterparts to be placed in the same group. So, if the underlying harmonic models differ, like the Humanistic minuscule in comparison with textura, this results in different groupings, i.e., in different harmonic systems within a grapheme system.

The grapheme system 'uncial' contains the harmonic systems uncials and semi-uncials and the uncial-derived gothic majuscules of the textura, rotunda, schwabacher, and bastarda/fraktur.

The 'Latin bookhand minuscule' system comprises the minuscules of the (mostly interrupted) 'book-hands' starting with the Carolingian minuscule. Further it contains the harmonic systems (all derived from the Carolingian minuscule) textura, rotunda, Humanistic minuscule, and roman type (in all cases: only minuscule [calligraphy] or lowercase [typography]). Although the morphology of the gothic book-hands is basically the same as that of the Humanistic minuscule, the differences (especially in the underlying secondary harmonic models [k, s, v, w, x, y, z]) are large enough to place them in different harmonic systems.

The 'Latin cursive minuscule' system comprises the uninterrupted hands, like Humanistic cursives and semi-uninterrupted hands, like the chancery italics ('cancellaresca') and their derived typographic variants.

The fact that capitals or uncials are combined with minuscules in written and printed texts and are adapted for this usage does not mean that their morphology is related to that of the minuscules. For instance the gothic majuscules and minuscules have some shapes in common, but mostly the constructions of these grapheme systems differ. Nevertheless the majuscules and minuscules are combined under single names, like 'textura' and 'rotunda', for the ease of use (and perhaps for classification reasons as well). Renaissance minuscules and capitals are indicated as a single group of letters under the name Humanistic minuscule.

The capitals, majuscules and minuscules on their own do not form completely coherent groups of letters. They often comprise letters from different origin, with subsequent different constructions: 'harmonic models'.

A9.4 Harmonic models

The grapheme systems Latin bookhand minuscule and Latin cursive minuscule contain two harmonic models: the primary harmonic model without any diagonals and the secondary harmonic model, which has been derived from the capitals and of which all letters containing diagonals (k, s, v, w, x, y, z). Consequently the grapheme systems are by definition inconsistent, despite the fact that they are considered unities. This results for instance in the fact that the spacing of the secondary harmonic model is a compromise; these letters are forced to fit as much as possible in the rhythmic system of the primary harmonic model. In the typographic practice the inevitable resulting inconsistencies in the letter spacing are circumvented with kerning pairs.

The vector-based construction of the Humanistic minuscule (and consequently roman type) can be captured in the primary harmonic model that is based on the construction and proportions of the o. Nineteen letterforms (a, b, c, d, e, f, g, h, i, j, l, m, n, p, q, r, long s, t, u) can directly be derived from the o by drawing vertical lines through the intersection points of the two translated circles. Because of the direct relation with the Humanistic cursive, the same grouping of characters can be made for this harmonic system.

A primary harmonic model by definition contains the majority of characters in a harmonic system. It defines the rules for the spacing, i.e., rhythmic system, and for the proportions of the remaining letters, which in case of the Humanistic minuscule (roman type) and Humanistic cursive (italic) are the diagonal letters k, s, v, w, x, y, z. These letters all are derived from the capitals and form together the secondary harmonic model (see next section).

The letters of the primary harmonic model can all be derived from the o, which implies that there is one proportional model within a proportional system. Matters can become more complex when the widths of the letters correspond to more than one proportional model. The rhythmic system will then normally be defined by the n.

If multiple proportional models are applied in the primary harmonic model, the rhythm will be messed up.

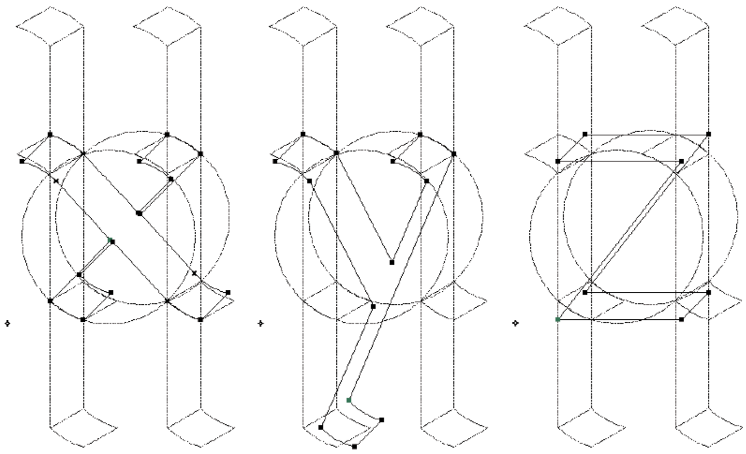


Figure A9.4 Fitting the secondary model using the parameters of the primary one.

As mentioned above, the diagonal letters of the Humanistic minuscule and cursive form together the secondary harmonic model. These letters have a morphology that is unrelated to that of the o-derived letterforms. In practice this means that these letters have to be forced to fit into the system defined by the primary harmonic model. For the Humanistic minuscule this implies that not only the widths of the diagonal letters have to adjusted, but also that elements like the 'feet' have to be added to the k, v, w, x, y (Figure A9.4). The calligrapher will usually also bend the diagonal strokes slightly to make the forms fit better in the atmosphere of the o-based letters.

The diagonal letters are forced into the rhythm of the primary harmonic system. The idea of equally dividing the space between the letters based on the space within the letters, i.e., in the counters, is basically impossible to maintain for the diagonal letters. The calligrapher forces these letters into the rhythm, by adapting and connecting letterforms. The type designer designs the diagonal letters in such a way that they do not obstruct the rhythm too much, for instance by shortening the serifs on the outsides, and, if possible, by adding spacing-corrections for individual letter combinations, the so-called 'kerning pairs'.

A9.5 Capitals

Roman capitals find their origins in the skeleton forms of the Greek's (Figure A9.5). The 'gutter' or ductus of the inscribed Roman capitals actually reveals the original underlying skeleton form. The relatively simple geometric constructions allow the application of a vector, using arbitrary angles. This is in contrast with the construction of the Carolingian and Humanistic minuscules.

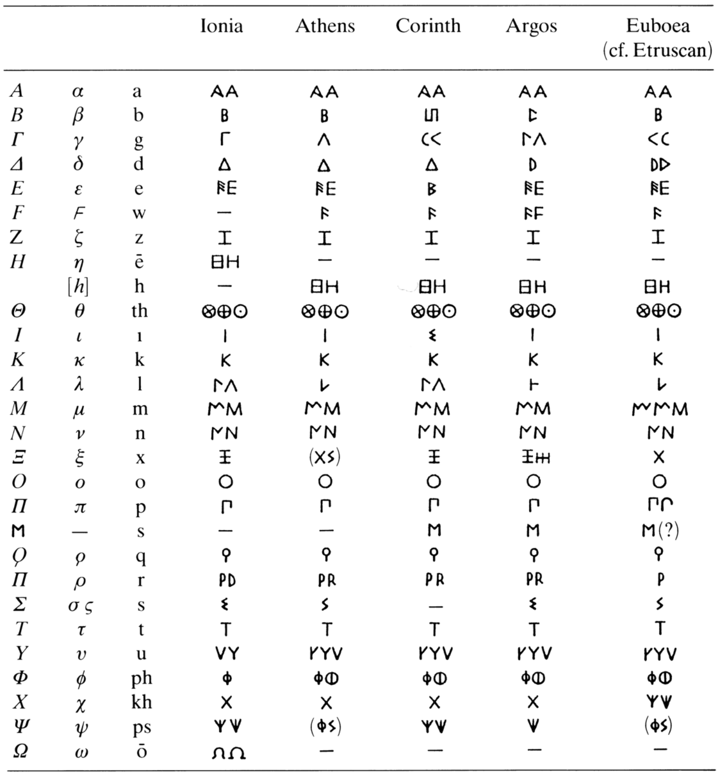


Figure A9.5 Archaic Greek alphabets.[451]

Figure A9.6 shows two lapidary inscriptions, with Greek monolinear capitals on the left and Roman flat brush-based capitals on the right. The construction of both harmonic systems is closely related, but the details clearly differ. This difference could have been caused by the application of the flat brush by the Romans, as Johnston stated: '[…] it is reasonable to suppose that the use of the pen may have strongly influenced the finished Roman characters.'[452]

[451] Cook, *Greek Inscriptions*, p.8.

[452] Johnston, *Formal Penmanship and Other Papers*, pp.36–37.

Figure A9.6 Greek inscription from the Roman period (left) and Roman imperial capitals (right).

A9.6 Uncial

Thompson writes in *An Introduction to Greek and Latin Palaeography* that:

> The term ‘uncial’ first appears in St. Jerome’s Preface to the book of Job, and is there applied to Latin letters, ‘uncialibus, ut vulgo aiunt, litteris,’ but the derivation of the word is not decided; we know, however, that it refers to the alphabet of curved forms.[453]

Uncials form the link between the capitals and the later Latin bookhand minuscules. In early Greek cursive specimens on papyrus minuscule forms can also be found.[454] It was the common type used by the Greeks and Romans, and also in the early Middle Ages.

Uncials were a more informal variant of the Capitals: ‘[…] curves are freely introduced as being more readily inscribed with the pen of soft material such as papyrus.’[455] The shapes of the uncials were further developed when vellum replaced papyrus: ‘[…] the strong material and smooth surface of prepared vellum were adapted to receive a stronger writing, one in which the scribe could give rein to his skill in calligraphy […].’[456] The dating of early vellum uncial manuscripts seems to be difficult ‘[…] since few fixed points are available.’[457] The oldest of these manuscripts date back approximately to the first centuries A.D., but the later general use of parchment instead of papyrus for book production was the result of this preference by the Christian Church.[458]

---

[453] Thompson, *An Introduction to Greek and Latin Palaeography*, p.102.
[454] Ibid., p.103.
[455] Ibid., p.102.
[456] Ibid., p.137.
[457] Diringer, *The Book before Printing*, p.202.
[458] Ibid., p.202.

The blending of the majuscules and minuscules resulted in the Carolingian script at the end of the eighth century.[459] The majuscules of the gothic book-hands from the late twelfth century onwards directly descended from the uncials.

A9.7 Latin book-hand minuscule

The Carolingian minuscule and the derived Humanistic minuscule find their shapes in the broad nib. Figure A9.7 shows a geometric representation of the movements made when writing most of the letters (except the k, s, and v–z range) of the Humanistic minuscule with a broad nib and a vector angle of 30 degrees. Because of the vector-shape pen, the circular movement when making an o results in a translation of the circle. Such twin-point strokes become directly visible when written with a points-level double pencil.

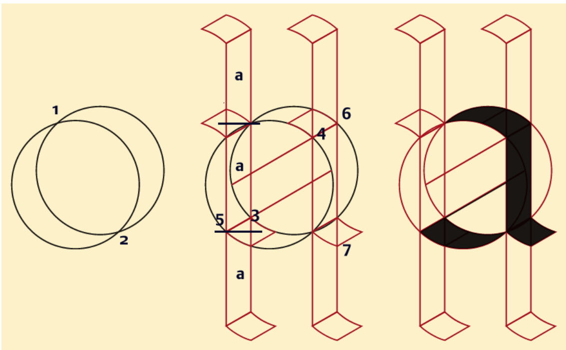


Figure A9.7 Construction of the primary harmonic model of the Humanistic minuscule.

Vertical lines can be drawn through the intersection points *1* and *2* of the circles (labelled 'dimples' by Johnston). These lines intersect with the circles at *3* and *4*. Drawing the vector (which has a constant length, of course) from these intersection points results in intersections with the circles at *5* and *6*. The drawing of vertical lines through these intersections results in the creation of stems. Repeating the stem part (indicated by 'a' inside the circles) results in ascender and descender lengths. The short stroke endings can also be derived from the circles and the intersections with the vertical lines, like at point *7*.

To calculate the stem-width (perpendicularly measured) from a certain vector length in combination with a certain vector-angle, relatively simple mathematics are involved. In case of a translation over 30 degrees, the stem thickness will be the width of the vector multiplied with sin 60 degrees (= 0.87 vector).

[459] Ibid., p.287.

A9.8 Latin cursive minuscule

In the chapter on *The Roman Cursive Script* in *An Introduction to Greek and Latin Palaeography* Thompson shows a table of Latin cursive alphabets written by Romans with the stilus and with the pen, of which Figure A9.8 shows the monolinear-line alphabets. These Roman cursive alphabets 'represent the ordinary writing of the people for about the first three centuries of the Christian era. The letters are essentially the old Roman letters written with fluency, and undergoing certain modifications in their forms, which eventually developed into the minuscule hand.'[460] According to Thompson the sloped character of the letters is caused by the circumvention of friction: 'The natural tendency, in writing on resisting or clinging surface such as wax, is to turn the point of the writing implement inwards and hence to slope the letters to the left.'[461]

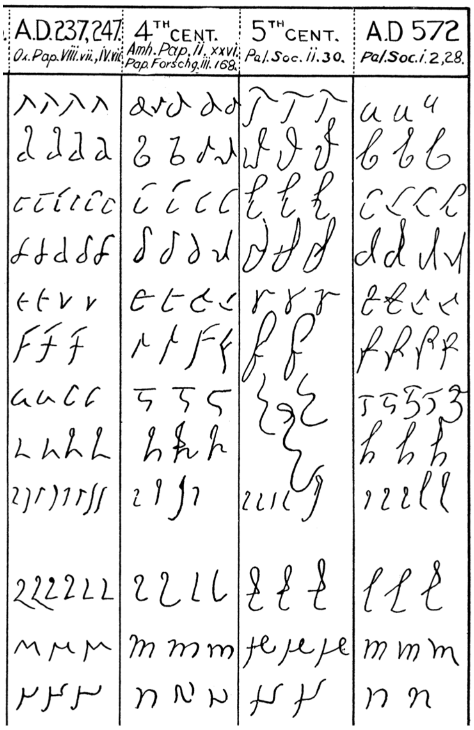


Figure A9.8 Latin cursive alphabets as written with a pen by the Romans.

The part of the table reproduced in Figure A9.8 shows a remarkable diversity in shapes, which foreshadow many of the formal and informal variants that appeared at later times. Especially the sixth-century Roman cursive in the right column does not seem to have diverged much from our modern handwriting.

---

[460] Thompson, *An Introduction to Greek and Latin Palaeography*, p.311.
[461] Ibid., p.315.

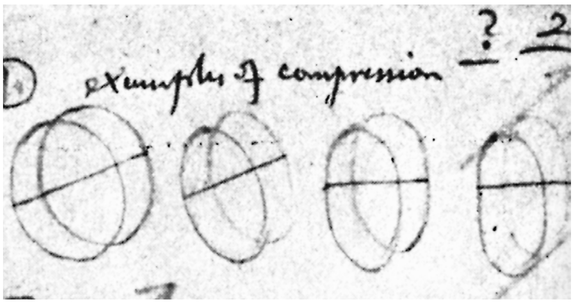


Figure A9.9 Notes from Johnston showing the first step to italic, i.e., compression.[462]

Cursive and italic are terms used interchangeably: 'It is convenient to use the term "Italics" for both the cursive formal writing and the printing resembling it. Italic type was first used in a "Virgil" printed by Aldus Manutius of Venice in 1500. [...] It was counterfeited almost immediately (in German and Holland it was called "cursive") [...].'[463] Noordzij uses in *The Stroke of the Pen* the term 'italic' exclusively for 'hybridized' cursives, which are cursives with an interrupted construction.[464]

The cursive is also sometimes called 'running hand' ('cursive' is derived from the Medieval Latin word 'cursivius', which in finds its origin in the Medieval Latin word 'currere', which means run or gallop).[465] The first condition for writing fast(er) is to cover a smaller area per letter, and therefore the letters have to be compressed. Edward Johnson described this compression as the first step towards italic letters (Figure A9.9). The other prerequisite is uninterrupted writing, i.e., connecting the strokes of a letter without lifting the pen from the paper. If applicable, letters within a word can be connected. Formalisation of the cursive letterforms led to interrupted variants: '[...] we may expect to find hybrids in any situation where writing is intended to be beautiful (e.g. Arrighi's books) [...].'[466] Cursives are from origin informal (meant for ordinary writing), but there are formally written variants, like the gothic bastarda and the Renaissance cancellaresca. The construction of the latter was formalised by interrupting the upstroke.

The vector angle (pen angle) for the Latin bookhand minuscule is generally 30 degrees. If letters are compressed they become relatively bolder. This effect can be tempered by applying a steeper vector-angle, which reduces the stem width. Compressed letters contain less horizontal information and if the arches of formal

---

462 Johnston, *Formal Penmanship and Other Papers*, p.160.

463 Edward Johnston, *Writing and Illuminating & Lettering* (London: Sir Isaac Pitman & Sons Ltd., 1945), p.275.

464 Noordzij, *The Stroke of the Pen*, p.33.

465 <http://www.myetymology.com/latin/cursivus.html>

466 Noordzij, op. cit., p.33.

book-hands are replaced by upstrokes, as is done in cursive hands, there are only a couple of horizontal strokes left, like the top of the a (and related letters like b, d, g, p, q) and the z. The steeper angle also helps to reduce the friction; the more the vector-angle is in the direction of the upstroke, the less friction will be encountered.

The angle of the pen is, of course, relative to the slope of the characters. The idea that the angle for cursives is fixed at 45 degrees is a mistake in my opinion. It can be found in almost every book on writing: '[…] when square-edged hard tools are used, a tendency to maintain the same cant throughout a body of writing, to accent the thinnest edge stroke and to write about 45 degrees cant.'[467] To keep the horizontally stressed strokes in balance with the vertical ones, the stem-width should remain the same when perpendicularly measured.

This leads to the equation 's = p x sin (90 – α – β)', where s = stem width, p = pen width, α = pen angle, and β = italic angle, as shown in Figure A9.10. This implies that for slanting the letters a degree, the vector-angle should decrease by a degree. This means that with a 'normal' italic angle of 15 degrees, the vector-angle should be 30 degrees, which is the same as for a Humanistic minuscule. In other words: if a Humanistic minuscule is combined with a related cursive, the same vector-angle can be applied when the cursive is slanted 15 degrees.

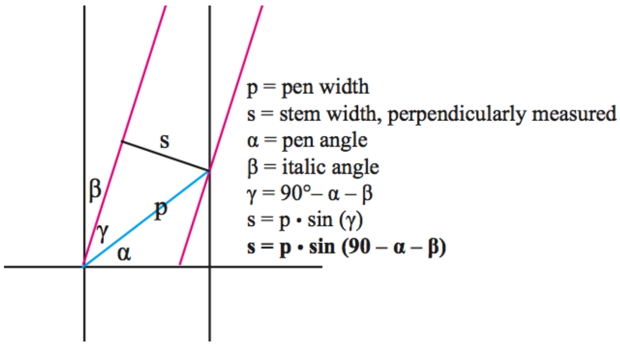


Figure A9.10 Reduction of the pen angle compensates for the slanting-effect on the stem-thickness.

Cursives or italics do not necessarily have to be slanted. Formal cursive hands like bastarda stand straight upwards. The bastarda can hardly be described as a 'running' hand; in this case the construction of the upstrokes reduces the speed of writing. Slanting looks to be a prerequisite for faster writing, because it makes shortcutting easier. The suppression of horizontally-stressed parts at the end of clockwise upstrokes and subsequently at the end of counter-clockwise upstrokes is a prerequisite for making upstrokes.

[467] Catich, *The Origin of the Serif*, p.144.

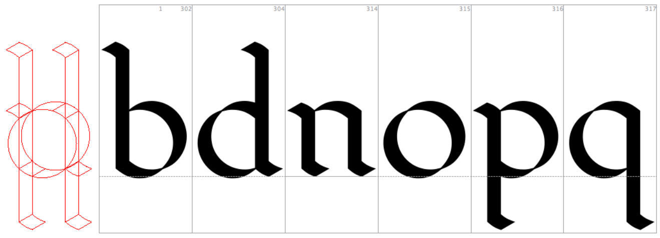


Figure A9.11 Geometric representation of the Humanistic minuscule.

The cursive letterforms from the Renaissance are directly related to the formal minuscules; hence the letters can be similarly mapped in harmonic models. The main differences between the Renaissance formal and informal hands are the compression of the letterforms and the shortcuts, i.e., upstrokes, which suppress the arches in the latter. Due to the compression, the cursive letters lose some of their curvilinearity.

Figure A9.11 shows a geometric representation of the Humanistic minuscule made with a vector-angle of 30 degrees. In Figure A9.12 these letters are compressed and slanted 15 degrees; the vector-angle remains the same.

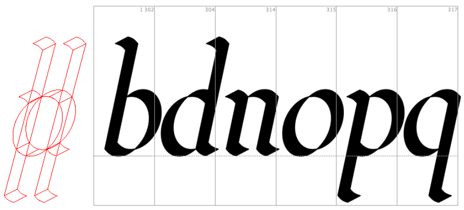


Figure A9.12 Slanted and compressed variant of the Humanistic minuscule.

Figure A9.13 shows a suppression of the arches due to the (shortcutting) upstroke. Let me underline here that this is a purely theoretical representation.

Figure A9.13 Slanted and compressed variant of the Humanistic minuscule with a shortcut.

A9.9 Relational system

The boldness, (weight or density) of a letter is the relation between the pen strokes and the counters. Because of the direct relationship between the size of the counters and the space between the letters (rhythmic system), the boldness has an effect on all white spaces. In the case of a broad nib, emboldening implies the lengthening of the vector, although this only leads to emboldening if the height of the letter is kept unchanged. Lengthening the vector always leads to an increase of contrast (the relation between the width and the thickness of the nib), but an increase of contrast does not by definition lead to an increase of weight.

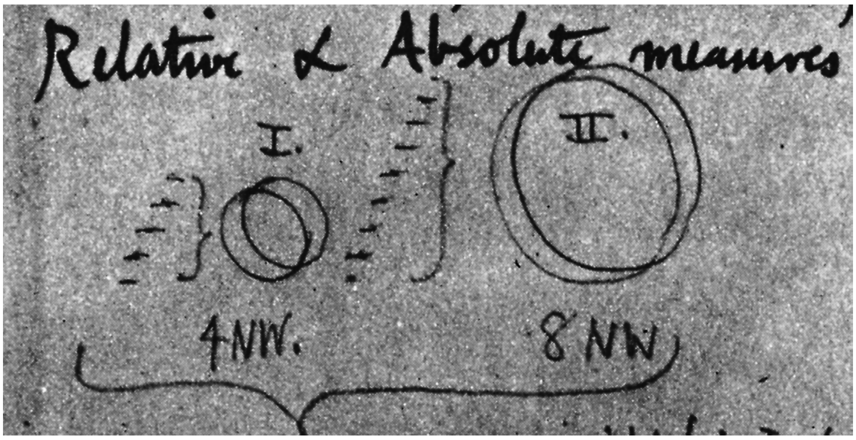


Figure A9.14 Notes from Johnston in which he describes the relation between weight and height.

Weight is therefore a relative matter. Johnston defined weight as follows: 'The weight may be described as the relation of the width of the pen's broadest stroke to the height of the letters. And, as the width of the broadest stroke is given by the breath of the nib, this ratio is most conveniently expressed – and measured – in nib-widths […].'[468] Noordzij followed Johnston in *The Stroke of the Pen* and also applied the effect onto the flexible-pointed pen ('expansion'): 'The ratio of the translation or the expansion to the x-height of the script could be a figure for the description of weight.'[469]

Both Johnston and Noordzij place the western writing within the 3-5 nib-widths in relation to x-height range. Johnston labelled the 5:1 ratio 'light', the 4:1 ratio 'medium', and the 3:1 ratio 'heavy'. Noordzij used the term 'relative translation' and places the Carolingian and Renaissance scripts in the 5:1 range, the gothic scripts in the 3:1 range, and the Mannerist scripts (sixteenth century) in the 3:1 – 5:1 range.[470]

468 Johnston, *Formal Penmanship and Other Papers*, p.91.
469 Noordzij, *The Stroke of the Pen*, p.12.
470 Ibid., p.13.

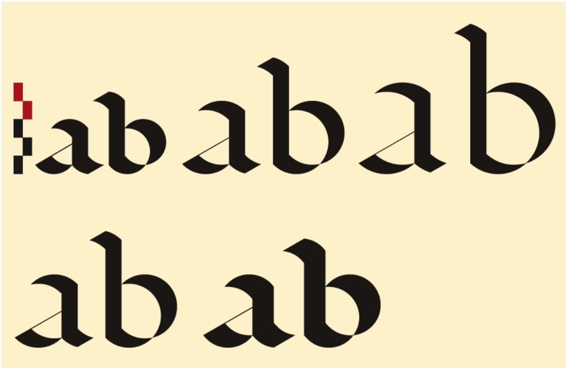


Figure A9.15 Relative (top) and absolute (bottom) increase of weight.

The top row of Figure A9.15 shows an increase of height of the letters and a fixed pen width. The ratio for the x-heights varies from three times the pen width to five times the pen width. The effect of the 3:1 ratio is that the first letters look bolder because of the relatively small counters. The contrast is the same in all three variants, i.e., the relation between the pen width and the pen thickness is unchanged.

In the bottom row, the increase of weight is achieved by lengthening the vector while retaining the x-height. The thickness of the pen is unchanged and this also leads to an increase of the contrast. This effect is applied when a bold version is made for a typeface, although normally the contrast is lowered somewhat as well because optically the thin parts look thinner in relation to a broader nib.

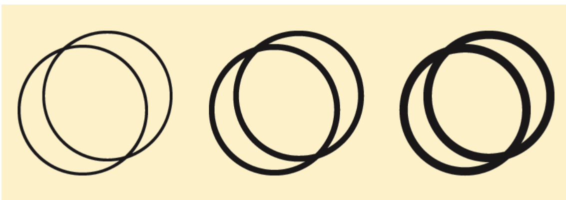


Figure A9.16 Reduction of contrast by emboldening of the twin-points.

The decrease in contrast can be described as an emboldening of the twin points (think of a double-pencil) with which the translated forms are drawn. The ratio of pen-width and pen-thickness can be expressed in the same way as the relation between pen-width and x-height. The relational system comprises two ratios:

– *pen-width : x-height* and

– *pen-width : pen thickness.*

In the case of a translation over 30 degrees, the stem width/thickness (perpendicularly measured) is pen-width x sin 60 degrees, which is 0.87 pen width. This means that with a (x-height:pen-width) ratio of 5:1, the stem width is 1/5.75 of the x-height. Adrian Frutiger's approximation[471] of a 'normal' stem width of a fifth to a sixth leaves some room, but obviously Frutiger took into account that the lowering of the contrast (making the thin parts thicker) increases the total weight. The stem-width of sans serifs, which have a serifed counterpart, usually differs from the latter for that (optical) reason.

A9.10 Proportional system

There is a direct hierarchical relationship between the size of the counters, i.e., the space within the letters, the space between the letters, the word spaces, the space between the lines and even the margins of a text. The more space there is within the characters, the more space between the characters, between the words, between the lines, and around the texts is required.

The consequence of relatively more or less space between the lines as a result of the space within the lines (as a result of the counters) is that there is more or less room for ascenders and descenders as well. Relatively open letters, like the ones by Jenson for instance, will require a considerable amount of space between the lines, and this leaves room for relatively long ascenders and descenders as well. This is especially important for the shape of the g. Condensed letters, like in textura type, should be tightly set in the vertical direction and hence require short ascenders and descenders. Ascenders and descenders should match the proportions within the x-height; too short would mean a distorted relationship and too long would mean that to prevent clipping too much line spacing has to be applied.

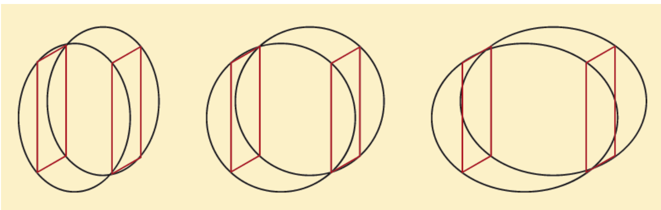


Figure A9.17 Condensing or expanding the circular movement: the stems remain the same.

The relation between x-height, ascenders, and descenders within a harmonic system can be changed by either expanding or compressing the system. The relation in horizontal direction, i.e., letter widths, and the relation between x-height and ascenders and descenders are a direct consequence of the width of the harmonic

[471] Adrian Frutiger, *Zur Geschichte der linearen, serifenlosen Schriften* (Bad Homburg: Linotype AG, ca.1986), p.8.

system, which can be defined as the proportional system. In the main harmonic systems for the Latin minuscule book-hands and Latin cursive minuscule, the relation between the width and the height of the model is evident.

A harmonic system can contain more than one proportional system; the relation between the curved letters b, c, d, e, o, p, q can for instance be based on a different proportional system than the other letters within a harmonic system. In typefaces from different style periods one can find different proportional systems. The way proportional systems are handled within a type design can be considered as characteristic of the designer's idiom.

Because the relational system is in theory the direct result of the proportional system, the relation in writing between the width of the broad nib and the x-height could be considered the *relative proportion*. It is interesting to see that when the relative proportion is changed to 3:1, the counters in the perpendicular letters and curvilinear ones become more equal. The larger the pen width becomes, the greater the difference between the counters of these letters. This effect seems most obvious in the typefaces from the Italian and French Renaissance, which find their origin in the 'relative proportion' 5:1.

A9.11 Monoform and polyform

Typefaces can be based on a single proportional model, like Van den Keere's Parangon Romain (Figure A9.18), or contain multiple proportional models (Figure A9.19), like Van den Keere's Canon Romain.

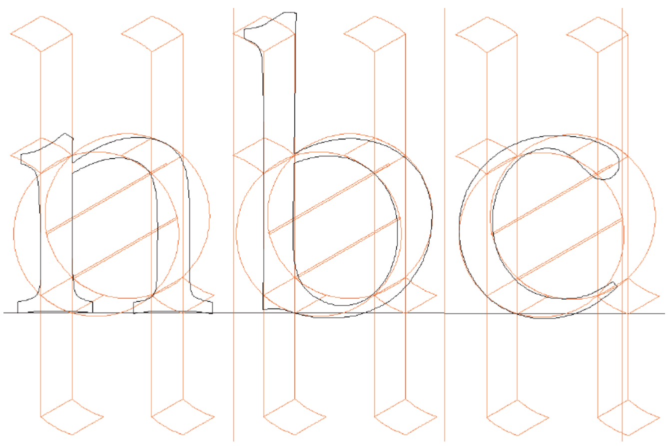


Figure A9.18 Van den Keere's Parangon Romain fits in a single proportional model.

In case of more than one proportional model, the rhythmic system will by definition be a compromise, because the interval of counters will be disturbed. From the research I have done so far in this area, I tentatively conclude that during the Italian Renaissance there were only single proportional models applied in the text typefaces and that in the French Renaissance multiple proportional models were only applied in the display point sizes. The application of multiple proportional models in text sizes seems to appear in the seventeenth century. One wonders if the larger point sizes from the past were used at that time as examples for the smaller type. Further investigations are required to answer this question.

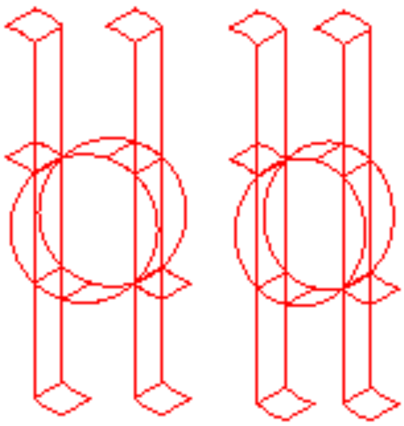


Figure A9.19 Typefaces can contain multiple proportional models.

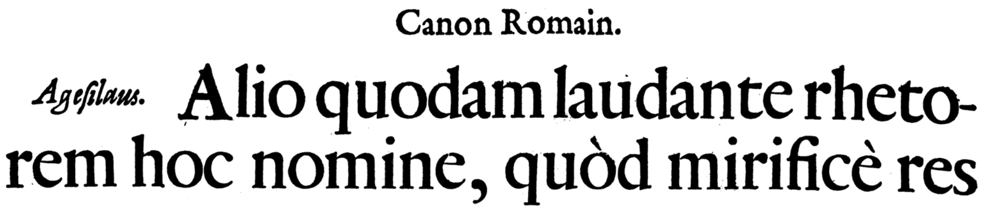
Condensing the 'round' letters provides a way to make a typeface more economic. Van Krimpen applied this idea clearly in his design for Spectrum, which was originally developed as a bible face. Transferring this to the current technology, one could imagine that for instance adding an alternative set for the 'round' letters to a typeface would give the typographer some more options to control the required space.[472]

The expected relation between the size of the counters and the length of ascenders and descenders is the shortening of the latter in case of compression. Figure A9.19 shows the combination of two proportional models with a fixation of the length of the ascenders and descenders based on one of the applied models, in this case the widest (left). In the compressed version on the right the ascenders and descenders look longer in relation to the size of the counter and have to be shortened for a more balanced shaping.

[472] The OpenType format offers the 'stylistic set' option for this purpose.

A9.12 Relative proportional system

The spacing has to be tighter for larger (display) point sizes in comparison with the spacing for smaller (text) point sizes. The reason for this is that the letters become optically more separated at a larger size if the same spacing is applied as for small point sizes.


Canon Romain.

Ageſilaus. Alio quodam laudante rheto-
rem hoc nomine, quòd mirificè res

Figure A9.20 Van den Keere's Canon Romain showing condensed perpendicular letters.[473]

Corrections for this optical effect can be incorporated in the type design itself; in the time of foundry type (before the application of Benton's pantograph) every point size was a type on its own and had to be cut separately. This made adaptations to the different point sizes a standard practice. For instance Van den Keere compressed the perpendicular letters for his larger point sizes, such as his Canon Romain, and obviously used fence posting based on the n for the spacing.


Canon d'Eſpaigne.

Plato Athenienſis. Dicebat in morte a-
micorum quieſcendū eſſe:

Figure A9.21 The proportions of the Canon d'Espaigne seem related to those of the rotunda.[474]

The proportions of the Canon Romain seem to be related to the ones in rotunda type, like in Van den Keere's Canon d'Espainge. In both cases the type contains two proportional models and because of the condensed n's, the related spacing is cramped. Vervliet notes on the Canon Romain: 'In the design of this face Van den Keere kept to the regional tradition of bold, fat-faced Romans with a big x-height, comparable for weight with Gothic letters [...].'[475] Not only are the weight and the relatively large x-height in Van den Keere's Canon Romain comparable with the

---

[473] Vervliet and Carter, *Type Specimen Facsimiles* 2, p.8.

[474] Ibid., p.8.

[475] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.230.

proportions of the rotunda, but the different proportional systems of the latter are also applied in the roman display type.

A9.13 Using systems and models for measurement

Measuring the proportions of letters, such as the x-height, stem widths, and the length of ascenders and descenders, is not complex. One can simply use a ruler, or when there are digital descriptions of the letters available, one can check the coordinates. The relations between the related parts in the different letters can also be measured. More difficult, however, is the representation of the outcome: if there is no generic model, that can be referred to and that can be used to 'rebuild' and represent the letters using the underlying parameters, the result of the measurements can only be shown by graphs.

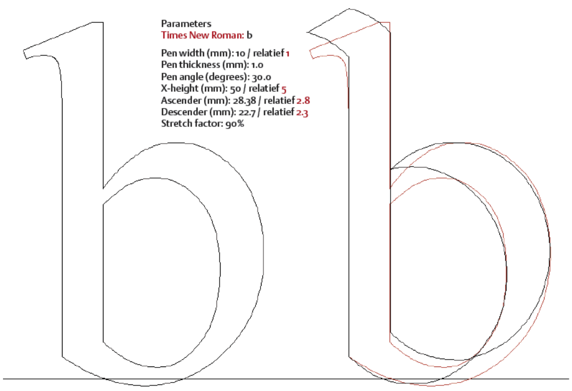


Figure A9.22 Translation of the b of Times New Roman into proportional parameters.

The parameters for the described primary harmonic models for roman and italic type (pen width, pen thickness, pen angle, ascender, descender, stretch factor, italic angle, and curve flattening) can be used to measure typefaces and to translate their underlying patterns into primary harmonic models. Figure A9.22 shows a translation of the lowercase b of Times New Roman into a primary harmonic model. Although the details between the b of Times New Roman and the generic harmonic model differ, the basic characteristics, like character width, stem width, and pen angle, can clearly be visualized.

The measurement of the underlying parameters can be done by software and represented in listings ('pre-sets'), which can be applied in the LetterModeller application, which is described in Chapter 3 Section 2.

APPENDIX 10: SPACING AND CASTING

A10.1 Introduction

This appendix is supplemental to the Chapter 4 and is specifically referred to in Section 1. It provides additional information on the relation between the spacing (fitting) and casting of foundry type.

A10.2 Historical background

One sometimes gets the feeling that the fitting of type is taken for granted in the literature on typography. For instance, in the introduction of *Sixteenth-Century Printing Types of the Low Countries*, Vervliet spends only a few lines on the justification of matrices:

> The strike must be 'justified' to form a matrix. The faces must be filed so as to make the depth of the impression uniform in the whole set of matrices, and so as to make them rectangular and parallel, with margins on either side of the letter calculated to make it look evenly spaced in relation to others and to look upright on the page.[476]

Fournier mentions that matrices should be justified in such a way that after placing them in the mould the subsequently cast type 'has all the accuracy and finish required for printing.' He proceeds with that 'this is called justifying for fixed registers.'[477] Further on Fournier writes on casting: 'The letter m of every fount is taken first, and when this is right it is used as a pattern for the others. Three m's are put in the lining-stick and the first to be cast of every sort is put between them and made to tally with them. The necessary alterations are then made in the mould and the matrix.'[478] This contradicts with the previous statement because if the matrices are justified for fixed registers the checking of the m and other letters in between m's can be skipped. For casting with fixed registers only the position of a single letter has to be checked. Based on my measurements I believe the length of the serifs were an indication for the positioning of the registers in Renaissance roman type. The serifs of the lowercase l were perfectly suited for this because of the letter's symmetry within the x-height.

In Fournier's time also matrices were used that were not justified for fixed registers. These matrices were accompanied by 'set patterns', which were collections of pre-cast type. The caster could use these by putting the type into a matrix for setting the mould's registers.

---

[476] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, pp.7,8.

[477] Carter, *Fournier on Typefounding*, p.89.

[478] Ibid., p.106.

In *Type Spaces* Burnhill describes the 'refined system of dimensional' control, which he found in the publications by Manutius. Burnhill mentions a possible limitation of character widths: 'My guess is that in-house typographic norms had been around since Gutenberg sorted mechanized script into sub-sets by reference to common character widths – say. No more than five or six groupings in all – then constructed a set of fixed-width moulds to suit.'[479] Textura type is very well suited for limiting the number of character widths. Because of the morphologic relationship with textura, a small number of character widths can also be used for roman type –not for the horizontal proportions Fournier and his contemporaries used, but definitely for the archetypal models. The reduced number of widths must have made the justification for fixed registers relatively simple.

A10.3 Spacing and rhythm

The spacing of written letters will be the result of an organic rhythm, i.e., a flowing movement. The goal is a general effect of evenness.[480] This rhythm results in an interval of vertical strokes, of which the ones of the perpendicular letters, like h, i, j, l, m, n, and u, in particular result in a fencing rhythm. The more identical the space between the perpendicular letters and the space inside the letters (the counters) are, the more regular the rhythm will be.

In case of textura the fencing can become very strong and can even affect the recognisability of the letters. The repetition of black and white in the textura easily forces the calligrapher into the fencing rhythm. In case of the Humanistic minuscule the rhythm asks for more control of the pen.

Noordzij puts in *The Stroke* the emphasis on intervals of counters and spaces, which he calls 'white shapes': 'The white shapes are constituted only in the combination of letters; there is no simple measure of their size and they follow almost incidentally from the black strokes which solicit so much attention.' According to Noordzij maintaining the equilibrium in the white is especially important.[481] Noordzij implies that the fencing is the result of spacing instead of the opposite.

The traditional approach in type design and typography is to ensure that the space between the counters is an optical repetition of the space within the counters. The problem, however, is that for the Latin script this concept works well for letters with enclosed counters, like n and o, but not for letters that are (partly) open within

---

[479] Burnhill, *Type Spaces*, p.10.
[480] Johnston, *Writing and Illuminating & Lettering*, p.43.
[481] Ibid., p.42.

the x-height, like a, c, and e, or for letters that contain diagonals, like k, s, and v–z. And, of course, in order to combine lowercase with capitals compromises have to be made.

The even distribution of (white) space is something that a calligrapher tries to achieve as much as possible and, because of the flexibility of writing, ad hoc character variants can be applied. The division of space in equal parts to provide a mechanism for creating rhythmic uniformity within type inevitably leads to problems because the written letters were not developed (did not evolve) with the idea in mind of placing them on rectangles at a later stage. For instance, the lowercase a and e have partly open counters, which at some point transform into the letter space. The question of where exactly the borderline between the counter and the letter space can be placed is only relevant to the typographer, because the calligrapher does not need to answer this.

The equilibrium idea cannot be applied on very light or very bold or extensively condensed type designs. At some point these variants will deviate too much from the scheme of the archetypes. In the case of extra bold letters, at some point the space between the letters will become inevitably larger than the space in the counters, for instance because serifs cannot be made shorter.

A10.4 Stem interval

The rhythm in the roman type by Jenson shows a clear rhythm of the stems: the stem interval. Figure A10.1 shows the roman Jenson also used for his *Epistolæ ad Brutum* edition. Jenson clearly applied 'fence-posting' (based on the proportional model) here: the stem interval within the n was used as the basis for spacing. This stem interval seems to have been dominant for the proportions of Jenson's capitals as well.

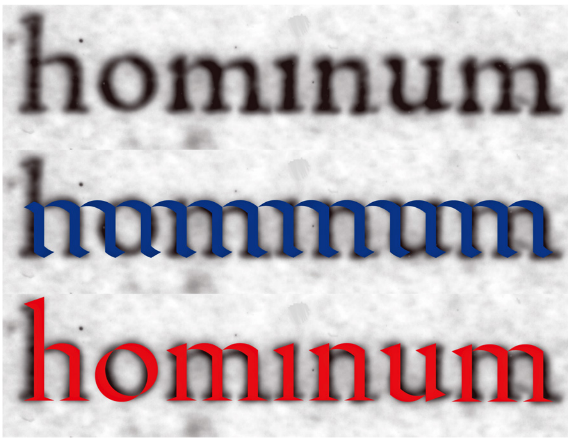


Figure A10.1 Detail from *Cicero, Epistolæ ad Brutum* (Jenson, 1470).

The small differences in Figure A10.1 between the applied fences and the roman by Jenson are partly the result of expectable irregularities in the type itself, because the relatively small point size (approximately 16 'current' points) made both casting and printing impossible on a more detailed level. On the other hand it is well possible that Jenson was aware of the fact that not all (sorts of) stems require equal distances to the side bearings. Kapr refers in *The Art of Lettering* to this fact:

> When several m's are placed together then all strokes must have the same optical distance and other letters inserted between two m's would have to be in harmony with this rhythm. The inter character interval before the first downstroke and the distance after the third downstroke of the m must together correspond to the counter of the m.[482]

The spacing Jenson applied on his roman type also shows the equilibrium idea and hence the result is an optimal combination of balanced white space and a regular stem interval. Griffo's type for the *Hypnerotomachia Poliphili* shows the same balance (Figure A10.2).

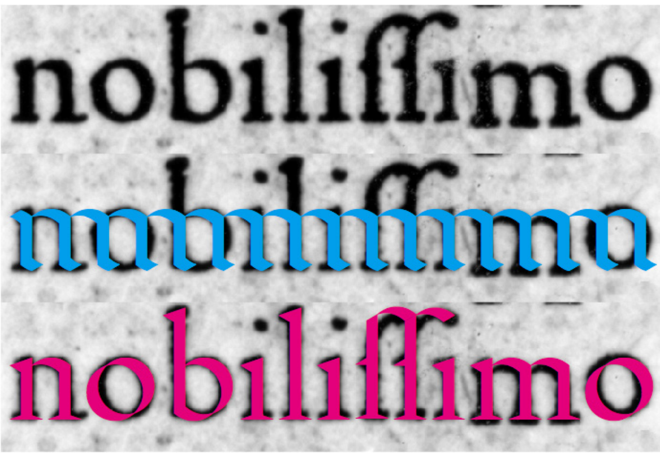


Figure A10.2 Detail from *Hypnerotomachia Poliphili*, published by Manutius in 1499, with applied 'fence-posting'.

The distance between the stems is dictated by the spaces in the letters, which are all related to each other, because of the fact that the letters share the same proportional system. The length of the serifs helps to preserve the space between the letters. Conversely, the serifs work as wedges and help to force the letters in the rhythmic system. Jan Tschichold briefly mentions the stem interval in *Treasury of Alphabets and Lettering*: 'The old lettering masters followed the rule that all the basic strokes of a

---

[482] Kapr, *The Art of Lettering*, p.308.

word should be spaced at approximately equal distance. This rule is disregarded today; lower case letters are pushed together.'[483]

This optimal rhythmic system only works for text sizes, i.e., roughly 16 points (Jenson) and smaller. Because of the lack of serifs, it is impossible to apply such spacing on sans serif typefaces, with the exception perhaps of condensed versions, where there is not much space in the first place. The stem interval in sans serifs with proportions related to the archetypes is due to the lack of serifs by definition disturbed.

Figure A10.3 The serif version of DTL Haarlemmer combines a regular stem interval with equilibrium of space.

Figure A10.3 shows the serif version of DTL Haarlemmer. The space between the perpendicular letters is optically equal to the space inside the letters. The serifs make it impossible to tighten the spacing more, because they would collide then.

Figure A10.4 The sans-serif version of DTL Haarlemmer has a slightly disturbed stem interval.

Figure A10.4 shows the sans-serif version of DTL Haarlemmer. Although the equilibration of the spacing is obvious, the stem interval of the serif version could not be maintained, as is shown in Figure A10.5.

[483] Jan Tschichold, *Treasury of Alphabets and Lettering* (Ware, Hertfordshire: Omega Books, 1985), p.34.

Figure A10.5 Stem intervals in the serif and sans-serif version of DTL Haarlemmer compared.

A10.5 n- and m-widths

Figure A10.6 shows the m's on n-fences of Adobe Jenson, Monotype Bembo, Monotype Poliphilus, and Adobe Garamond Premier respectively. The last two typefaces have m's, which have smaller counters than the n's. Over time the relatively condensed m seems to have become common practice for type designers. In *Letters of Credit* Tracy mentions the 'untypical' width of the m (in relation to fitting):

> '[…] for the fitting of the lowercase, the standards being the n and o. (Fournier specified the m; but since that is often untypical, being designed after the n, with narrower interior spaces than those in n, h and u, the n seems a better choice for the standard.)'[484]

If the m is untypical, why would a type designer make an m like that, and why did Fournier, who was a very experienced punchcutter, advise the use of the m as standard for the fitting?

Figure A10.6 The m of Adobe Jenson (1), Monotype Bembo (2), Monotype Poliphilus (3), Adobe Garamond Premier (4) on n-fences.

The four typefaces shown here are interpretations of Italian and French Renaissance type. The original type by Griffo applied in the *Hypnerotomachia Poliphili* (Figure A10.2) does not seem to have such a convincingly condensed m, and neither do the smaller point sizes cut by Garamont. Griffo did not cut 'display' type, but Garamont did: in Figure A10.7 his Gros Canon Romain seems to have a slightly narrower m (top) in comparison with the n (bottom). The Petit Canon Romain and the Parangon

[484] Tracy, *Letters of Credit*, p.74.

Romain have m's of which the counters are equal to those of the n's. The Garamond Premier is not based only on Garamont's designs for smaller point sizes; its revivalist Slimbach also took Garamont's larger type into account. So, this can explain the differences of the counters of the m and the n shown in Figure A10.7.

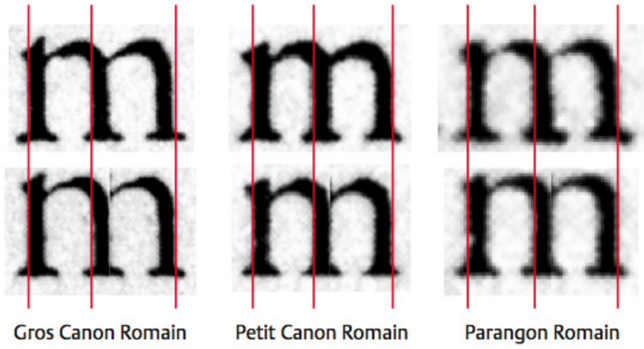


Figure A10.7 The widths of a few of Garamont's m's compared.

One can only guess why the m of Monotype Poliphilus seems to be more condensed than the original type. Perhaps the condensing was forced by the mapping of the Monotype matrix case –or was it influenced by an expected difference of the size of the m and n counters?

In *The Alphabet* Goudy illustrates his interpretations of historical typefaces, including Jenson's 'Eusebius' type, and he praises 'the perfect harmony and symmetry of the letters.'[485] On the same plates he shows his own Kennerley typeface. Goudy interpreted the 'Eusebius' type with equal counters in the m and the n, but the counter of the n of his own typeface is considerably wider than the counters of the m. So, although Goudy praised Jenson's harmony, he did not copy the n-m correlation in his own type.

In *Roman Letter Forms* Thompson wrote about the m: 'The small m is not formed by merely adding another stroke to the n, but the whole character is somewhat condensed to distinguish it from the n.'[486] One can imagine that this is applicable to textura type, but for roman type the 'distinguishing' argument does not seem to be very valid.

485 Goudy, *The Alphabet*, p.96.
486 Tommy Thompson, *How to Render Roman Letter Forms* (New York: Holme Press, 1946), p.31.

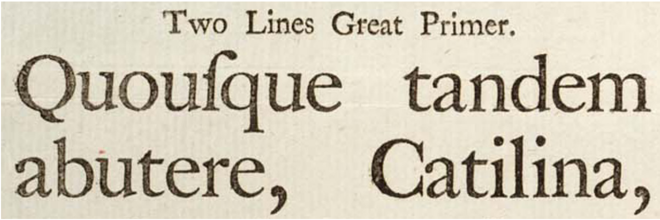


Figure A10.9 William Caslon's *Two Lines Great Primer*.

Especially in his larger point sizes William Caslon made the m more condensed (Figure A10.9), and so did Rosart (Figure A10.10). These larger point sizes also show a tighter spacing, which seems to be based on the counters of the m. This is in line with Kapr's note that:

> According to the experience of the punchcutters, the average distance from letter to letter is about equal to the counter of the m. Therefore the rhythm of the strokes and the stroke distance of the vertical in the m must be particularly carefully balanced. When several m's are placed together then all strokes must have the same optical distance and other letters inserted between two m's would have to be in harmony with this rhythm.[487]

Kapr's statement is in contradiction with Tracey's ideas, but seems to underline Fournier's approach.

Figure A10.10 Jacques-Francois Rosart's Grand Canon Romain.

The question is why the aforenamed punchcutters made the counters of the m's narrower than the counters of the n's. Could it be that the early punchcutters were aware of the fact that larger point sizes need a (slightly) tighter spacing than smaller point sizes, and that they subsequently cut the m more condensed as an indication for the fitting? Fournier's specification of the m would make perfect sense then. At some point in history (probably the seventeenth century) the condensed m must have become a sort of standard for all point sizes, including the ones for text.

---

[487] Kapr, *The Art of Lettering*, p.308.

AII.1 Introduction

This appendix is supplemental to Section 6 of Chapter 9. It provides additional information on the Kernagic and LS Cadencer tools and presents results of the auto-spacing process based on cadence units.

AII.2 Brief recapitulation of the cadence-units concept

In this dissertation the relation between steminterval and (roundness of) curves, and the translation of the rhythmic pattern into cadence-units is described in great detail.

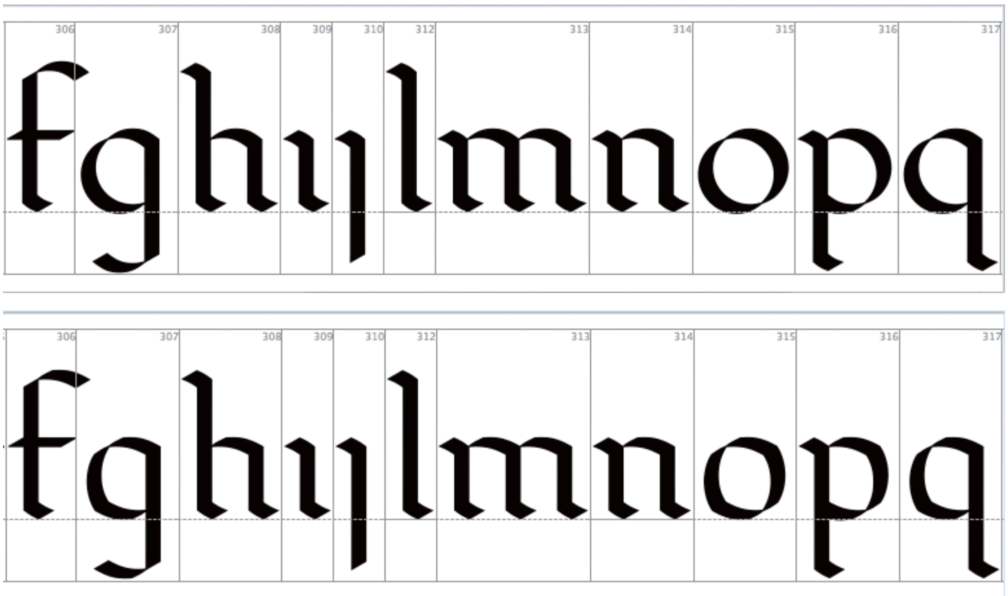


Figure AII.1 Flattening of curves in LeMo leaves the character widths unattached.

Measurements of Renaissance foundry type and matrices –as part of this research– clearly prove that standardised character widths were used. With the LeMo application the relation between stem interval and the overshoot of curves can simply be demonstrated; the flattening of curves leaves the stem interval and hence the character widths unaffected (Figure AII.1).

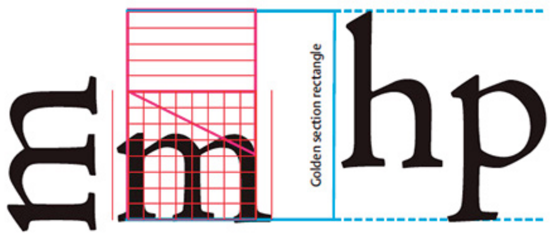


Figure AII.2 Simple grid distilled from Jenon's archetypal roman type.

It is plausible that Nicolas Jenson's archetypal roman type was defined on a grid. It is possible that Jenson defined the x-height of his roman as five times the vertical stroke-width, i.e., stem thickness, instead of using the pen-width as a calligrapher will do (Figure AII.2). This unit-arrangement system is rather coarse and it only works well for letters that share the archetypal proportions. As soon as one changes these proportions, things become more complex.

Figure AII.3 Van den Keere's (Gros) Canon Romain.

For example Van den Keere's Canon Romain, which shares the proportions of Van den Keere's rotunda type Canon d'Espaigne, clearly deviates from Jenson's archetypal model for roman type (Figure AII.3).

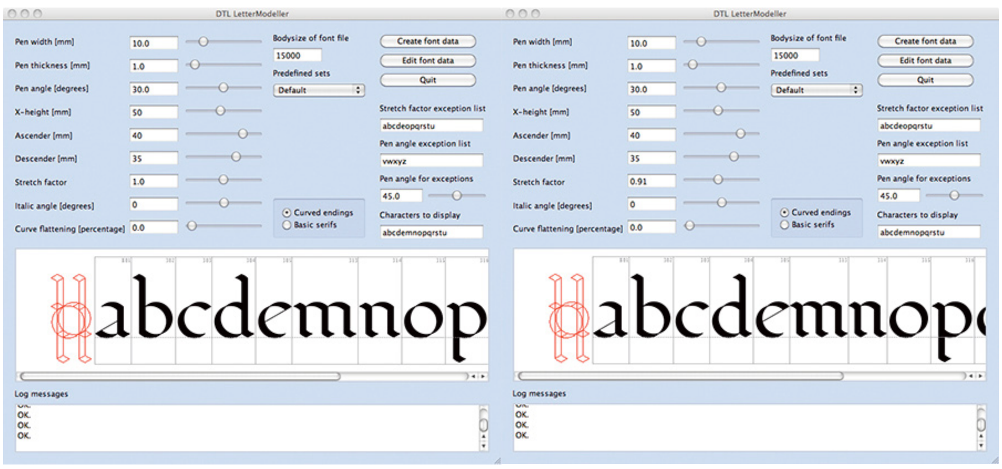


Figure AII.4 In LeMo some letters can be stretched and other ones can be left unattached.

This effect can be reproduced with LeMo by 'stretching' some letters and by leaving other ones unaffected (Figure AII.4). The rhythmical pattern is obstructed and the original mechanism does not provide a correct fitting. Such a deviation requires an adapted patterning. I distilled a system from especially French Renaissance type in which the stem interval (marked with 'a' in Figure AII.5) is divided into what I baptised 'cadence units' (Figure AII.5). As a consequence the units are not by definition related anymore to the vertical stroke width, and subsequently the system is more versatile. However, these units are organical: they are distilled from the intrinsic patterning of the design itself. This forms the basis for the parameterised cadence-units fitting.

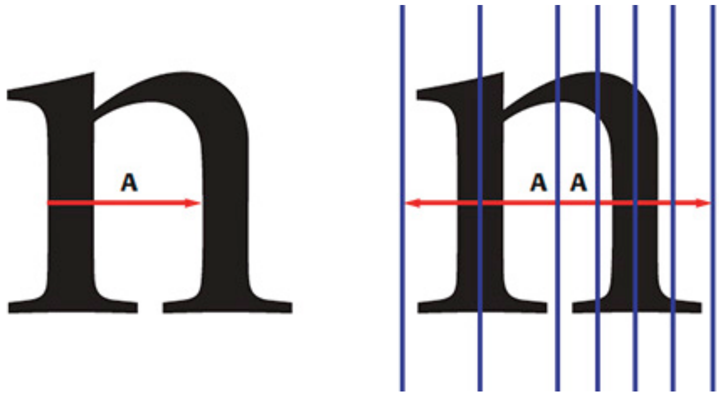


Figure AII.5 Cadence units are the result of a division of the stem interval.

Cadence units are always font-specific. This in contrast with the units that are used in digital font tools, which are always universal. The density of the units can be defined by the user and can be as refined as is preferred. However, this resolution does not have to be extremely high to generate a detailed spacing. That is one of the strengths of the system: a smaller design-related unit-arrangement system makes fitting easier to oversee and more controllable.

If types are morphologically related, a comparable fitting system can be exchanged between the types. The simplest way is to translate side-bearings into cadence units and to store these in a table. Because the size of cadence units is always font-specific, the units will become smaller or wider if the stem interval decreases or increases respectively. One can compare the effect with playing an accordion. The distances to the side bearings can be measured from stems or from extremes (curves or serifs). Distilled values can be listed and used for morphologically related typefaces, irrespective of whether these are more condensed or wider than the archetypal model.

The table system is a simplification and a translation of a patterning that was at the basis of textura and roman type. Initially a relatively simple pattern was required to control all aspects of the Renaissance type production and also to make the justification of lines simpler. Later in history the system shifted to an optical interpretation of the early systematisation and standardisation. In the eighteenth century so-called set patterns (bundles of precast type for setting the registers of the mould) were delivered together with matrices that do not show the initial standardised widths. And in that case the stem interval is not the dominant factor anymore, but the focus comes on equilibrium of white space. And looking primarily – if not only– at the white space in counters and between characters is what is taught in type design (and typography) nowadays.

This equilibrium-approach results by definition in an interruption of the stem interval if one does not take the latter into account. It is highly plausible that Jenson's asymmetric serifs, like the ones of the lowercase n, were meant to position the characters measurably centred in their widths. By shortening the serifs of the lowercase n at the left and enlarging them at the right, the weight was balanced at both sides and the side-bearings placed at equal distances from the stems. Nowadays type designers will for instance put somewhat more space at the left side of the i in comparison with the left side of the l.

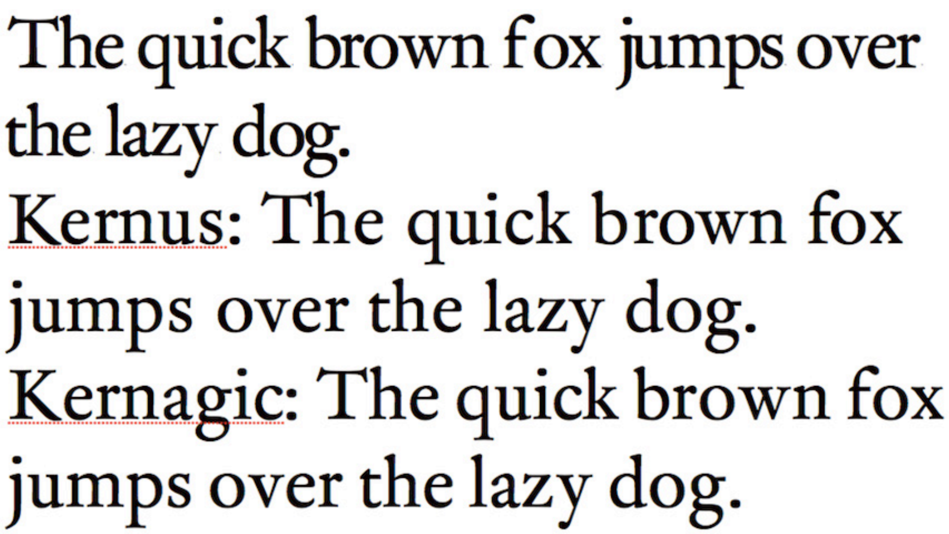


Figure AII.6 DTL Fell with zero side-bearings, Kernus 3.0 fitting, and Kernagic fitting.

The IKARUS-based[488] program Kernus 3.0, developed by the German software and type company URW(++) calculates the space between characters based on a couple of key characaters, like the lowercase n and o. It rasterizes the areas between characters and takes a couple of (exception) rules into account, like to prevent collisions between parts of different letters. Depending on the design, for instance the lengths of serifs can differ in basically identical situations and consequently the stem interval, will be to some extent interrupted. As mentioned, for cadence-based fitting the stem interval forms the basis. Figure AII.6 shows respectively DTL Fell with zero side-bearings, Kernus 3.0 fitting, and Kernagic fitting.

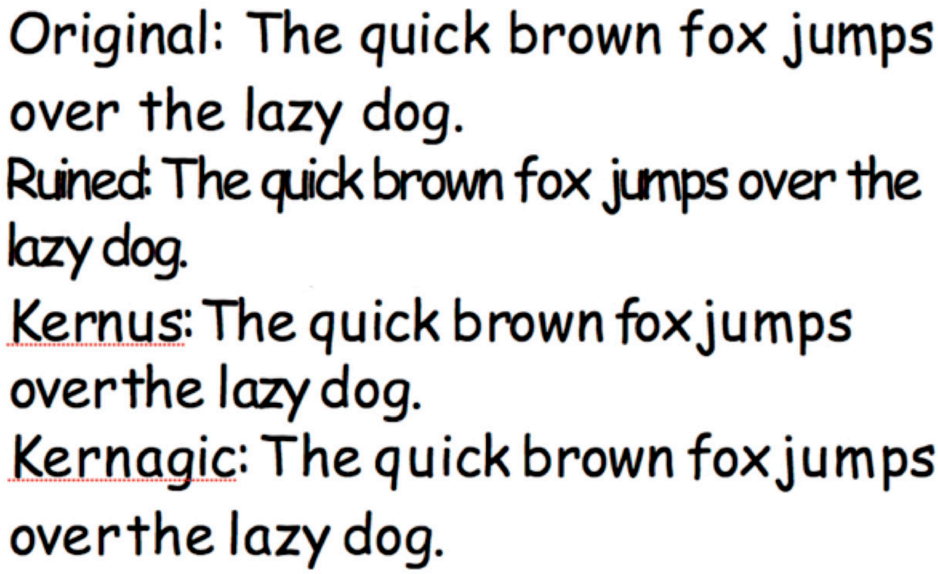


Figure AII.7 Comic Sans with zero side-bearings, Kernus 3.0 fitting, and Kernagic fitting.

If a design clearly deviates from the archetypal models, like Comic Sans, then it looks obvious that trying to achieve equilibrium of white space by seems to make more sense than trying to distil (and subsequently apply) a candence-based fitting. However, the related test (Figure AII.7) shows a mixed result. Partly the Kernus 3.0 approach provides better spacing and partly the Kernagic outcomes are preferable. The required relation to the archetypal font used for generating the list of values, implies that a font with for instance very flat curves requires more units from the extremes of these curves to the side bearings. The idea is that at the end the application that applies such tables is capable of recognizing the degree of flatness and also whether the typeface is serifed or a sans serif. The first range of the following tests were made with Kernagic, which lacks such intelligence. However, during these

488 <https://en.wikipedia.org/wiki/Ikarus_(typography_software)>

test the implementation of the cadence-units system into another tool named LS Cadencer, which supports the basis for such intelligence, was initiated.

AII.3 Kernagic tests

For these tests so-called 'Cadence Units Spacing Table' (CUST) files have been used. The values in these tables are based on the ones distilled from archetypal fonts. The tables use 32 units from left of left stem to left of right stem of lowercase n, which is the stem interval (Figure AII.8).

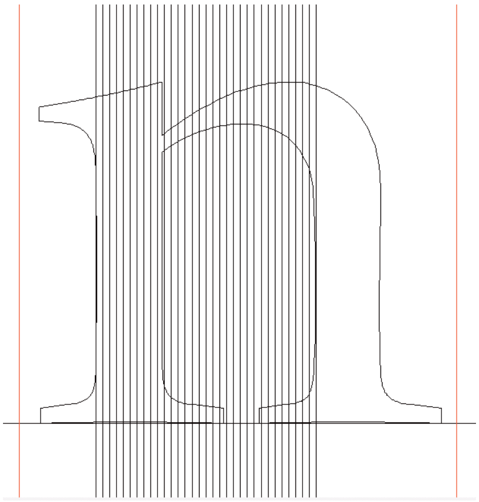


Figure AII.8 For the Kernagic tests the stem interval was divided into 32 cadence units.

For defining the tables a range of typefaces that can be considered archetypal was analysed. In case of the Renaissance Roman [Regular] CUST file, Adobe Jenson, Adobe Garamond, and DTL Haarlemmer formed the basis. Subsequently the table was empirically adjusted and fixed while applying it on a range of test fonts. For the Humanist Sans Roman [Regular] CUST file DTL Haarlemmer Sans was selected as archetypal font, and for the Grotesk Roman [Regular] CUST file DTL Nobel. The applied CUST versions are preliminary and no doubt the system will be improved over time.

It should be mentioned here that for calculating the distances to the side bearings the grid is actually moved. The higher the resolution of the grid, the less this movement is necessary. The more one dilutes the table the more the grid becomes universal: it will be applicable to every morphologically related font without the necessity to shift the units before applying them. In case of a 64-units grid for the stem interval, stems and curves will fit within the grid. It should also mentioned that the grids that seem to have been applied by Renaissance punchcutters is less refined than the ones used for these tests. A grid with a relatively low resolution basically requires the adaptation of the design to the grid.

The big advantage of the system is that the units applied are organic, i.e., distilled from the type itself, as mentioned. This in contrast with the digital grid for the em in which a present-day type designer normally designs and which is also used to define the fitting and kerning. Usually this 1000 units or a multiple of this value, and this is unnecessarily refined for positioning the side bearings. At the end the cadence units are translated into the actual em-units. This inevitably results in some rounding when the stem interval has to be divided into a certain number of units. However, the tests seem to prove that the tolerance is quite acceptable. An alternative method would be to adjust the stem interval to the grid.

If a typeface is not deliberately designed on a cadence-unit grid, the system can be used for spacing still, as is proven by the fitting tests. By diluting the grid, the boundaries of the glyphs of such a typeface will fit in the grid eventually. Hence, a 64-unit grid will theoretically be even more universal, but preliminary tests show not much difference in the outcomes in comparison with a 32-unit grid.

Even if one does apply the fitting optically, the auto-spacing (preferably) in combination with the display of the underlying pattern can help to improve matters. It provides a second opinion and one can compare one's optical spacing with an approach that formed the basis for the conditioning of the type designer's eye. One can even adjust proportions to the distilled patterns.

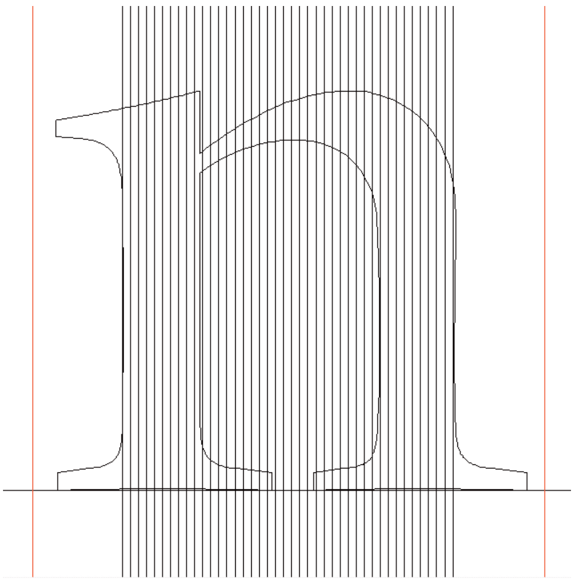


Figure A11.9 A bug in Kernagic results in a different definition of the stem interval.

The CUST files' table headers show some deviations from the default 32 units. The reason for this is that the applied version of Kernagic calculates the n-basis from left of left stem to right of right stem of lowercase n (Figure AII.9), instead of from left of left stem to left of right stem. This is actually a bug. Because the latter distance is the stem interval and the stem-thickness is not always the same, this makes the interpretation of the tables slightly inaccurate. The bug can be circumvented by dividing the stem interval into 32 units and to subsequently divide the distance of left of left stem to right of right stem of lowercase n by the value of the distilled cadence-unit. However, the deviation is in general small; for instance in case of Times New Roman the rounded outcome was 42 units and in case of Baskerville 40. However, in case of the latter the conversion to the nearest integer resulted in an identical grid as with 41 units, as is shown below.

The invention of printing from movable types was one of
the chief events affecting the history of European civiliza-
tion. The task of duplicating texts without variance was im-
possible before Gutenberg equipped the scholar with the
accuracy of type.

Figure AII.10 Times New Roman's original fitting.

The invention of printing from movable types was one of the
chief events affecting the history of European civilization.
The task of duplicating texts without variance was impossible
before Gutenberg equipped the scholar with the accuracy of
type.

Figure AII.11 Times New Roman spaced with Kernagic (CUST: Renaissance Roman, n_basis: 41 [default]).

The invention of printing from movable types was one of the
chief events affecting the history of European civilization.
The task of duplicating texts without variance was impossible
before Gutenberg equipped the scholar with the accuracy of
type.

Figure AII.12 Times New Roman spaced with Kernagic (CUST: Renaissance Roman, n_basis: 42).

It is not peculiar that there is not much tolerance when it comes to the n_basis value, because the horizontal proportions of most typefaces for text purposes are closely related to the archetypal models from the Renaissance. So, the default number of units specified in the CUST files are commonly shared values. In case there was a deviation, i.e., a font-specific value applied, this is mentioned in the tests. The outcomes are preceded by a text typeset in the original version of the font. Because this test focused on the fitting and kerning was not implemented, kerning has been turned off for all texts.

The CUST system works in such a way that the distilled units are font-specific. For applying a CUST file, the proportions do not have to be exactly identical to the archetypal ones used for defining the table; as long as the morphology is related, the system will work. The applied tables use a certain number of units for creating side bearings (see text above). The number of units defined in the 'n-basis' entry can be manipulated however: a larger value will make the spacing more condensed (the units become smaller) and a smaller value makes the spacing wider (the units become larger). All values can be altered on the fly in a text editor when a font is opened in Kernagic.

AII.4 Bold variants

Bold weights are deviations from the original pattern of roman type, which was initially only meant for the 'regular' weight. One can approach the bold weights in two ways: with a specifically adapted table representing the narrower counters and hence the small distances to the side bearings in comparison with the regular weight (Figure AII.13), or by adapting the same table as is used for the regular weight, taking into account that the bold weight is a variant of the regular one. In the latter case the same unit-values can be used as for the regular weight if the size of the units is decreased.

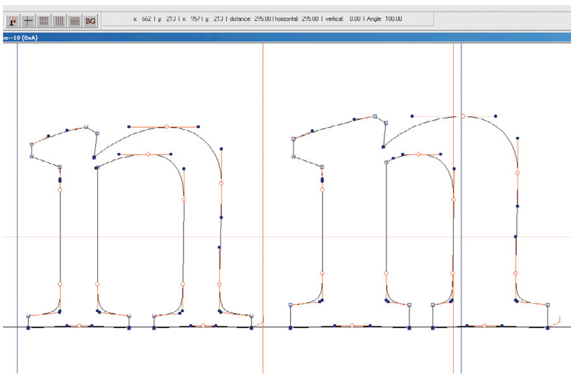


Figure AII.13 Bold weights have narrower counters than regular weights and require a tighter spacing.

In the tests following this recapitulation, the same tables have been used for the regular, (the intermediate) medium, and bold weights. In general the counters (horizontally measured) of the bold weights are roughly 25 percent smaller as those of the regular ones. Hence, the medium weights are around 12.5 percent smaller. As default the number of units have been relatively adjusted in the tables for the medium and bold weights.

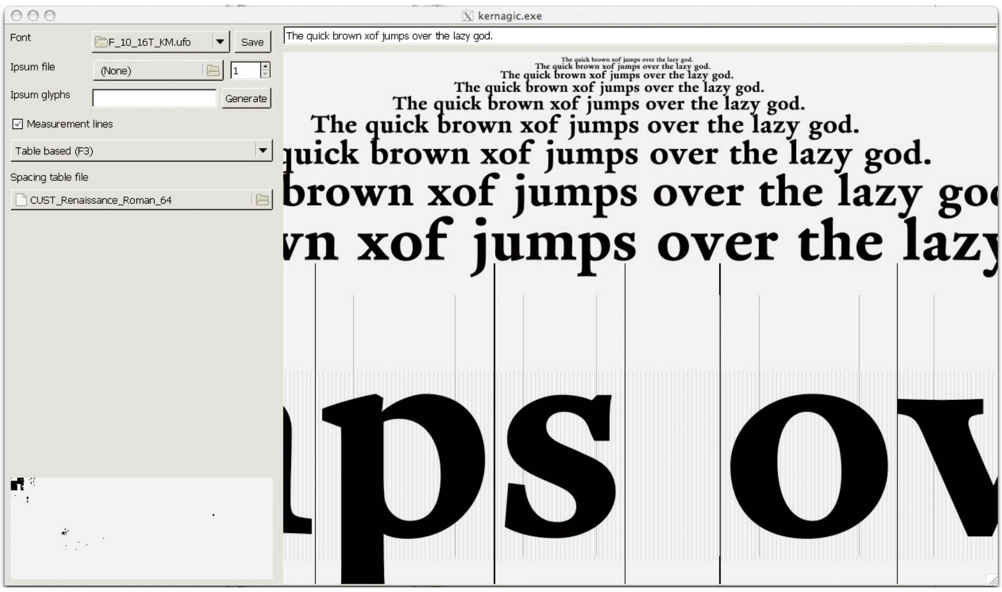


Figure AII.14 Cadence-units spacing of the bold variant of DTL Fell in Kernagic.

AII.5 Italic variants

Italic (or cursive) variants can be handled the same way as the roman type ones, i.e., using a specific table based on archetypal models. However, this requires a more precise point of measurement of the stems. Another matter that should be taken into account is the angle of the italics, which can differ quite a bit. When it comes to shape, roughly two archetypal models for italics can be traced: the Italian Renaissance italic (think of Arrighi) with its basically interrupted construction and the French Renaissance cursive (think of Granjon and Guyot) with its basically uninterrupted construction and rounder shapes

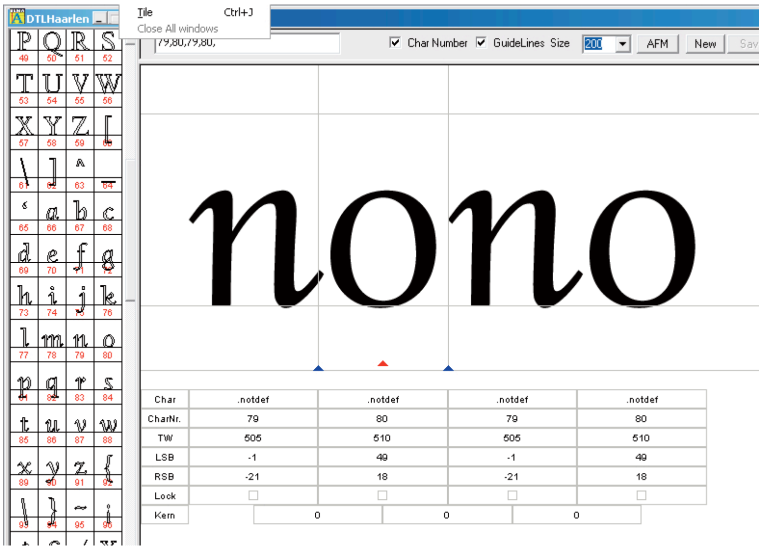


Figure AII.15 An upwards-slanted version of the cursive of DTL Haarlemmer was made for testing.

Preliminary tests were also made with an upwards-slanted variant cursive of DTL Haarlemmer to investigate whether this could be handled like roman type using roman-type CUST file (Figure AII.16). The outcomes have not been very satisfactory so far.

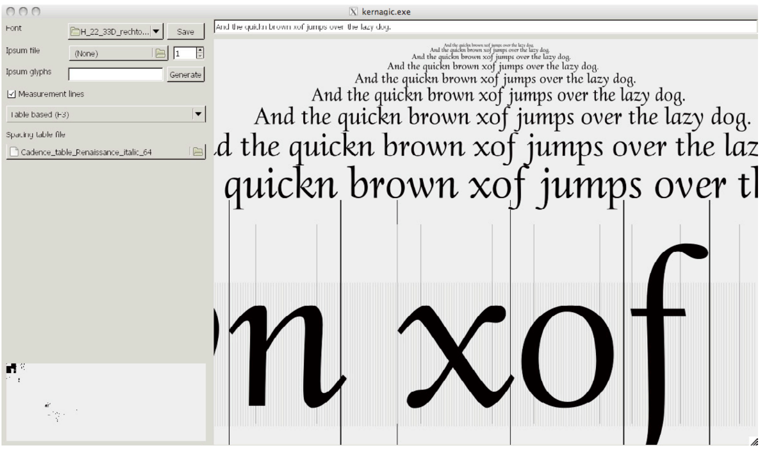


Figure AII.16 Spacing test in Kernagic with an upwards-slanted version of the cursive of DTL Haarlemmer.

AII.6 Environmental setting Kernagic tests

The workflow on a Mac OS X.5 system (this system is relatively old, but used for parts of DTL's font-production workflow still) was as follows: first an OpenType CFF font (.otf) was converted to the UFO format in the font editor FontForge under X11 (Figure AII.17).

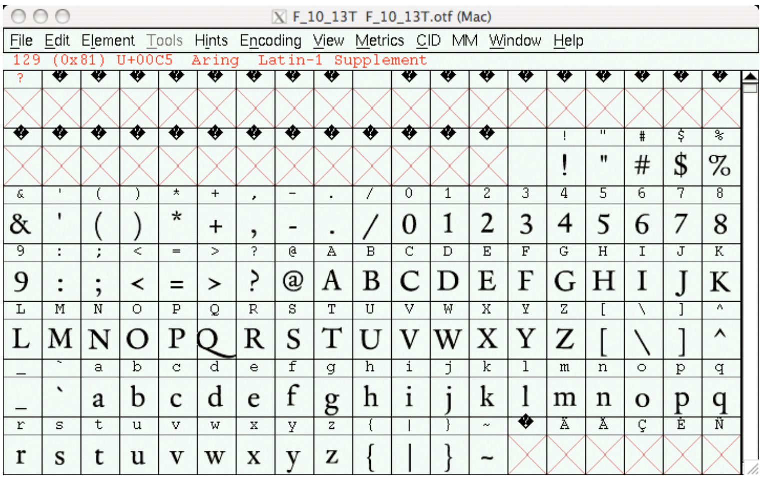


Figure AII.17 An OpenType CFF font was converted to the UFO format.

Second, the UFO file was opened in Kernagic (running in a Wineskin environment) and a CUST file was applied (Figure AII.18). The new fitting was calculated in a split second. Third, FontForge was used to generate an OpenType CFF font from the UFO file.

Figure AII.18 The UFO file was auto-spaced in Kernagic.

Fourth, the .otf was converted to .be format using DTL BezierMaster. The last step was necessary because the applied version of Kernagic contains bugs for the calculating the left side bearing of the lowercase g and the right side bearing of the lowercase f. These values were manually corrected by placing the distilled grid behind the characters in question and subsequently changing the side bearings according to the values in the table (Figure AII.19).

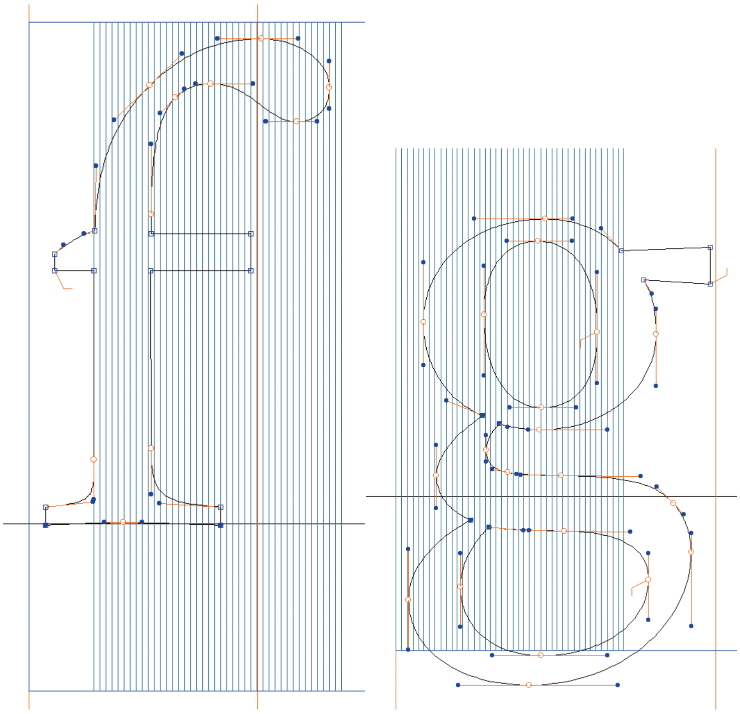


Figure AII.19 The distilled grid was reproduced in BezierMaster for the application of manual corrections .

There was inevitably some rounding involved, because the grid can only be defined in integers. This manual grid-fitting could also have been done directly in FontForge, but it felt more convenient for me in BezierMaster (which was for a large part developed to my needs). Next CFF-based OpenType font was generated for typesetting in QuarkXpress 7 (the use of the latter application was quite arbitrary; it was just available on the testing system).

Although theoretically Kernagic should have been able to read-in the width of the wordspace in units too, this was unfortunately not always done properly during this test (to be investigated). Subsequently, in all fonts to which Kernagic has been applied, the word space has been defined as 1/5 of the em, i.e., 200 units. In most cases this made the line lengths by definition a bit different in comparison with the original spacing, irrespective of the deviations in the fitting of the characters (most fonts have a default word space which is too large anyway). However, all DTL fonts (with exception of condensed variants) have a word space of 200 units.

All tests are preceded by the applied CUST's:

– CUST_Renaissance_Roman_32

– CUST_Humanist_Sans_32

– CUST_Humanist_Sans_semi_flat_32

– CUST_Grotesk_32

AII.7 LS Cadencer tests

Just like Kernagic, the LS Cadencer is a tool for the batch fitting ('auto-spacing') of fonts. The LS Cadencer uses cadence units (distilled from the stem interval) to position the side bearings from either extremes on the x-axis or stems (Figure AII.20).

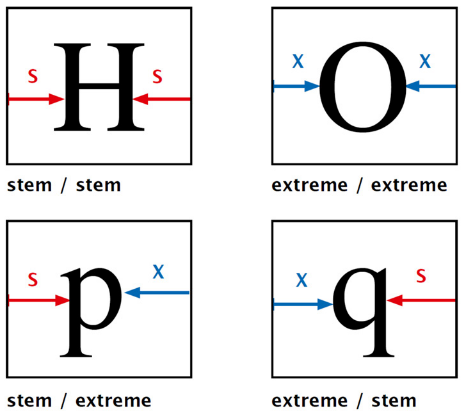
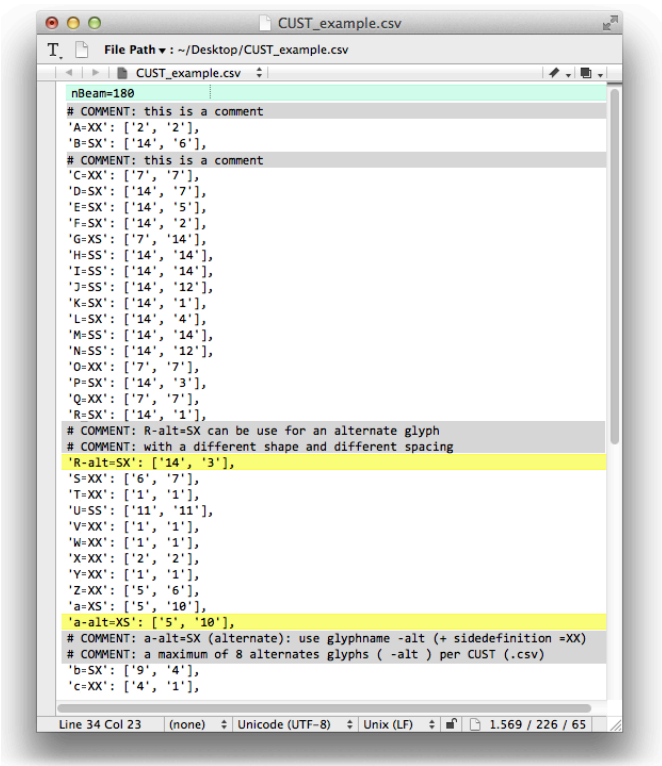


Figure AII.20 Positioning of the side bearings (using units) is done from either stem (s) or extreme (x).

To apply units for the positioning of the side bearings, pre-defined CUST files that I developed are used (Figure AII.21). These tables are fully comparable with the one shown in Figure 5.23.




```
nBeam=180
# COMMENT: this is a comment
'A=XX': ['2', '2'],
'B=SX': ['14', '6'],
# COMMENT: this is a comment
'C=XX': ['7', '7'],
'D=SX': ['14', '7'],
'E=SX': ['14', '5'],
'F=SX': ['14', '2'],
'G=XS': ['7', '14'],
'H=SS': ['14', '14'],
'I=SS': ['14', '14'],
'J=SS': ['14', '12'],
'K=SX': ['14', '1'],
'L=SX': ['14', '4'],
'M=SS': ['14', '14'],
'N=SS': ['14', '12'],
'O=XX': ['7', '7'],
'P=SX': ['14', '3'],
'Q=XX': ['7', '7'],
'R=SX': ['14', '1'],
# COMMENT: R-alt=SX can be use for an alternate glyph
# COMMENT: with a different shape and different spacing
'R-alt=SX': ['14', '3'],
'S=XX': ['6', '7'],
'T=XX': ['1', '1'],
'U=SS': ['11', '11'],
'V=XX': ['1', '1'],
'W=XX': ['1', '1'],
'X=XX': ['2', '2'],
'Y=XX': ['1', '1'],
'Z=XX': ['5', '6'],
'a=XS': ['5', '10'],
'a-alt=XS': ['5', '10'],
# COMMENT: a-alt=SX (alternate): use glyphname -alt (+ sidedefinition =XX)
# COMMENT: a maximum of 8 alternates glyphs ( -alt ) per CUST (.csv)
'b=SX': ['9', '4'],
'c=XX': ['4', '1'],
```

Figure AII.21 An example of a CUST table.

The LS Cadencer uses a slightly more refined method than Kernagic for positioning the points of measurement: the adjustable 'n-beam' (Figure A11.22) plus a few optional exceptions for the lowercase f ('f-beam') and g ('g-beam'). These beams define the horizontal position from where the units to the side bearing must be calculated. For example, if the terminal of the f is used as starting point for the positioning of the right side bearing, the outcome will clearly differ than if the crossbar of the f is used as starting point.

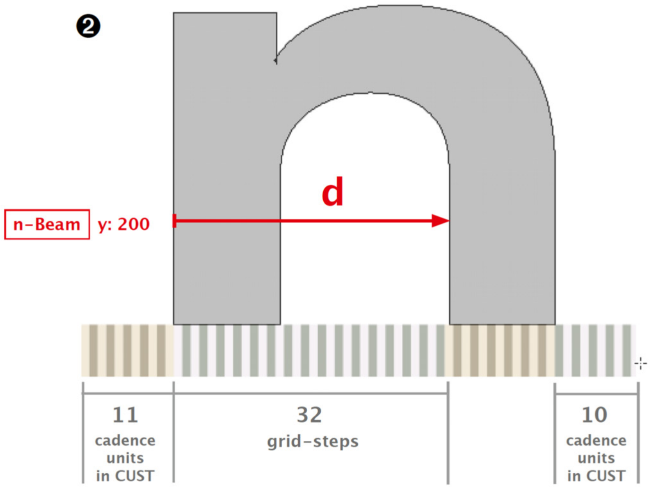


Figure A11.22 Beams, such as the 'n-beam' are used for determining from which position units are applied.

The LS Cadencer displays grids and beams by default in the glyph-editing windows of the Glyphs and RoboFont font editors (Figure A11.23), in this way also providing the option to manually supersede the positioning of the side bearings using the calculated cadence units in the background. The display of the grid in the background of the characters also makes it possible to adjust the characters to the grid itself. This will make the patterning a conscious part of the design process. Such grid fitting is in line with the patterning I distilled from Jenson's archetypal model, as discussed in Section 2 of Chapter 5. The application of cadence units is not restricted to roman type: they also work –using adapted tables– for italics. Hence, there is an option to slant the side bearings to the angle of the glyphs before the units are applied.

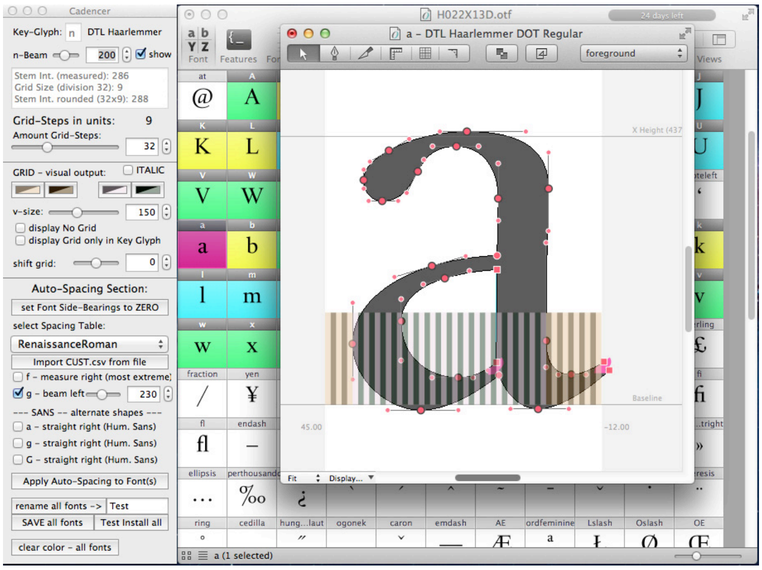


Figure AII.23 Grids and beams are displayed by LS Cadencer in the glyph-editing window

For fine-tuning the spacing, the division of the stem interval into cadence units can be altered by either increasing or decreasing the number of units. Because the position of the side bearings is defined in units and the number is fixed in the CUST files, an increased amount of units results in a tighter fitting, and a decreased amount in a wider one.

AII.8 Environmental setting LS Cadencer tests

The pages with auto-spaced type that follow the outcomes of the Kernagic tests, are the result of the application of the LS Cadencer extension in Robofont under system Mac OS X.7 on a MacBook Pro. The fonts were fitted in presence of their creators, i.e., TypeMedia students, at the KABK on the morning of Wednesday 11 February 2015.[489] The PDF's containing the type specimens and the table comparisons were generated on Thursday 12 February 2015.

AII.9 LS Cadenculator tests

The LS Cadenculator translates the fitting of characters into distances from either extremes on the x-axis or stems to the side bearings, which are then defined in cadence units. For this it uses the centre of the x-height for measurements by default, but a beam can be used here as well for altering the vertical point of measurement. The outcomes of the measurements are stored in cust files; these files can be imported into the LS Cadencer tool and subsequently used for the spacing of fonts.

---

489 With exception of Jasper Terra's Roman Regular type, which was cadenced a couple of days earlier.

LS Cadenculator can generate CUST files based on the spacing measured in single fonts or in multiple fonts, in which case it will calculate the most commonly used spacing among the fonts measured. The generated CUST files can be adapted in a text editor or directly in the LS Cadencer tool. Reports of the measurements can be stored in text files and as graphs in PDF format, as shown at the end of this appendix.

```
Cadence Units Spacing Table
Renaissance Roman [Regular-Bold]
Version 0.1

n_basis: 41

A extreme 2 extreme 2
B stem 14 extreme 6
C extreme 7 extreme 7
D stem 14 extreme 7
E stem 14 extreme 5
F stem 14 extreme 2
G extreme 7 stem 14
H stem 14 stem 14
I stem 14 stem 14
J stem 14 stem 12
K stem 14 extreme 1
L stem 14 extreme 4
M stem 14 stem 14
N stem 14 stem 12
O extreme 7 extreme 7
P stem 14 extreme 3
Q extreme 7 extreme 7
R stem 14 extreme 1
S extreme 6 extreme 7
T extreme 1 extreme 1
U stem 11 stem 11
V extreme 1 extreme 1
W extreme 1 extreme 1
X extreme 2 extreme 2
Y extreme 1 extreme 1
Z extreme 5 extreme 6

a extreme 5 stem 10
b stem 9 extreme 4
c extreme 4 extreme 1
d extreme 4 stem 10
e extreme 4 extreme 3
f stem 11 extreme 1
g extreme 5 extreme 1
h stem 10 stem 10
i stem 11 stem 10
j stem 10 stem 9
k stem 10 extreme 0
l stem 10 stem 10
m stem 11 stem 10
n stem 11 stem 10
o extreme 4 extreme 4
p stem 10 extreme 4
q extreme 4 stem 9
r stem 11 extreme 0
s extreme 4 extreme 4
t stem 9 extreme 1
u stem 10 stem 11
v extreme 0 extreme 0
w extreme 0 extreme 0
x extreme 0 extreme 0
y extreme 0 extreme 0
z extreme 4 extreme 4

. extreme 7 extreme 7
: extreme 7 extreme 7
; extreme 7 extreme 7
, extreme 6 extreme 7
```

DTL Fell [Regular]
-with zero side bearings:

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

DTL Fell [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Fell [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis 32 (the number of units is decreased; as a result the units are larger)
note: because some characters like r (right side) and v have zero-unit side bearings in
the table, larger units disturb the even distribution of the wider spacing. For this
reason instead of zero a single unit would be better. If that is considered too wide for
the default setting, the resolution can for instance be doubled, i.e., 128 units for the
n_basis.
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

gOHamburevonstif
gOHamburevonstif
gOHamburevonstif
gOHamburevonstif
gOHamburevonstif
gOHamburevonstif
Hamburevonstif

```
DTL Fell [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 32 with zero-unit side bearings replaced by one-unit side bearings
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Fell [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 50 (the number of units is increased; as a result the units are smaller)
note: also here the problem the zero-unit side bearings occur.
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

DTL Fell [Medium]
-with zero side bearings:

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

DTL Fell [Medium] Kernagic
-table: Renaissance Roman [Regular-Bold] version 0.1
n_basis: 47

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Fell [Bold]
-with zero side bearings:
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Fell [Bold] Kernagic
-table: Renaissance Roman [Regular-Bold] version 0.1
n_basis: 51
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Jenson Pro [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Jenson Pro [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
(Monotype) Bembo Book [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
(Monotype) Bembo Book [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
note: TrueType format (encountered problems during generation of .otf [to be investi-
gated]).
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Garamond Pro [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Garamond Pro [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Garamond Pro [Bold]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Garamond Pro [Regular-Bold] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 51
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL VandenKeere [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL VandenKeere [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Minion Pro [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Minion Pro [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Arno Pro [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Arno Pro [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
note: TrueType format (encountered problems during generation of .otf [to be investi-
gated]).
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Times New Roman [Regular]
-default, i.e., original fitting
note: the fitting of the digital TNR is somewhat irregular due to the underlying
18 units-arrangement system of the hot-metal composing machine.
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Times New Roman [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Caslon Pro [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Adobe Caslon Pro [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Fleischmann (text) [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Fleischmann (text) [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before G utenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
(Monotype) Baskerville [Regular]
-default, i.e., original fitting
note: TrueType (.dfont)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
(Monotype) Baskerville [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
note: converted to .otf
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Haarlemmer [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Haarlemmer [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Haarlemmer [Medium]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Haarlemmer [Medium] Kernagic
-table: Renaissance Roman [Regular-Bold] version 0.1
n_basis: 47 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

DTL Haarlemmer [Bold]
-default, i.e., original fitting

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

DTL Haarlemmer [Regular] Kernagic
-table: Renaissance Roman [Regular-Bold] version 0.1
n_basis: 51

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Documenta [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Documenta [Regular] Kernagic
-table: Renaissance Roman [Regular] version 0.1
n_basis: 41 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Cadence Units Spacing Table
Humanist Sans
Version 0.1

n_basis 40

A extreme 4 extreme 4
B stem 10  extreme 6
C extreme 6 extreme 5
D stem 10  extreme 6
E stem 10  extreme 3
F stem 10  extreme 2
G extreme 6 stem 9
H stem 10  stem 10
I stem 10  stem 10
J stem 10 stem 10
K stem 10  extreme 1
L stem 10  extreme 3
M stem 10  stem 10
N stem 10  stem 10
O extreme 6 extreme 6
P stem 10  extreme 2
Q extreme 6 extreme 6
R stem 10  extreme 1
S extreme 6 extreme 7
T extreme 1 extreme 1
U stem 9 stem 9
V extreme 1 extreme 1
W extreme 1 extreme 1
X extreme 2 extreme 2
Y extreme 1 extreme 1
Z extreme 4 extreme 4

a extreme 4 stem 10
       # for a with straight stem:
       # a extreme 4 stem 8
b stem 9 extreme 4
c extreme 4 extreme 1
d extreme 4 stem 9
e extreme 4 extreme 4
f stem 10 extreme 1
g extreme 6 extreme 1
h stem 9 stem 8
i stem 9 stem 9
j stem 9 stem 9
k stem 9 extreme 1
l stem 9 stem 9
m stem 9 stem 8
n stem 9 stem 8
o extreme 4 extreme 4
p stem 9 extreme 4
q extreme 4 stem 9
r stem 9 extreme 0
s extreme 4 extreme 4
t stem 10 extreme 2
u stem 8 stem 9
v extreme 1 extreme 1
w extreme 1 extreme 1
x extreme 2 extreme 2
y extreme 1 extreme 1
z extreme 3 extreme 3

. extreme 5 extreme 5
: extreme 6 extreme 6
; extreme 6 extreme 6
, extreme 4 extreme 4
```

```
DTL Haarlemmer Sans [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Haarlemmer Sans [Regular] Kernagic
-table: Humanist Sans [Regular] version 0.1
n_basis: 40 (default)
note: because the font formed the main basis (so far) for this table, the outcome is
almost identical to the original fitting.
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Caspari [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Caspari [Regular] Kernagic
-table: Humanist Sans [Regular] version 0.1
n_basis: 40 (default)
note: the original fitting is a bit tight.
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
(Monotype) Gill Sans [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
(Monotype) Gill Sans [Regular] Kernagic
-table: Humanist Sans [Regular] version 0.1
n_basis: 40 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Prokyon [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Prokyon [Regular] Kernagic
-table: Humanist Sans [Regular] version 0.1
n_basis: 40 (default)
note: left side bearing of g identical to that of d.
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Cadence Units Spacing Table
For Humanist-related Sans with semi-flat curves like Lucida Grande.
Version 0.1

n_basis 40

A extreme 4 extreme 4
B stem 10  extreme 6
C extreme 8 extreme 5
D stem 10  extreme 7
E stem 10  extreme 3
F stem 10  extreme 2
G extreme 7 stem 9
H stem 10  stem 10
I stem 10  stem 10
J stem 10 stem 10
K stem 10  extreme 1
L stem 10  extreme 3
M stem 10  stem 10
N stem 10  stem 10
O extreme 7 extreme 7
P stem 10  extreme 2
Q extreme 7 extreme 7
R stem 10  extreme 1
S extreme 6 extreme 7
T extreme 1 extreme 1
U stem 9 stem 9
V extreme 1 extreme 1
W extreme 1 extreme 1
X extreme 2 extreme 2
Y extreme 1 extreme 1
Z extreme 4 extreme 4

a extreme 4 stem 10
       # for a with straight stem:
       # a extreme 4 stem 8
b stem 9 extreme 6
c extreme 6 extreme 2
d extreme 6 stem 9
e extreme 6 extreme 6
f stem 10 extreme 1
# For 'binocular-shaped' g:
# g extreme 6 extreme 1
# For 'single story' g:
g extreme 6 stem 9
h stem 9 stem 8
i stem 9 stem 9
j stem 9 stem 9
k stem 9 extreme 1
l stem 9 stem 9
m stem 9 stem 8
n stem 9 stem 8
o extreme 6 extreme 6
p stem 9 extreme 6
q extreme 6 stem 9
r stem 9 extreme 1
s extreme 4 extreme 4
t stem 10 extreme 2
u stem 8 stem 9
v extreme 1 extreme 1
w extreme 1 extreme 1
x extreme 2 extreme 2
y extreme 1 extreme 1
z extreme 3 extreme 3

. extreme 5 extreme 5
: extreme 6 extreme 6
; extreme 6 extreme 6
, extreme 4 extreme 4
```

Lucida Grande [Regular]
-default, i.e., original fitting

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

Lucida Grande [Regular] Kernagic
-table: Humanist-related Sans [Regular] *semi-flat* version 0.1
n_basis: 40 (default)

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

Lucida Grande [Regular] Kernagic
-table: Humanist-related Sans [Regular] *semi-flat* version 0.1
n_basis: 38

The invention of printing from movable types was one of the chief events affecting the history of Euro-pean civilization. The task of duplicating texts with-out variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prej-udiced connoisseurs in the fifteenth century de-plored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

Lucida Grande [Regular] Kernagic
-table: Humanist-related Sans [Regular] *semi-flat* version 0.1
n_basis: 38 | with corretions: /c RSB+1, /f RSB+1, /t RSB+1, /t RSB+1, /v LSB+1 RSB+1, /w LSB+1 RSB+1, /y LSB+1 RSB+1

The invention of printing from movable types was one of the chief events affecting the history of Euro-pean civilization. The task of duplicating texts with-out variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prej-udiced connoisseurs in the fifteenth century de-plored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Argo [Regular]
-default, i.e., original fitting
note: the original fitting is a bit tight
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Argo [Regular] Kernagic
-table: Humanist-related Sans [Regular] semi-flat version 0.1
n_basis: 40 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Cadence Units Spacing Table
Grotesks
Version 0.1

n_basis 42

A extreme 1 extreme 1
B stem 10  extreme 6
C extreme 4 extreme 3
D stem 10  extreme 4
E stem 10  extreme 5
F stem 10  extreme 2
       # For G with rounded right side:
       G extreme 4 stem 4
       # For G with stem at the right:
       # G extreme 4 stem 10
H stem 10  stem 10
I stem 10  stem 10
J stem 1 stem 10
K stem 10  extreme 1
L stem 10  extreme 2
M stem 10  stem 10
N stem 10  stem 10
O extreme 4 extreme 4
P stem 10  extreme 1
Q extreme 4 extreme 1
R stem 10  extreme 1
S extreme 3 extreme 5
T extreme 1 extreme 1
U stem 8 stem 8
V extreme 1 extreme 1
W extreme 1 extreme 1
X extreme 1 extreme 1
Y extreme 1 extreme 1
Z extreme 1 extreme 1

a extreme 4 stem 8
b stem 9 extreme 3
c extreme 3 extreme 2
d extreme 3 stem 9
e extreme 3 extreme 3
f stem 9 extreme 1
       # For 'binocular-shaped' g:
       g extreme 3 extreme 9
       # For 'single story' g:
       # g extreme 4 stem 8
h stem 9 stem 8
i stem 9 stem 9
j stem 9 stem 9
k stem 9 extreme 1
l stem 9 stem 9
m stem 9 stem 8
n stem 9 stem 8
o extreme 3 extreme 3
p stem 9 extreme 3
q extreme 3 stem 9
r stem 9 extreme 0
s extreme 3 extreme 4
t stem 8 extreme 1
u stem 8 stem 9
v extreme 1 extreme 1
w extreme 1 extreme 1
x extreme 1 extreme 1
y extreme 1 extreme 1
z extreme 1 extreme 1

. extreme 7 extreme 7
: extreme 8 extreme 8
; extreme 7 extreme 7
, extreme 8 extreme 8
```

```
DTL Nobel [Regular]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
DTL Nobel [Regular] Kernagic
-table: Grotesk [Regular] version 0.1
n_basis: 42 (default)
note: because the font formed the main basis (so far) for this table, the outcome is al-
most identical to the original fitting.
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Futura [Medium]
-default, i.e., original fitting
```

The invention of printing from movable types was one of the chief events affecting the history of Euro-pean civilization. The task of duplicating texts with-out variance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prej-udiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of dis-seminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Futura [Medium] Kernagic
-table: Grotesk [Regular] version 0.1
n_basis: 42 (default)
```

The invention of printing from movable types was one of the chief events affecting the history of European civilization. The task of duplicating texts without vari-ance was impossible before Gutenberg equipped the scholar with the accuracy of type. Prejudiced connois-seurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the printing press as a method of disseminating knowl-edge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day.

```
Font: Font Etienne Regular
Designer: Marko
Spacing: original (optical)
Note: based on archetypal model from Garamont
```

ABCDEFGHIJKLMNOPQRSTUVW
XYZabcdefghijklmnopqrstuvwxyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eo-rum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam lit-tera gothica, quam nunc putamus parum claram, anteposuerit litterarum formas humanitatis per seacula quarta decima et quinta decima. Eodem modo typi, qui nunc nobis videntur parum clari, fiant

OHamburgefontsiv

```
Font: Etienne Cadenced Regular
Designer: Marko
Stem Int. measured: 273 | rounded (32x9): 288
Grid Size (division 32): 9
```

ABCDEFGHIJKLMNOPQRSTUVW
XYZabcdefghijklmnopqrstuvwxyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eo-rum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam lit-tera gothica, quam nunc putamus parum claram, anteposuerit litterarum formas humanitatis per seacula quarta decima et quinta decima. Eodem modo typi, qui nunc nobis videntur parum clari, fiant

OHamburgefontsiv

```
selected CUST: RenaissanceRoman

A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 1
g_XX 5 1
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4
```

Font: Fournier Ordinaire
Designer: Loris
Spacing: original (optical)
Note: based on model from Fournier

ABCDEFGHIJKLMNOPQRST
UVWXYZabcdefghijklmnopqrst
uvwxyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate vel esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiar processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est

OHamburgefontsiv

```
Font: Fournier Ordinaire Cadenced Regular
Designer: Loris
Stem Int. measured: 321 | rounded (32x10): 320
Grid Size (division 32): 10
```

A|B|C|D|E|F|G|H|I|J|K|L|M|N|O|P|Q|R|S|T|
U|V|W|X|Y|Z|a|b|c|d|e|f|g|h|i|j|k|l|m|n|o|p|q|r|s|t|
u|v|w|x|y|z|:|,|.|;|

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus parum claram, anteposuerit litter-

---

OHamburgefontsiv

```
selected CUST: Fournier.csv
```

```
A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 1
g_XX 4 1
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4
```

```
Font: High Contrast
Designer: Bahman
Spacing: original (optical)
Note: none
```

ABCDEFGHIJKLMNOPQRSTUV
WXYZabcdefghijklmnopqrstuv
wxyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea con modo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse mo lestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et ius to odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugai nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitan est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica,

OHamburgefontsiv

```
Font: High Contrast
Designer: Bahman
Stem Int. measured: 331 | rounded (32x10): 320
Grid Size (division [to be checked]): …
```

ABCDEFGHIJKLMNOPQRSTU VWXYZabcdefghijklmnopqrstu vwxyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam

---

OHamburgefontsiv

```
selected CUST: RenaissanceRoman

A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 1
g_XX 5 1
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4
```

```
Font: Jasper Roman Regular
Designer: Jasper
Spacing: original (optical)
Note: none
```

ABCDEFGHIJKLMNOPQRSTUV
WXYZabcdefghijklmnopqrstuvw
xyz:,.;

The invention of printing from movable types was one of the chief events affecting the hist
y of European civilization. The task of duplicating texts without variance was impossible be
re Gutenberg equiped the scholar with the accuracy of type. Prejudiced connoisseurs in the
fteenth century deplored the new mass-production of books, but men of letters eagerly hail
the printing press as a method of disseminating knowledge in permanent form; and the ea
iest printed books soon rivalled in beauty, as they superseded in economy, the fine manusc
pts of their day. Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonum
y nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad m
im veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea cor
modo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse moles
e consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio
gnissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilis

---

OHamburgefontsiv

```
Font: Jasper Roman Cadenced Regular
Designer: Jasper
Stem Int. measured: 310 | rounded (32x10): 320
Grid Size (division 32): 10
```

ABCDEFGHIJKLMNOPQRSTUV
WXYZabcdefghijklmnopqrstuvwx
yz:,.;

The invention of printing from movable types was one of the chief events affecting the history o f European civilization. The task of duplicating texts without variance was impossible before G utenberg equiped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century deplored the new mass-production of books, but men of letters eagerly hailed the print ing press as a method of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day . Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod ti ncidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis no strud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dol ore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praese nt luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum solut

---

OHamburgefontsiv

```
selected CUST: Renaissance_Jasper.csv

A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 2
g_XX 4 2
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4
```

```
Font: Jasper Roman Bold
Designer: Jasper
Spacing: original (optical)
Note: none
```

ABCDEFGHIJKLMNOPQRSTU
VWXYZabcdefghijklmnopqrst
uvwxyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad mini veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit ess molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil in perdiet doming id quod mazim placerat facer possim assum. Typi non habent claritaten insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus parum claram, anteposuerit litterarum formas

---

OHamburgefontsiv

Font: Jasper Roman Cadenced Bold
Designer: Jasper
Stem Int. measured): 330 | rounded (40x8): 320
Grid Size (division 40): 8

ABCDEFGHIJKLMNOPQRST
UVWXYZabcdefghijklmnopqr
stuvwxyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus parum claram, anteposuerit litterarum

---

OHamburgefontsiv

---

selected CUST: CUST (selfmade)

A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 2
g_XX 3 1
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4

```
Font: Jasper Roman Sans Regular
Designer: Jasper
Spacing: original (optical)
Note: serif-like endings on d and u (in line with a)
```

ABCDEFGHIJKLMNOPQRSTUVW
XYZabcdefghijklmnopqrstuvwxyz:,
.;

The invention of printing from movable types was one of the chief events affecting the history
European civilization. The task of duplicating texts without variance was impossible before G
enberg equiped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth
entury deplored the new mass-production of books, but men of letters eagerly hailed the print
ng press as a method of disseminating knowledge in permanent form; and the earliest printed
ooks soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day
Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod ti
idunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nost
ud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis a
tem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dol
e eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praese
luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum solut

---

OHamburgefontsiv

Font: Jasper Roman Sans Cadenced Regular
Designer: Jasper
Stem Int. measured: 308 | rounded (32x10): 320
Grid Size (division 32): 10

ABCDEFGHIJKLMNOPQRSTUVWX
YZabcdefghijklmnopqrstuvwxyz:,.;

The invention of printing from movable types was one of the chief events affecting the history of Eu ropean civilization. The task of duplicating texts without variance was impossible before Gutenberg equiped the scholar with the accuracy of type. Prejudiced connoisseurs in the fifteenth century depl ored the new mass-production of books, but men of letters eagerly hailed the printing press as a me thod of disseminating knowledge in permanent form; and the earliest printed books soon rivalled in beauty, as they superseded in economy, the fine manuscripts of their day. Lorem ipsum dolor sit a met, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore mag na aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper sus cipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et a ccumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feu gait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet domin

---

OHamburgefontsiv

---

selected CUST: HumanistSans_Jasper.csv

A_XX 4 4
B_SX 10 6
C_XX 6 5
D_SX 10 6
E_SX 10 3
F_SX 10 2
G_XS 6 9
H_SS 10 10
I_SS 10 10
J_SS 10 10
K_SX 10 1
L_SX 10 3
M_SS 10 10
N_SS 10 10
O_XX 6 6
P_SX 10 2
Q_XX 6 6
R_SX 10 1
S_XX 6 7
T_XX 1 1
U_SS 9 9
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 4 4
a_XS 4 10
b_SX 9 4
c_XX 4 1
colon_XX 6 6
comma_XX 4 4
d_XS 4 9
e_XX 4 4
f_SX 10 1
g_XX 4 1
h_SS 9 8
i_SS 9 9
j_SS 9 9
k_SX 9 1
l_SS 9 9
m_SS 9 8
n_SS 9 8
o_XX 4 4
p_SX 9 4
period_XX 5 5
q_XS 4 9
r_SX 9 0
s_XX 4 4
semicolon_XX 6 6
t_SX 10 2
u_SS 8 10
v_XX 1 1
w_XX 1 1
x_XX 2 2
y_XX 1 1
z_XX 3 3

```
Font: NoName Regular
Designer: Elliot
Spacing: original (optical)
Note: none
```

ABCDEFGHIJKLMNOPQRSTUV
WXYZabcdefghijklmnopqrstuvw
xyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismo
tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, qu
nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequa
Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel
illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui
blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber
tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim
plac-erat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis q
facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii
legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem
consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus paru

OHamburgefontsiv

```
Font: NoName Cadenced Regular
Designer: Elliot
Stem Int. measured: 314 | rounded (32x10): 320
Grid Size (division 32): 10
```

ABCDEFGHIJKLMNOPQRSTUV
WXYZabcdefghijklmnopqrstuvw
xyz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim plac-erat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus parum claram, an-teposuerit litterarum formas humanitatis per seacula quarta decima et quinta

---

OHamburgefontsiv

```
selected CUST: RenaissanceRoman

A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 1
g_XX 5 1
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4
```

```
Font: Plinivs Regular
Designer: Benedikt
Spacing: original (optical)
Note: pseudo Jenson, relatively dark
```

ABCDEFGHIJKLMNOPQRSTUV
WXYZabcdefghijklmnopqrstuvwx
yz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem ve eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril d lenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus parum claram, anteposuerit litterarum formas humanitatis per seacula quarta decima et quinta decima. Eodem modo typi, qui nunc nobis videntur parum clari, fiant sollemnes in futurum.

OHamburgefontsiv

```
Font: Plinivs Cadenced Regular
Designer: Benedikt
Stem Int. measured: 282 | rounded (32x9): 288
Grid Size (division 32): 9
```

ABCDEFGHIJKLMNOPQRSTUV
WXYZabcdefghijklmnopqrstuvwx
yz:,.;

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus parum claram, anteposuerit litterarum formas humanitatis per seacula quarta decima et quinta decima. Eodem modo typi, qui nunc nobis videntur parum clari, fiant sollemnes in futurum.

OHamburgefontsiv

```
selected CUST: Plinivs.csv

A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 1
g_XX 5 1
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4
```

```
Font: Willhelm Book
Designer: Philipp
Spacing: original (optical)
Note: two cadenced versions with different units-sizes
```

A|B|C|D|E|F|G|H|I|J|K|L|M|N|O|P|Q|R|S|T|U|V|W|
X|Y|Z|a|b|c|d|e|f|g|h|i|j|k|l|m|n|o|p|q|r|s|t|u|v|w|x|y|z|:|,|.|;|

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt u laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore t feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet domin id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus parum claram, anteposuerit litterarum for mas humanitatis per seacula quarta decima et quinta decima. Eodem modo typi, qui nunc nobis vident parum clari, fiant sollemnes in futurum.

OHamburgefontsiv

```
Font: Willhelm Cadenced Book
Designer: Phillip
Stem Int. measured: 277 | rounded (32x9): 288
Grid Size (division 32): 9
```

A|B|C|D|E|F|G|H|I|J|K|L|M|N|O|P|Q|R|S|T|U|V|
W|X|Y|Z|a|b|c|d|e|f|g|h|i|j|k|l|m|n|o|p|q|r|s|t|u|v|w|x|y|z|
:|,|.|;|

Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit eorum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas est etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam littera gothica, quam nunc putamus parum claram, anteposuerit litterarum formas humanitatis per seacula quarta decima et quinta decima. Eodem modo typi, qui nunc nobis videntur parum clari, fiant sollemnes in futurum.

OHamburgefontsiv

```
selected CUST: Wilhelm_CUST.csv

A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 0
g_XX 4 1
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4
```

Font: <Font Willhelm Cadence Book
Designer: PhillipStem
Stem Int. measured: 277 | Stem Int. rounded (33x8): 264
Grid Size (division 33): 8

ABCDEFGHIJKLMNOPQRSTUVW
XYZabcdefghijklmnopqrstuvwxyz:,.;

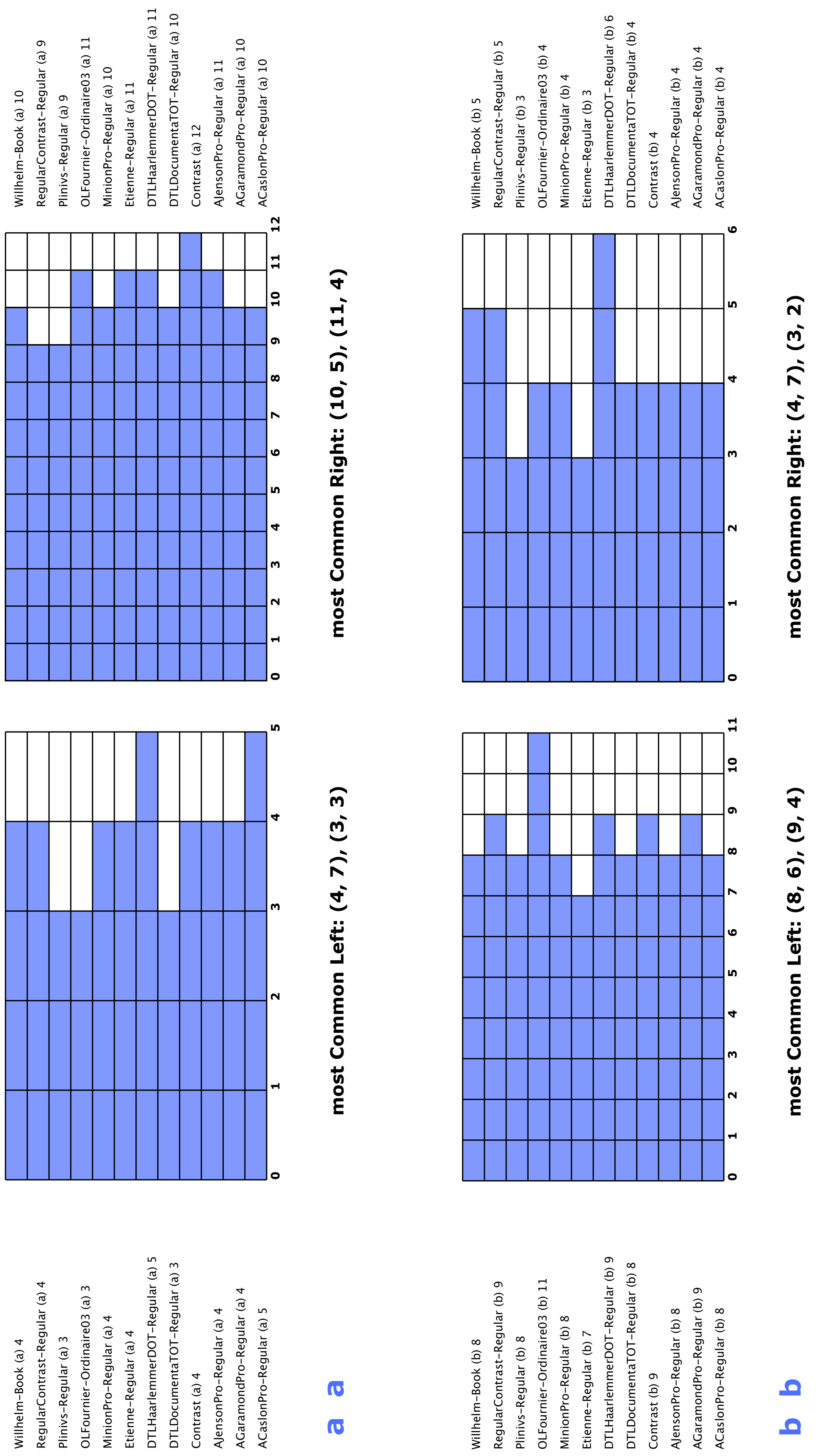
Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros e accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Nam liber tempor cum soluta nobis eleifend option congue nihil imperdiet doming id quod mazim placerat facer possim assum. Typi non habent claritatem insitam; est usus legentis in iis qui facit e rum claritatem. Investigationes demonstraverunt lectores legere me lius quod ii legunt saepius. Claritas es etiam processus dynamicus, qui sequitur mutationem consuetudium lectorum. Mirum est notare quam li tera gothica, quam nunc putamus parum claram, anteposuerit litterarum formas humanitatis per seacula quarta decima et quinta decima. Eodem modo typi, qui nunc nobis videntur parum clari, fiant sollemnes futurum.

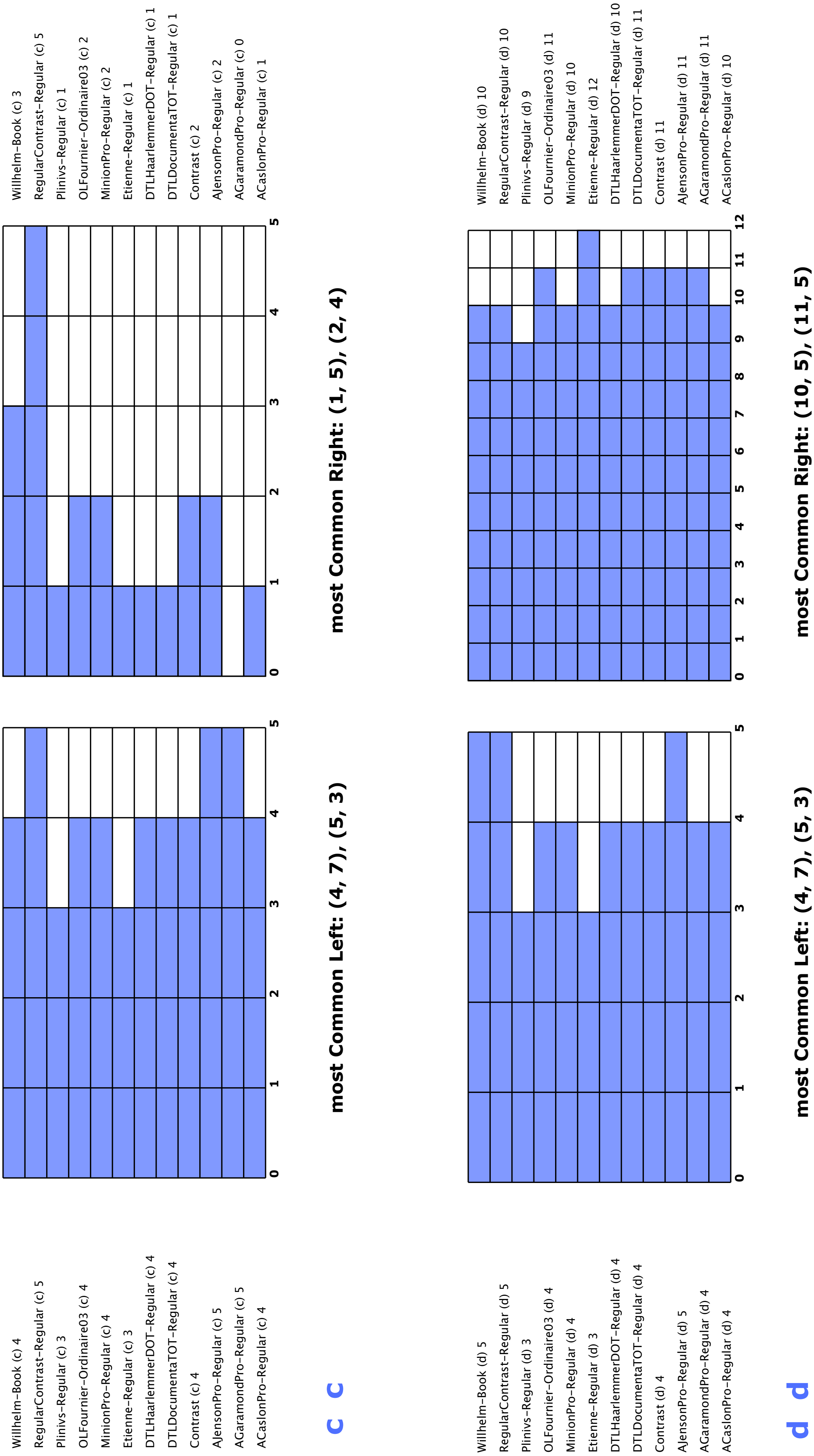
OHamburgefontsiv

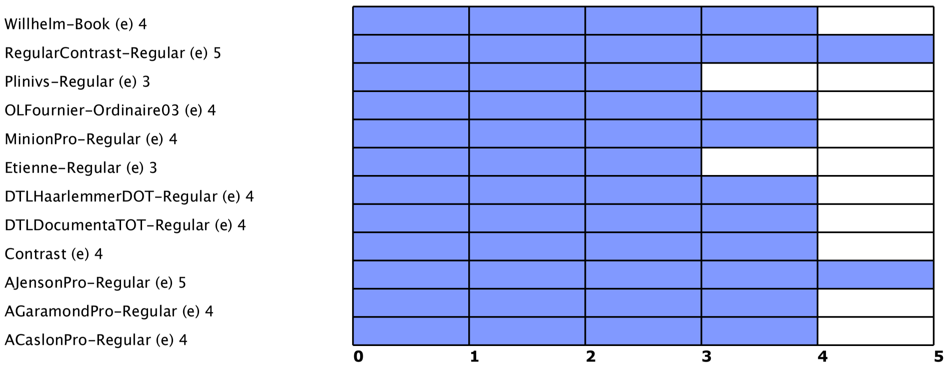
---

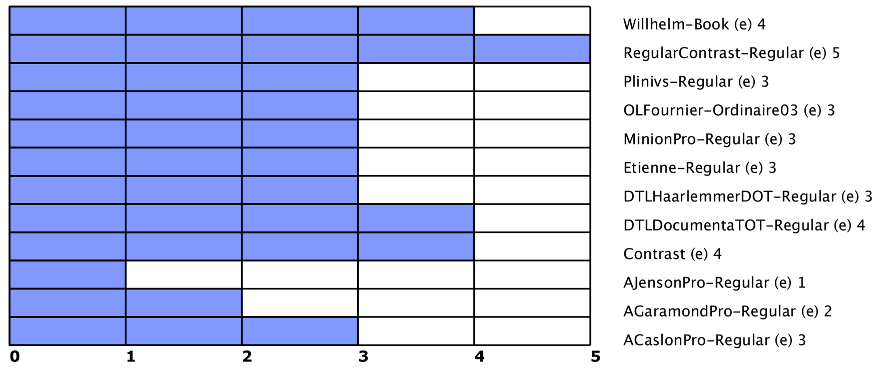
selected CUST: Wilhelm_CUST.csv

```
A_XX 2 2
B_SX 14 6
C_XX 7 7
D_SX 14 7
E_SX 14 5
F_SX 14 2
G_XS 7 14
H_SS 14 14
I_SS 14 14
J_SS 14 12
K_SX 14 1
L_SX 14 4
M_SS 14 14
N_SS 14 12
O_XX 7 7
P_SX 14 3
Q_XX 7 7
R_SX 14 1
S_XX 6 7
T_XX 1 1
U_SS 11 11
V_XX 1 1
W_XX 1 1
X_XX 2 2
Y_XX 1 1
Z_XX 5 6
a_XS 5 10
b_SX 9 4
c_XX 4 1
colon_XX 7 7
comma_XX 6 7
d_XS 4 10
e_XX 4 3
f_SX 11 0
g_XX 4 1
h_SS 10 10
i_SS 11 10
j_SS 10 9
k_SX 10 0
l_SS 10 10
m_SS 11 10
n_SS 11 10
o_XX 4 4
p_SX 10 4
period_XX 7 7
q_XS 4 9
r_SX 11 0
s_XX 4 4
semicolon_XX 7 7
t_SX 9 1
u_SS 10 11
v_XX 0 0
w_XX 0 0
x_XX 0 0
y_XX 0 0
z_XX 4 4
```


Willhelm–Book (a) 4
RegularContrast–Regular (a) 4
Plinivs–Regular (a) 3
OLFournier–Ordinaire03 (a) 3
MinionPro–Regular (a) 4
Etienne–Regular (a) 4
DTLHaarlemmerDOT–Regular (a) 5
DTLDocumentaTOT–Regular (a) 3
Contrast (a) 4
AJensonPro–Regular (a) 4
AGaramondPro–Regular (a) 4
ACaslonPro–Regular (a) 5
0 1 2 3 4 5
most Common Left: (4, 7), (3, 3)
Willhelm–Book (a) 10
RegularContrast–Regular (a) 9
Plinivs–Regular (a) 9
OLFournier–Ordinaire03 (a) 11
MinionPro–Regular (a) 10
Etienne–Regular (a) 11
DTLHaarlemmerDOT–Regular (a) 11
DTLDocumentaTOT–Regular (a) 10
Contrast (a) 12
AJensonPro–Regular (a) 11
AGaramondPro–Regular (a) 10
ACaslonPro–Regular (a) 10
0 1 2 3 4 5 6 7 8 9 10 11 12
most Common Right: (10, 5), (11, 4)
a a
Willhelm–Book (b) 8
RegularContrast–Regular (b) 9
Plinivs–Regular (b) 8
OLFournier–Ordinaire03 (b) 11
MinionPro–Regular (b) 8
Etienne–Regular (b) 7
DTLHaarlemmerDOT–Regular (b) 9
DTLDocumentaTOT–Regular (b) 8
Contrast (b) 9
AJensonPro–Regular (b) 8
AGaramondPro–Regular (b) 9
ACaslonPro–Regular (b) 8
0 1 2 3 4 5 6 7 8 9 10 11
most Common Left: (8, 6), (9, 4)
Willhelm–Book (b) 5
RegularContrast–Regular (b) 5
Plinivs–Regular (b) 3
OLFournier–Ordinaire03 (b) 4
MinionPro–Regular (b) 4
Etienne–Regular (b) 3
DTLHaarlemmerDOT–Regular (b) 6
DTLDocumentaTOT–Regular (b) 4
Contrast (b) 4
AJensonPro–Regular (b) 4
AGaramondPro–Regular (b) 4
ACaslonPro–Regular (b) 4
0 1 2 3 4 5 6
most Common Right: (4, 7), (3, 2)
b b


c c
Willhelm–Book (c) 4
RegularContrast–Regular (c) 5
Plinivs–Regular (c) 3
OLFournier–Ordinaire03 (c) 4
MinionPro–Regular (c) 4
Etienne–Regular (c) 3
DTLHaarlemmerDOT–Regular (c) 4
DTLDocumentaTOT–Regular (c) 4
Contrast (c) 4
AJensonPro–Regular (c) 5
AGaramondPro–Regular (c) 5
ACaslonPro–Regular (c) 4
0 1 2 3 4 5
most Common Left: (4, 7), (5, 3)
Willhelm–Book (c) 3
RegularContrast–Regular (c) 5
Plinivs–Regular (c) 1
OLFournier–Ordinaire03 (c) 2
MinionPro–Regular (c) 2
Etienne–Regular (c) 1
DTLHaarlemmerDOT–Regular (c) 1
DTLDocumentaTOT–Regular (c) 1
Contrast (c) 2
AJensonPro–Regular (c) 2
AGaramondPro–Regular (c) 0
ACaslonPro–Regular (c) 1
0 1 2 3 4 5
most Common Right: (1, 5), (2, 4)
d d
Willhelm–Book (d) 5
RegularContrast–Regular (d) 5
Plinivs–Regular (d) 3
OLFournier–Ordinaire03 (d) 4
MinionPro–Regular (d) 4
Etienne–Regular (d) 3
DTLHaarlemmerDOT–Regular (d) 4
DTLDocumentaTOT–Regular (d) 4
Contrast (d) 4
AJensonPro–Regular (d) 5
AGaramondPro–Regular (d) 4
ACaslonPro–Regular (d) 4
0 1 2 3 4 5
most Common Left: (4, 7), (5, 3)
Willhelm–Book (d) 10
RegularContrast–Regular (d) 10
Plinivs–Regular (d) 9
OLFournier–Ordinaire03 (d) 11
MinionPro–Regular (d) 10
Etienne–Regular (d) 12
DTLHaarlemmerDOT–Regular (d) 10
DTLDocumentaTOT–Regular (d) 11
Contrast (d) 11
AJensonPro–Regular (d) 11
AGaramondPro–Regular (d) 11
ACaslonPro–Regular (d) 10
0 1 2 3 4 5 6 7 8 9 10 11 12
most Common Right: (10, 5), (11, 5)

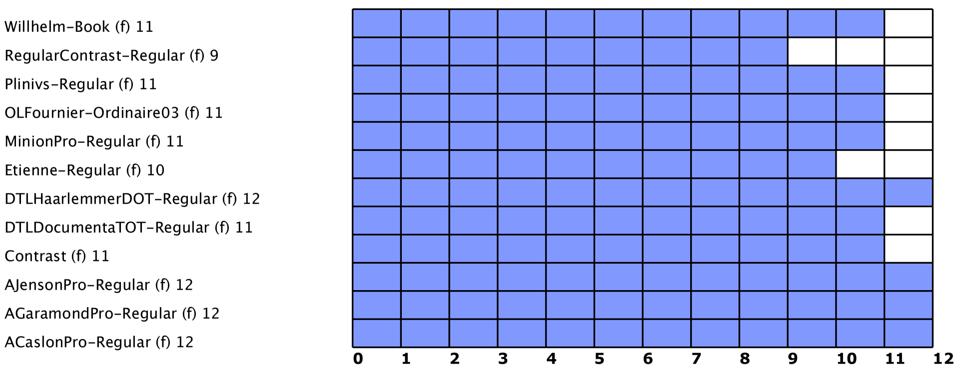


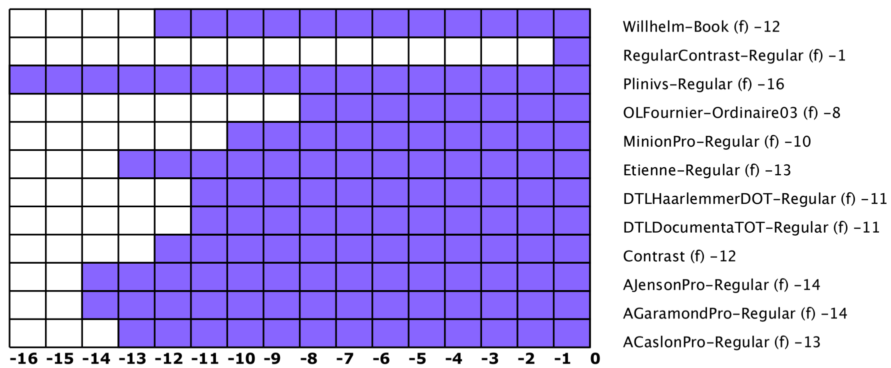


e e

most Common Left: (4, 8), (3, 2)

most Common Right: (3, 6), (4, 3)

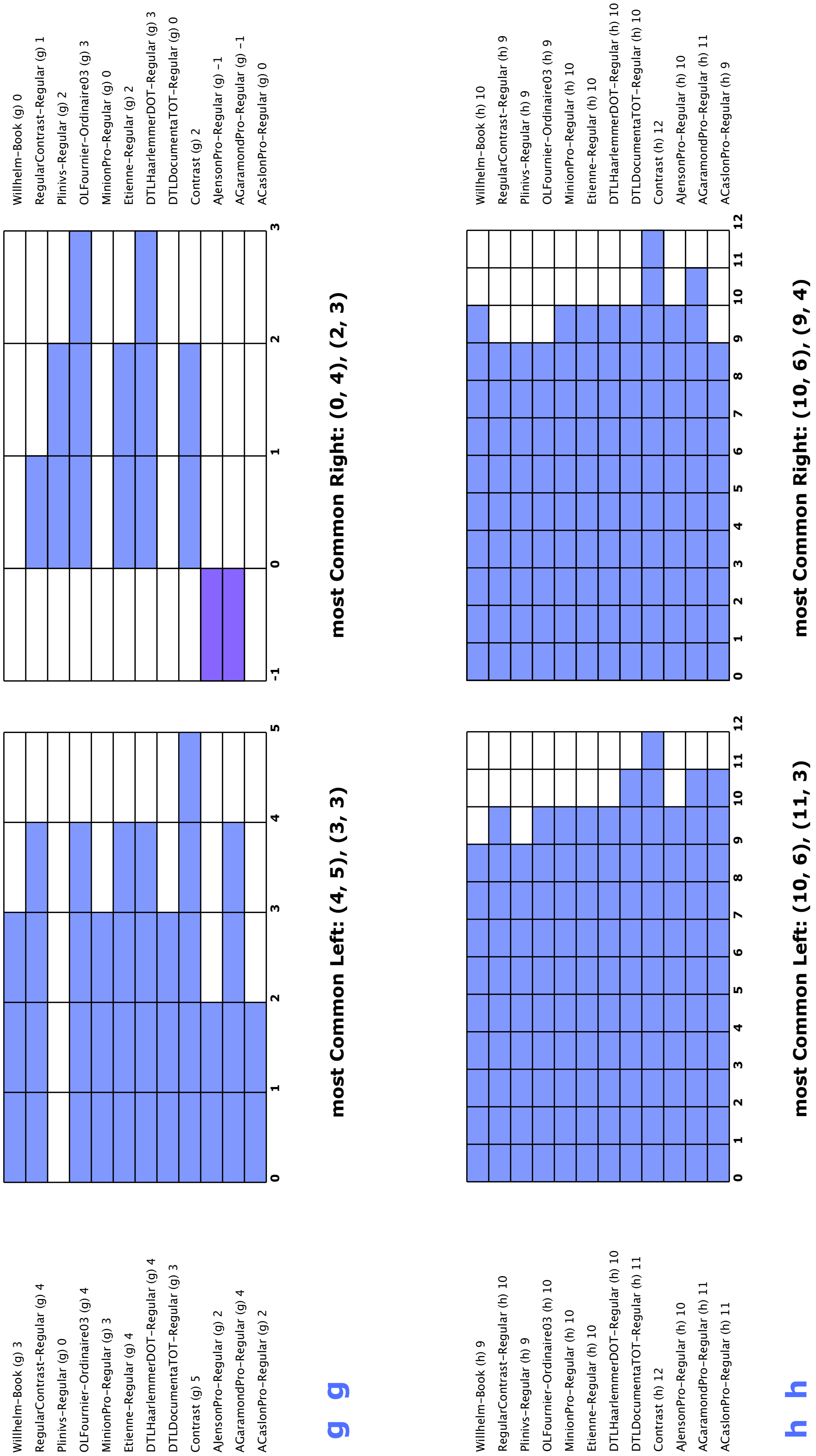


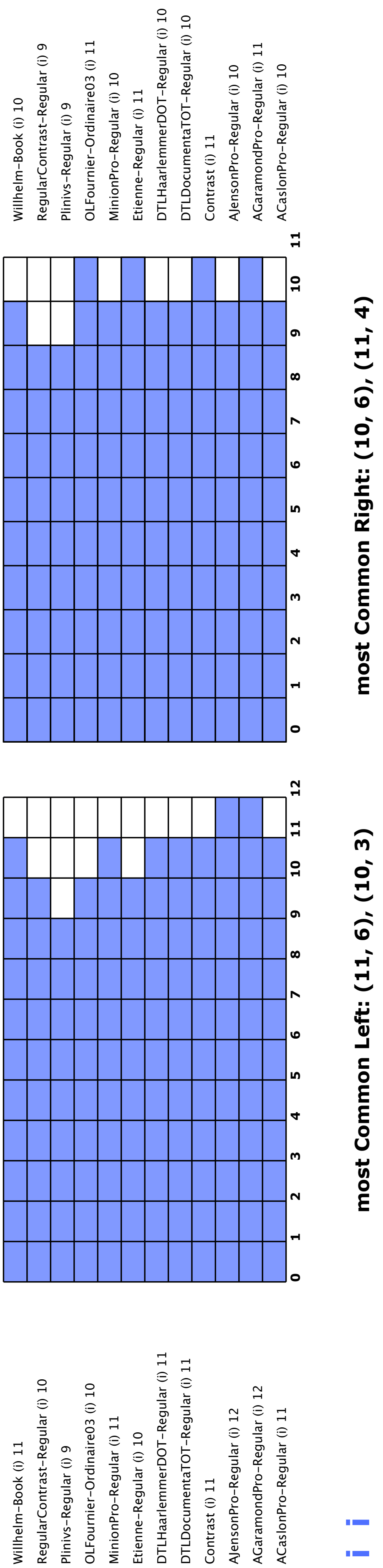


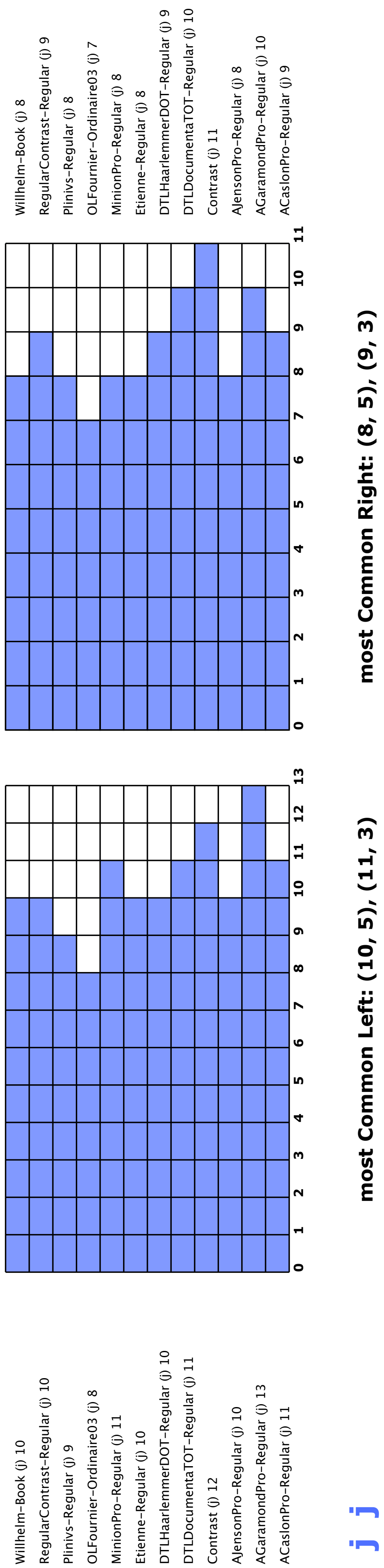
f f

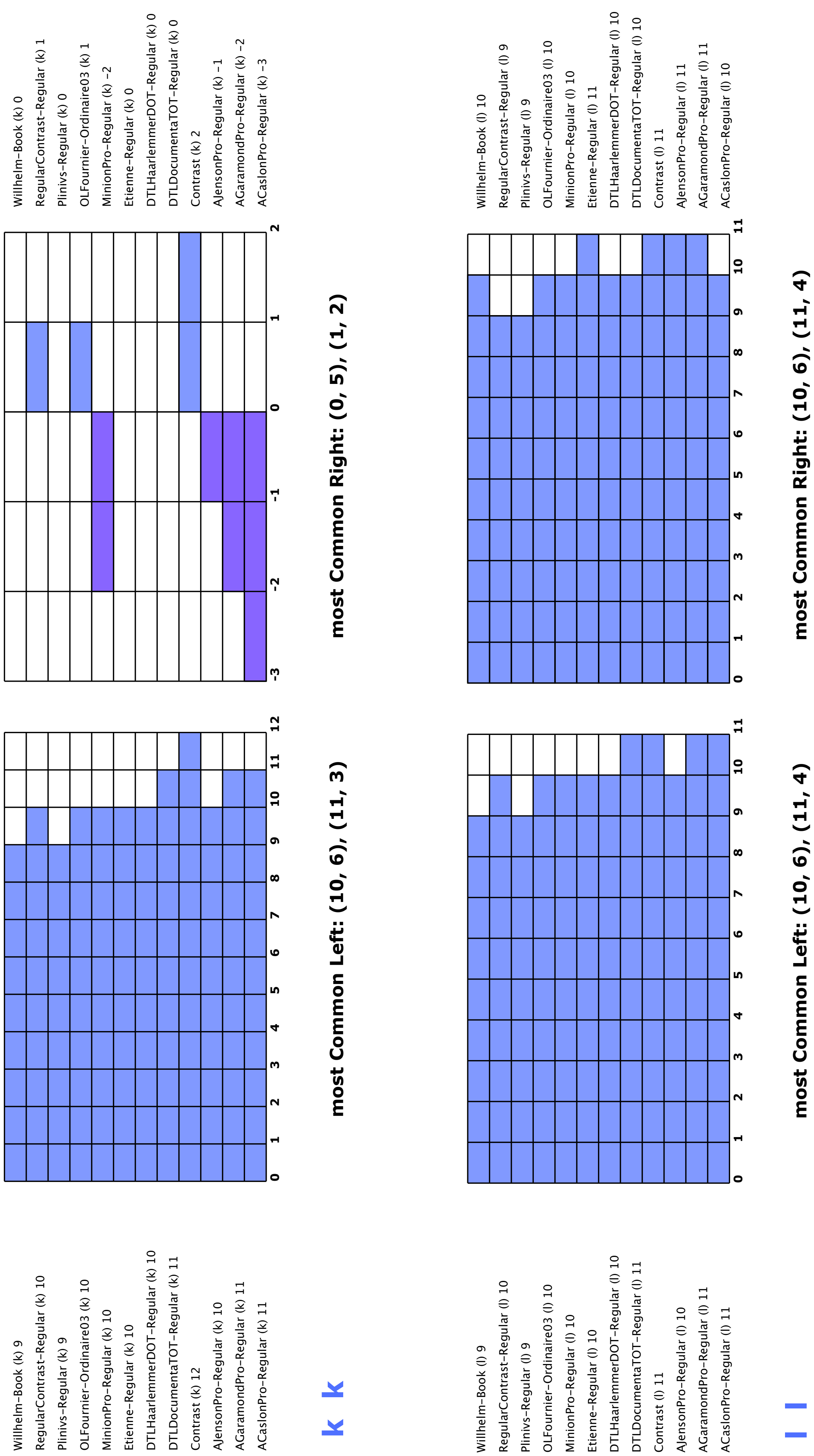
most Common Left: (11, 6), (12, 4)

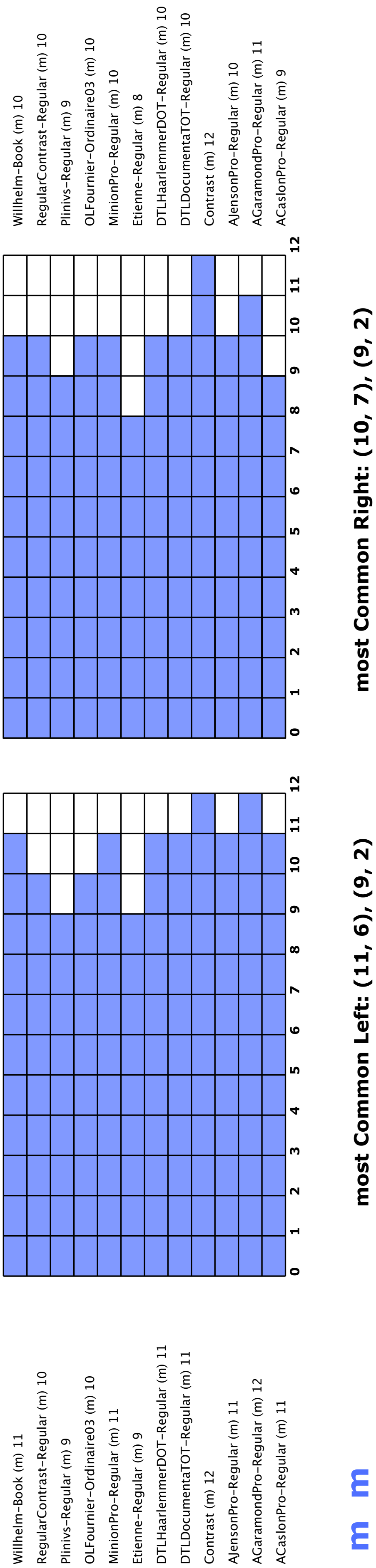
most Common Right: (-14, 2), (-13, 2)

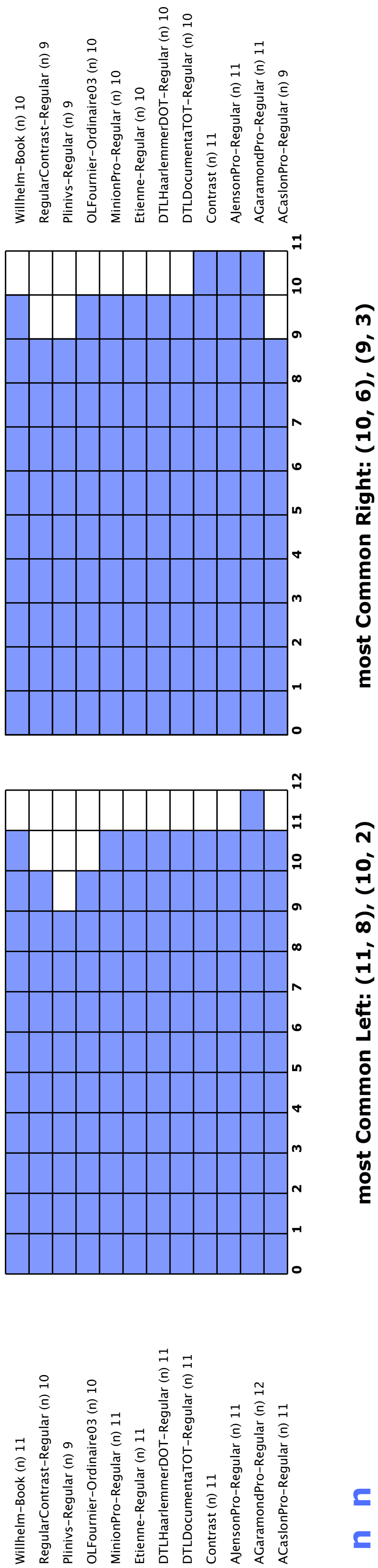

g g
Willhelm–Book (g) 3
RegularContrast–Regular (g) 4
Plinivs–Regular (g) 0
OLFournier–Ordinaire03 (g) 4
MinionPro–Regular (g) 3
Etienne–Regular (g) 4
DTLHaarlemmerDOT–Regular (g) 4
DTLDocumentaTOT–Regular (g) 3
Contrast (g) 5
AJensonPro–Regular (g) 2
AGaramondPro–Regular (g) 4
ACaslonPro–Regular (g) 2
most Common Left: (4, 5), (3, 3)
Willhelm–Book (g) 0
RegularContrast–Regular (g) 1
Plinivs–Regular (g) 2
OLFournier–Ordinaire03 (g) 3
MinionPro–Regular (g) 0
Etienne–Regular (g) 2
DTLHaarlemmerDOT–Regular (g) 3
DTLDocumentaTOT–Regular (g) 0
Contrast (g) 2
AJensonPro–Regular (g) –1
AGaramondPro–Regular (g) –1
ACaslonPro–Regular (g) 0
most Common Right: (0, 4), (2, 3)
h h
Willhelm–Book (h) 9
RegularContrast–Regular (h) 10
Plinivs–Regular (h) 9
OLFournier–Ordinaire03 (h) 10
MinionPro–Regular (h) 10
Etienne–Regular (h) 10
DTLHaarlemmerDOT–Regular (h) 10
DTLDocumentaTOT–Regular (h) 11
Contrast (h) 12
AJensonPro–Regular (h) 10
AGaramondPro–Regular (h) 11
ACaslonPro–Regular (h) 11
most Common Left: (10, 6), (11, 3)
Willhelm–Book (h) 10
RegularContrast–Regular (h) 9
Plinivs–Regular (h) 9
OLFournier–Ordinaire03 (h) 9
MinionPro–Regular (h) 10
Etienne–Regular (h) 10
DTLHaarlemmerDOT–Regular (h) 10
DTLDocumentaTOT–Regular (h) 10
Contrast (h) 12
AJensonPro–Regular (h) 10
AGaramondPro–Regular (h) 11
ACaslonPro–Regular (h) 9
most Common Right: (10, 6), (9, 4)

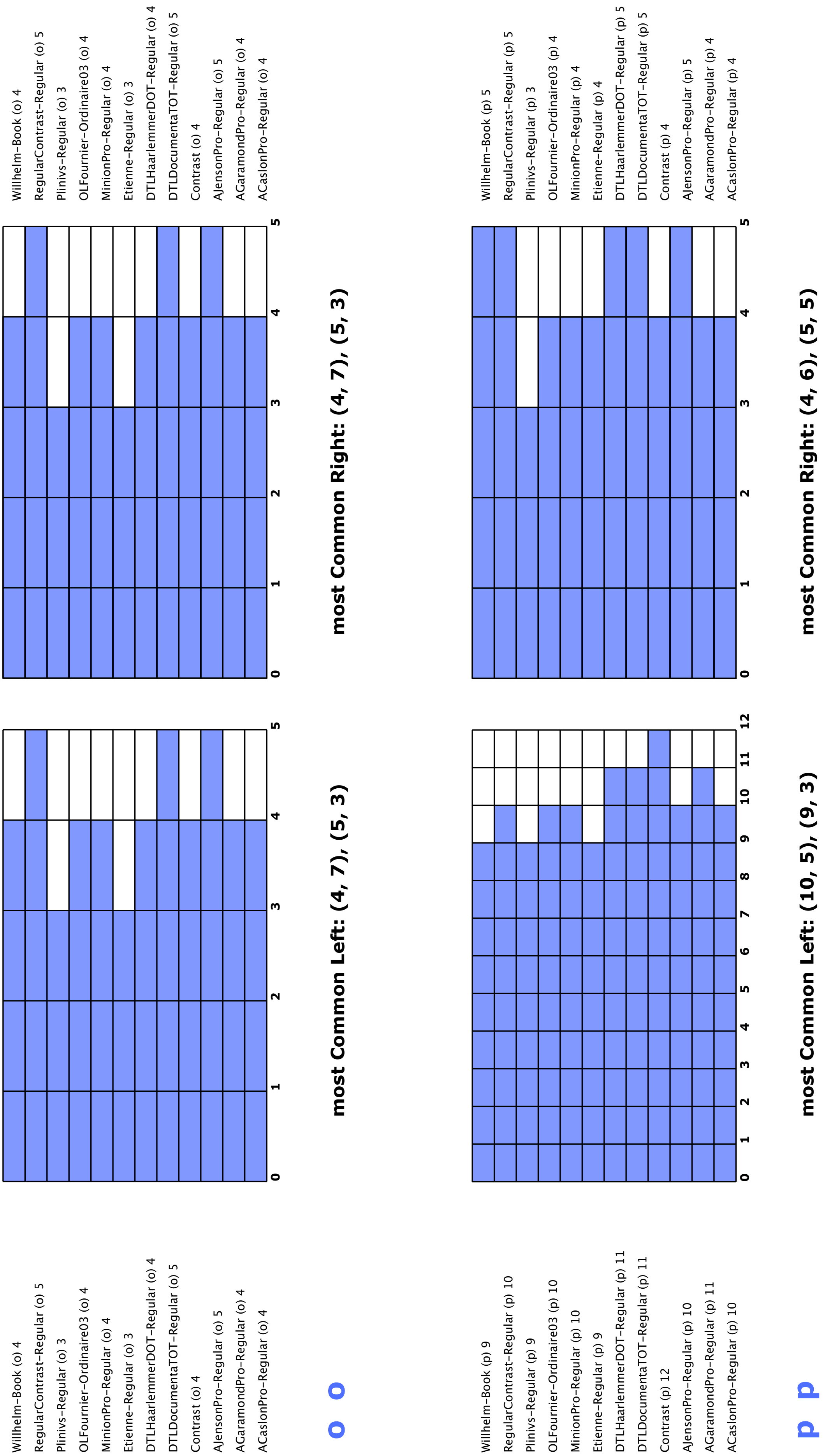

i i
Willhelm–Book (i) 11
RegularContrast–Regular (i) 10
Plinivs–Regular (i) 9
OLFournier–Ordinaire03 (i) 10
MinionPro–Regular (i) 11
Etienne–Regular (i) 10
DTLHaarlemmerDOT–Regular (i) 11
DTLDocumentaTOT–Regular (i) 11
Contrast (i) 11
AJensonPro–Regular (i) 12
AGaramondPro–Regular (i) 12
ACaslonPro–Regular (i) 11
0 1 2 3 4 5 6 7 8 9 10 11 12
most Common Left: (11, 6), (10, 3)
Willhelm–Book (i) 10
RegularContrast–Regular (i) 9
Plinivs–Regular (i) 9
OLFournier–Ordinaire03 (i) 11
MinionPro–Regular (i) 10
Etienne–Regular (i) 11
DTLHaarlemmerDOT–Regular (i) 10
DTLDocumentaTOT–Regular (i) 10
Contrast (i) 11
AJensonPro–Regular (i) 10
AGaramondPro–Regular (i) 11
ACaslonPro–Regular (i) 10
0 1 2 3 4 5 6 7 8 9 10 11
most Common Right: (10, 6), (11, 4)

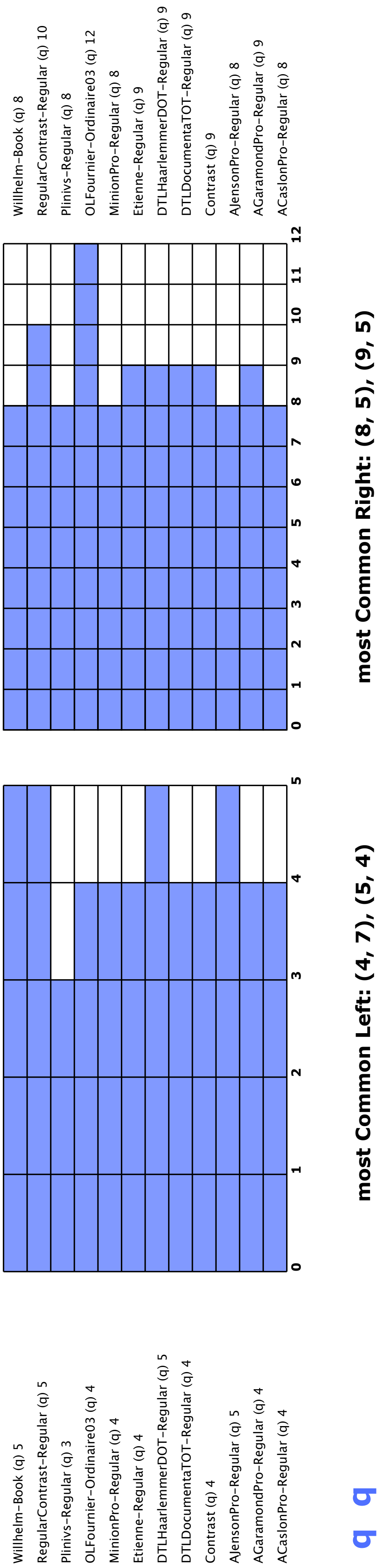

j j
Willhelm–Book (j) 10
RegularContrast–Regular (j) 10
Plinivs–Regular (j) 9
OLFournier–Ordinaire03 (j) 8
MinionPro–Regular (j) 11
Etienne–Regular (j) 10
DTLHaarlemmerDOT–Regular (j) 10
DTLDocumentaTOT–Regular (j) 11
Contrast (j) 12
AJensonPro–Regular (j) 10
AGaramondPro–Regular (j) 13
ACaslonPro–Regular (j) 11
0 1 2 3 4 5 6 7 8 9 10 11 12 13
most Common Left: (10, 5), (11, 3)
Willhelm–Book (j) 8
RegularContrast–Regular (j) 9
Plinivs–Regular (j) 8
OLFournier–Ordinaire03 (j) 7
MinionPro–Regular (j) 8
Etienne–Regular (j) 8
DTLHaarlemmerDOT–Regular (j) 9
DTLDocumentaTOT–Regular (j) 10
Contrast (j) 11
AJensonPro–Regular (j) 8
AGaramondPro–Regular (j) 10
ACaslonPro–Regular (j) 9
0 1 2 3 4 5 6 7 8 9 10 11
most Common Right: (8, 5), (9, 3)

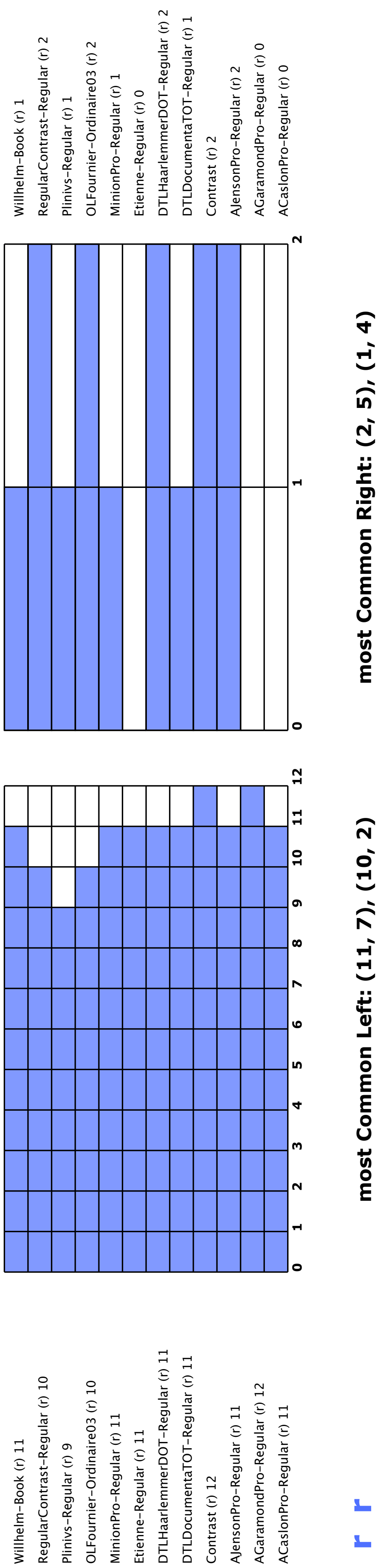

k k
most Common Left: (10, 6), (11, 3)
Willhelm-Book (k) 9
RegularContrast-Regular (k) 10
Plinivs-Regular (k) 9
OLFournier-Ordinaire03 (k) 10
MinionPro-Regular (k) 10
Etienne-Regular (k) 10
DTLHaarlemmerDOT-Regular (k) 10
DTLDocumentaTOT-Regular (k) 11
Contrast (k) 12
AJensonPro-Regular (k) 10
AGaramondPro-Regular (k) 11
ACaslonPro-Regular (k) 11
most Common Right: (0, 5), (1, 2)
Willhelm-Book (k) 0
RegularContrast-Regular (k) 1
Plinivs-Regular (k) 0
OLFournier-Ordinaire03 (k) 1
MinionPro-Regular (k) -2
Etienne-Regular (k) 0
DTLHaarlemmerDOT-Regular (k) 0
DTLDocumentaTOT-Regular (k) 0
Contrast (k) 2
AJensonPro-Regular (k) -1
AGaramondPro-Regular (k) -2
ACaslonPro-Regular (k) -3
l l
most Common Left: (10, 6), (11, 4)
Willhelm-Book (l) 9
RegularContrast-Regular (l) 10
Plinivs-Regular (l) 9
OLFournier-Ordinaire03 (l) 10
MinionPro-Regular (l) 10
Etienne-Regular (l) 10
DTLHaarlemmerDOT-Regular (l) 10
DTLDocumentaTOT-Regular (l) 11
Contrast (l) 11
AJensonPro-Regular (l) 10
AGaramondPro-Regular (l) 11
ACaslonPro-Regular (l) 11
most Common Right: (10, 6), (11, 4)
Willhelm-Book (l) 10
RegularContrast-Regular (l) 9
Plinivs-Regular (l) 9
OLFournier-Ordinaire03 (l) 10
MinionPro-Regular (l) 10
Etienne-Regular (l) 11
DTLHaarlemmerDOT-Regular (l) 10
DTLDocumentaTOT-Regular (l) 10
Contrast (l) 11
AJensonPro-Regular (l) 11
AGaramondPro-Regular (l) 11
ACaslonPro-Regular (l) 10

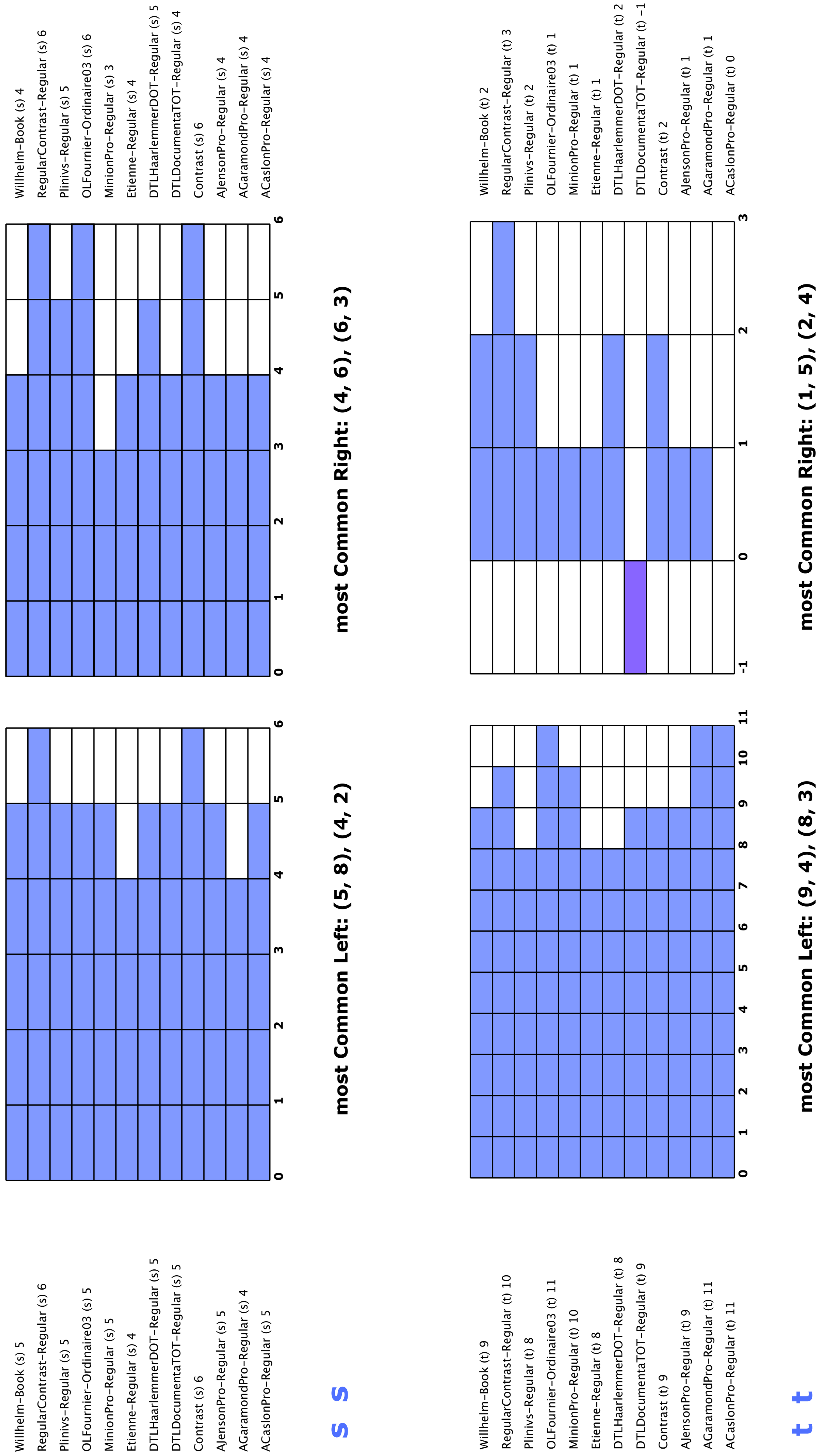

Willhelm-Book (m) 10
RegularContrast-Regular (m) 10
Plinivs-Regular (m) 9
OLFournier-Ordinaire03 (m) 10
MinionPro-Regular (m) 10
Etienne-Regular (m) 8
DTLHaarlemmerDOT-Regular (m) 10
DTLDocumentaTOT-Regular (m) 10
Contrast (m) 12
AJensonPro-Regular (m) 10
AGaramondPro-Regular (m) 11
ACaslonPro-Regular (m) 9
0 1 2 3 4 5 6 7 8 9 10 11 12
most Common Right: (10, 7), (9, 2)
0 1 2 3 4 5 6 7 8 9 10 11 12
most Common Left: (11, 6), (9, 2)
Willhelm-Book (m) 11
RegularContrast-Regular (m) 10
Plinivs-Regular (m) 9
OLFournier-Ordinaire03 (m) 10
MinionPro-Regular (m) 11
Etienne-Regular (m) 9
DTLHaarlemmerDOT-Regular (m) 11
DTLDocumentaTOT-Regular (m) 11
Contrast (m) 12
AJensonPro-Regular (m) 11
AGaramondPro-Regular (m) 12
ACaslonPro-Regular (m) 11
m m

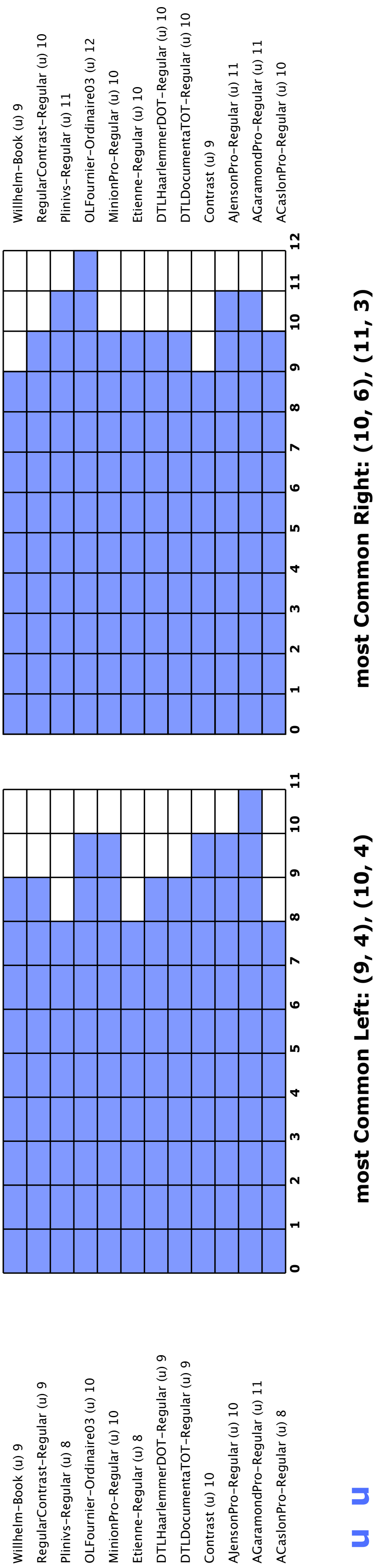

Willhelm-Book (n) 10
RegularContrast-Regular (n) 9
Plinivs-Regular (n) 9
OLFournier-Ordinaire03 (n) 10
MinionPro-Regular (n) 10
Etienne-Regular (n) 10
DTLHaarlemmerDOT-Regular (n) 10
DTLDocumentaTOT-Regular (n) 10
Contrast (n) 11
AJensonPro-Regular (n) 11
AGaramondPro-Regular (n) 11
ACaslonPro-Regular (n) 9
0 1 2 3 4 5 6 7 8 9 10 11
most Common Right: (10, 6), (9, 3)
0 1 2 3 4 5 6 7 8 9 10 11 12
most Common Left: (11, 8), (10, 2)
Willhelm-Book (n) 11
RegularContrast-Regular (n) 10
Plinivs-Regular (n) 9
OLFournier-Ordinaire03 (n) 10
MinionPro-Regular (n) 11
Etienne-Regular (n) 11
DTLHaarlemmerDOT-Regular (n) 11
DTLDocumentaTOT-Regular (n) 11
Contrast (n) 11
AJensonPro-Regular (n) 11
AGaramondPro-Regular (n) 12
ACaslonPro-Regular (n) 11
n n

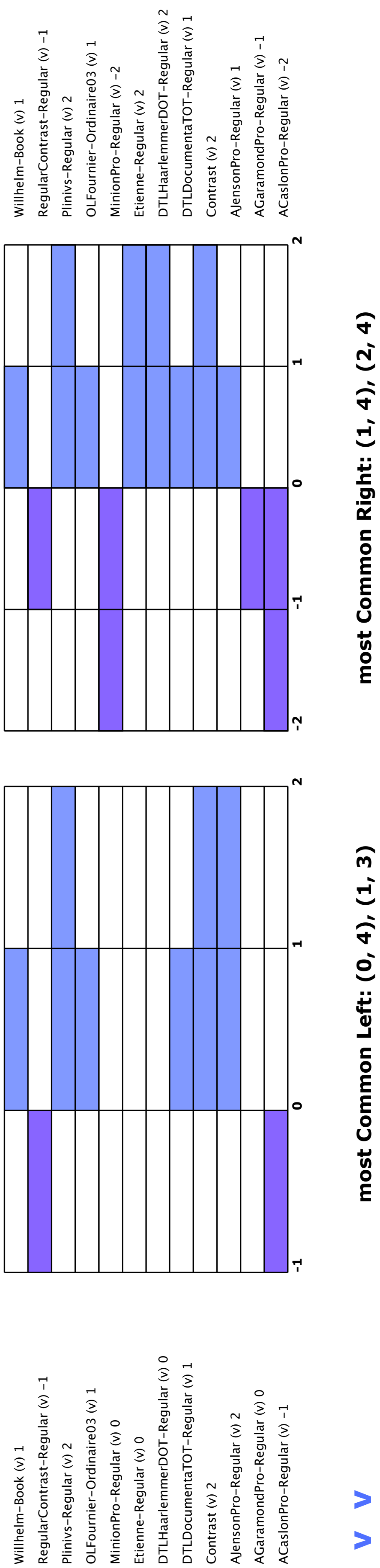

o o
Willhelm–Book (o) 4
RegularContrast–Regular (o) 5
Plinivs–Regular (o) 3
OLFournier–Ordinaire03 (o) 4
MinionPro–Regular (o) 4
Etienne–Regular (o) 3
DTLHaarlemmerDOT–Regular (o) 4
DTLDocumentaTOT–Regular (o) 5
Contrast (o) 4
AJensonPro–Regular (o) 5
AGaramondPro–Regular (o) 4
ACaslonPro–Regular (o) 4
0 1 2 3 4 5
most Common Left: (4, 7), (5, 3)
0 1 2 3 4 5
most Common Right: (4, 7), (5, 3)
p p
Willhelm–Book (p) 9
RegularContrast–Regular (p) 10
Plinivs–Regular (p) 9
OLFournier–Ordinaire03 (p) 10
MinionPro–Regular (p) 10
Etienne–Regular (p) 9
DTLHaarlemmerDOT–Regular (p) 11
DTLDocumentaTOT–Regular (p) 11
Contrast (p) 12
AJensonPro–Regular (p) 10
AGaramondPro–Regular (p) 11
ACaslonPro–Regular (p) 10
0 1 2 3 4 5 6 7 8 9 10 11 12
most Common Left: (10, 5), (9, 3)
Willhelm–Book (p) 5
RegularContrast–Regular (p) 5
Plinivs–Regular (p) 3
OLFournier–Ordinaire03 (p) 4
MinionPro–Regular (p) 4
Etienne–Regular (p) 4
DTLHaarlemmerDOT–Regular (p) 5
DTLDocumentaTOT–Regular (p) 5
Contrast (p) 4
AJensonPro–Regular (p) 5
AGaramondPro–Regular (p) 4
ACaslonPro–Regular (p) 4
0 1 2 3 4 5
most Common Right: (4, 6), (5, 5)

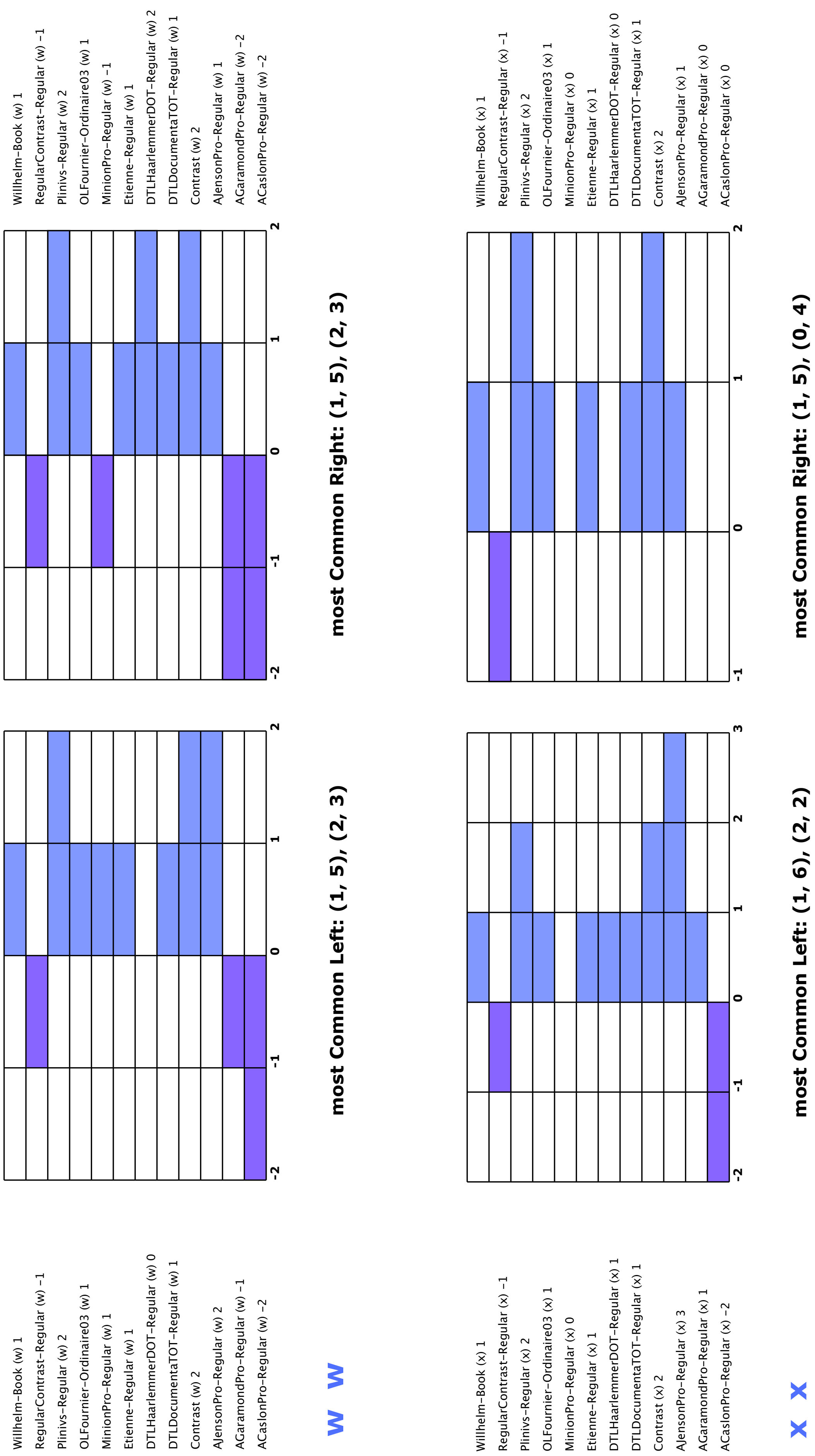

q q
Willhelm–Book (q) 5
RegularContrast–Regular (q) 5
Plinivs–Regular (q) 3
OLFournier–Ordinaire03 (q) 4
MinionPro–Regular (q) 4
Etienne–Regular (q) 4
DTLHaarlemmerDOT–Regular (q) 5
DTLDocumentaTOT–Regular (q) 4
Contrast (q) 4
AJensonPro–Regular (q) 5
AGaramondPro–Regular (q) 4
ACaslonPro–Regular (q) 4
most Common Left: (4, 7), (5, 4)
Willhelm–Book (q) 8
RegularContrast–Regular (q) 10
Plinivs–Regular (q) 8
OLFournier–Ordinaire03 (q) 12
MinionPro–Regular (q) 8
Etienne–Regular (q) 9
DTLHaarlemmerDOT–Regular (q) 9
DTLDocumentaTOT–Regular (q) 9
Contrast (q) 9
AJensonPro–Regular (q) 8
AGaramondPro–Regular (q) 9
ACaslonPro–Regular (q) 8
most Common Right: (8, 5), (9, 5)

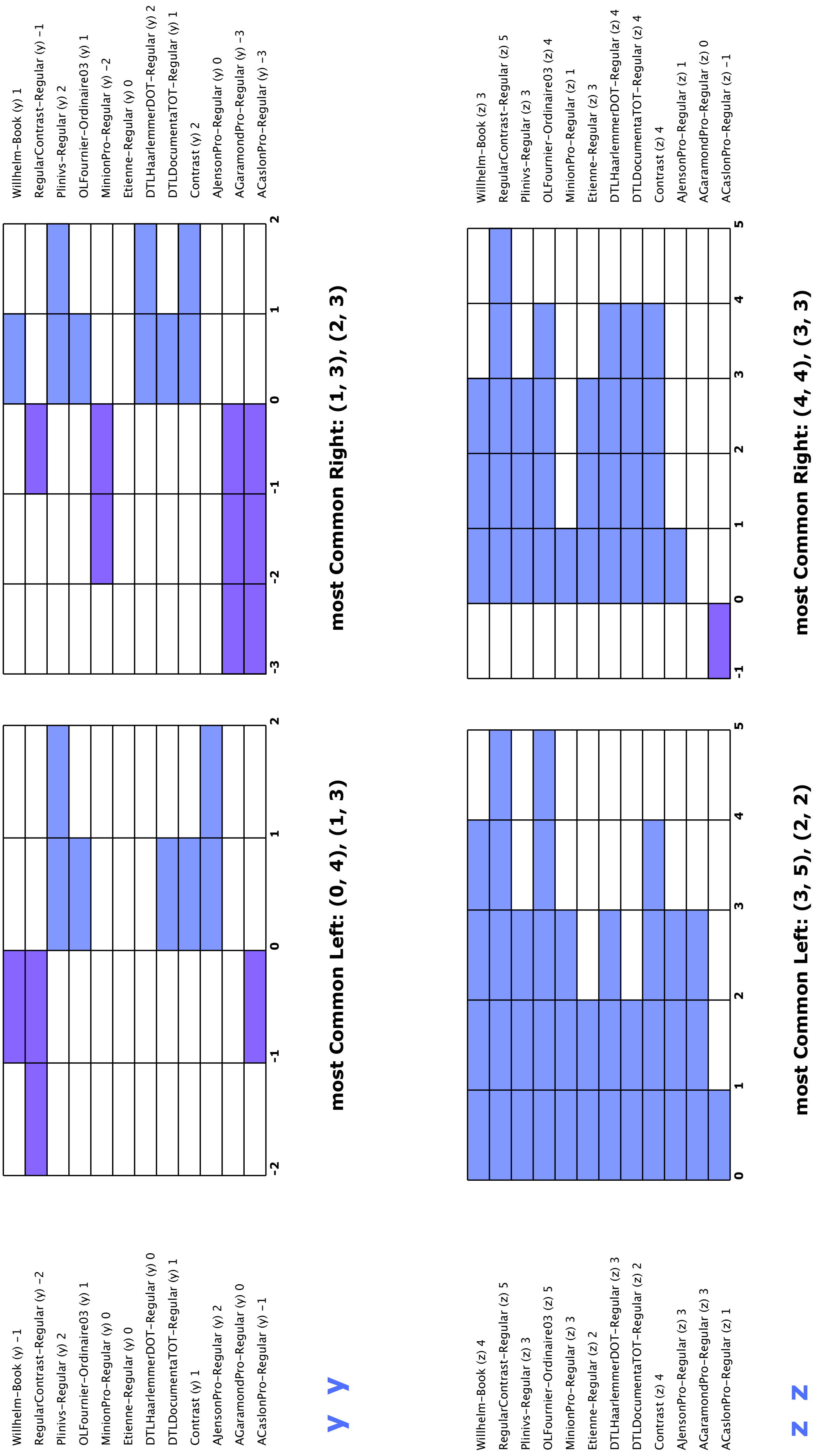

r r
Willhelm–Book (r) 11
RegularContrast–Regular (r) 10
Plinivs–Regular (r) 9
OLFournier–Ordinaire03 (r) 10
MinionPro–Regular (r) 11
Etienne–Regular (r) 11
DTLHaarlemmerDOT–Regular (r) 11
DTLDocumentaTOT–Regular (r) 11
Contrast (r) 12
AJensonPro–Regular (r) 11
AGaramondPro–Regular (r) 12
ACaslonPro–Regular (r) 11
most Common Left: (11, 7), (10, 2)
Willhelm–Book (r) 1
RegularContrast–Regular (r) 2
Plinivs–Regular (r) 1
OLFournier–Ordinaire03 (r) 2
MinionPro–Regular (r) 1
Etienne–Regular (r) 0
DTLHaarlemmerDOT–Regular (r) 2
DTLDocumentaTOT–Regular (r) 1
Contrast (r) 2
AJensonPro–Regular (r) 2
AGaramondPro–Regular (r) 0
ACaslonPro–Regular (r) 0
most Common Right: (2, 5), (1, 4)

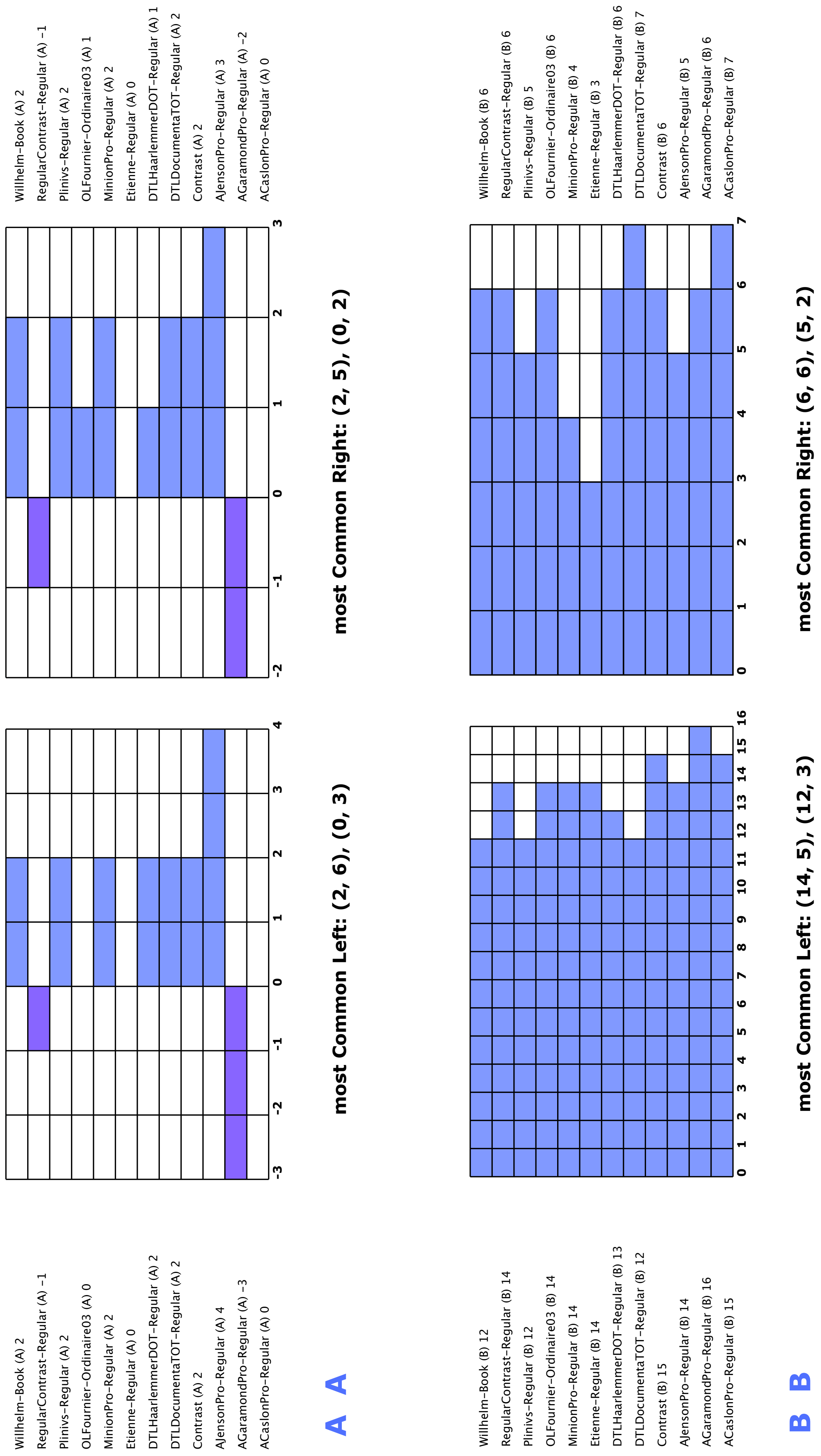

s s
Willhelm–Book (s) 5
RegularContrast–Regular (s) 6
Plinivs–Regular (s) 5
OLFournier–Ordinaire03 (s) 5
MinionPro–Regular (s) 5
Etienne–Regular (s) 4
DTLHaarlemmerDOT–Regular (s) 5
DTLDocumentaTOT–Regular (s) 5
Contrast (s) 6
AJensonPro–Regular (s) 5
AGaramondPro–Regular (s) 4
ACaslonPro–Regular (s) 5
0 1 2 3 4 5 6
most Common Left: (5, 8), (4, 2)
Willhelm–Book (s) 4
RegularContrast–Regular (s) 6
Plinivs–Regular (s) 5
OLFournier–Ordinaire03 (s) 6
MinionPro–Regular (s) 3
Etienne–Regular (s) 4
DTLHaarlemmerDOT–Regular (s) 5
DTLDocumentaTOT–Regular (s) 4
Contrast (s) 6
AJensonPro–Regular (s) 4
AGaramondPro–Regular (s) 4
ACaslonPro–Regular (s) 4
0 1 2 3 4 5 6
most Common Right: (4, 6), (6, 3)
t t
Willhelm–Book (t) 9
RegularContrast–Regular (t) 10
Plinivs–Regular (t) 8
OLFournier–Ordinaire03 (t) 11
MinionPro–Regular (t) 10
Etienne–Regular (t) 8
DTLHaarlemmerDOT–Regular (t) 8
DTLDocumentaTOT–Regular (t) 9
Contrast (t) 9
AJensonPro–Regular (t) 9
AGaramondPro–Regular (t) 11
ACaslonPro–Regular (t) 11
0 1 2 3 4 5 6 7 8 9 10 11
most Common Left: (9, 4), (8, 3)
Willhelm–Book (t) 2
RegularContrast–Regular (t) 3
Plinivs–Regular (t) 2
OLFournier–Ordinaire03 (t) 1
MinionPro–Regular (t) 1
Etienne–Regular (t) 1
DTLHaarlemmerDOT–Regular (t) 2
DTLDocumentaTOT–Regular (t) -1
Contrast (t) 2
AJensonPro–Regular (t) 1
AGaramondPro–Regular (t) 1
ACaslonPro–Regular (t) 0
-1 0 1 2 3
most Common Right: (1, 5), (2, 4)

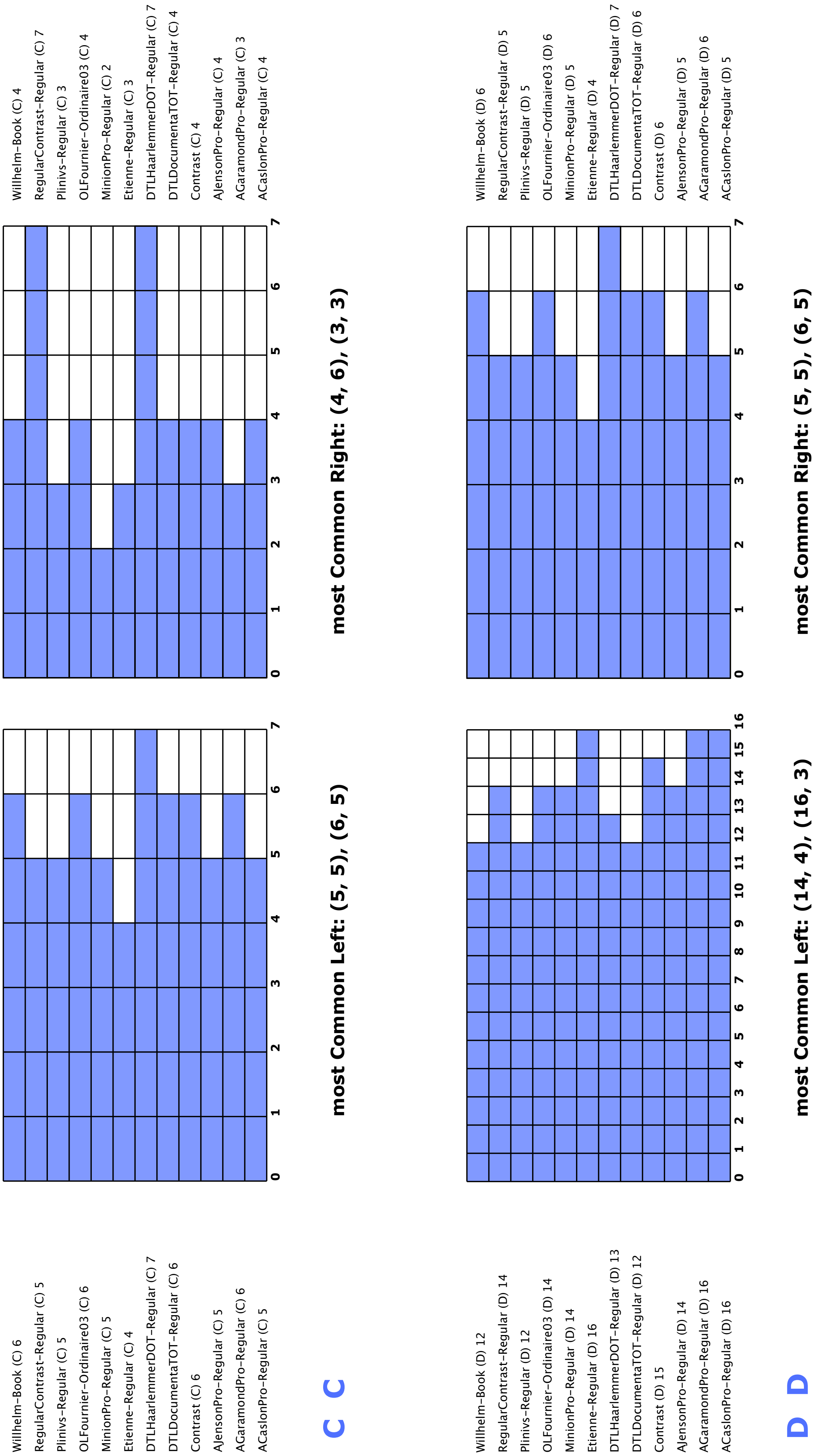

u u
Willhelm–Book (u) 9
RegularContrast–Regular (u) 9
Plinivs–Regular (u) 8
OLFournier–Ordinaire03 (u) 10
MinionPro–Regular (u) 10
Etienne–Regular (u) 8
DTLHaarlemmerDOT–Regular (u) 9
DTLDocumentaTOT–Regular (u) 9
Contrast (u) 10
AJensonPro–Regular (u) 10
AGaramondPro–Regular (u) 11
ACaslonPro–Regular (u) 8
most Common Left: (9, 4), (10, 4)
Willhelm–Book (u) 9
RegularContrast–Regular (u) 10
Plinivs–Regular (u) 11
OLFournier–Ordinaire03 (u) 12
MinionPro–Regular (u) 10
Etienne–Regular (u) 10
DTLHaarlemmerDOT–Regular (u) 10
DTLDocumentaTOT–Regular (u) 10
Contrast (u) 9
AJensonPro–Regular (u) 11
AGaramondPro–Regular (u) 11
ACaslonPro–Regular (u) 10
most Common Right: (10, 6), (11, 3)

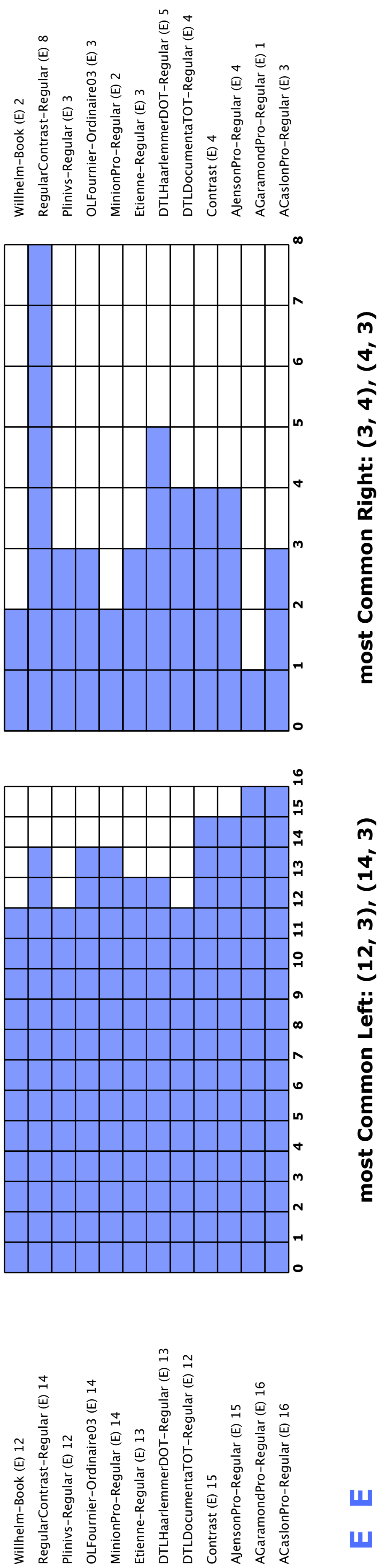

v v
Willhelm–Book (v) 1
RegularContrast–Regular (v) –1
Plinivs–Regular (v) 2
OLFournier–Ordinaire03 (v) 1
MinionPro–Regular (v) 0
Etienne–Regular (v) 0
DTLHaarlemmerDOT–Regular (v) 0
DTLDocumentaTOT–Regular (v) 1
Contrast (v) 2
AJensonPro–Regular (v) 2
AGaramondPro–Regular (v) 0
ACaslonPro–Regular (v) –1
most Common Left: (0, 4), (1, 3)
Willhelm–Book (v) 1
RegularContrast–Regular (v) –1
Plinivs–Regular (v) 2
OLFournier–Ordinaire03 (v) 1
MinionPro–Regular (v) –2
Etienne–Regular (v) 2
DTLHaarlemmerDOT–Regular (v) 2
DTLDocumentaTOT–Regular (v) 1
Contrast (v) 2
AJensonPro–Regular (v) 1
AGaramondPro–Regular (v) –1
ACaslonPro–Regular (v) –2
most Common Right: (1, 4), (2, 4)

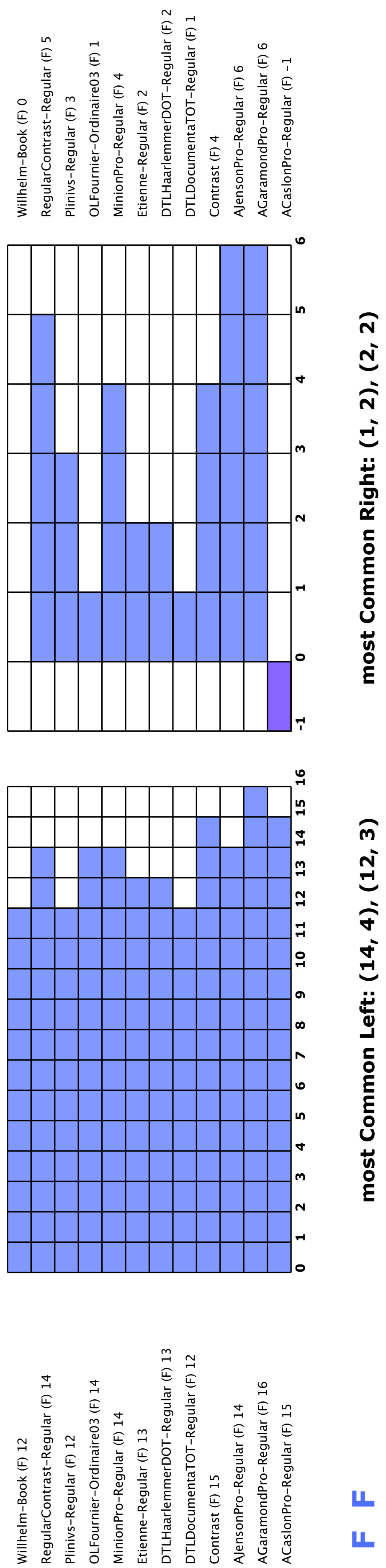

w w
most Common Left: (1, 5), (2, 3)
most Common Right: (1, 5), (2, 3)
Willhelm–Book (w) 1
RegularContrast–Regular (w) –1
Plinivs–Regular (w) 2
OLFournier–Ordinaire03 (w) 1
MinionPro–Regular (w) 1
Etienne–Regular (w) 1
DTLHaarlemmerDOT–Regular (w) 0
DTLDocumentaTOT–Regular (w) 1
Contrast (w) 2
AJensonPro–Regular (w) 2
AGaramondPro–Regular (w) –1
ACaslonPro–Regular (w) –2
Willhelm–Book (w) 1
RegularContrast–Regular (w) –1
Plinivs–Regular (w) 2
OLFournier–Ordinaire03 (w) 1
MinionPro–Regular (w) –1
Etienne–Regular (w) 1
DTLHaarlemmerDOT–Regular (w) 2
DTLDocumentaTOT–Regular (w) 1
Contrast (w) 2
AJensonPro–Regular (w) 1
AGaramondPro–Regular (w) –2
ACaslonPro–Regular (w) –2
x x
most Common Left: (1, 6), (2, 2)
most Common Right: (1, 5), (0, 4)
Willhelm–Book (x) 1
RegularContrast–Regular (x) –1
Plinivs–Regular (x) 2
OLFournier–Ordinaire03 (x) 1
MinionPro–Regular (x) 0
Etienne–Regular (x) 1
DTLHaarlemmerDOT–Regular (x) 1
DTLDocumentaTOT–Regular (x) 1
Contrast (x) 2
AJensonPro–Regular (x) 3
AGaramondPro–Regular (x) 1
ACaslonPro–Regular (x) –2
Willhelm–Book (x) 1
RegularContrast–Regular (x) –1
Plinivs–Regular (x) 2
OLFournier–Ordinaire03 (x) 1
MinionPro–Regular (x) 0
Etienne–Regular (x) 1
DTLHaarlemmerDOT–Regular (x) 0
DTLDocumentaTOT–Regular (x) 1
Contrast (x) 2
AJensonPro–Regular (x) 1
AGaramondPro–Regular (x) 0
ACaslonPro–Regular (x) 0

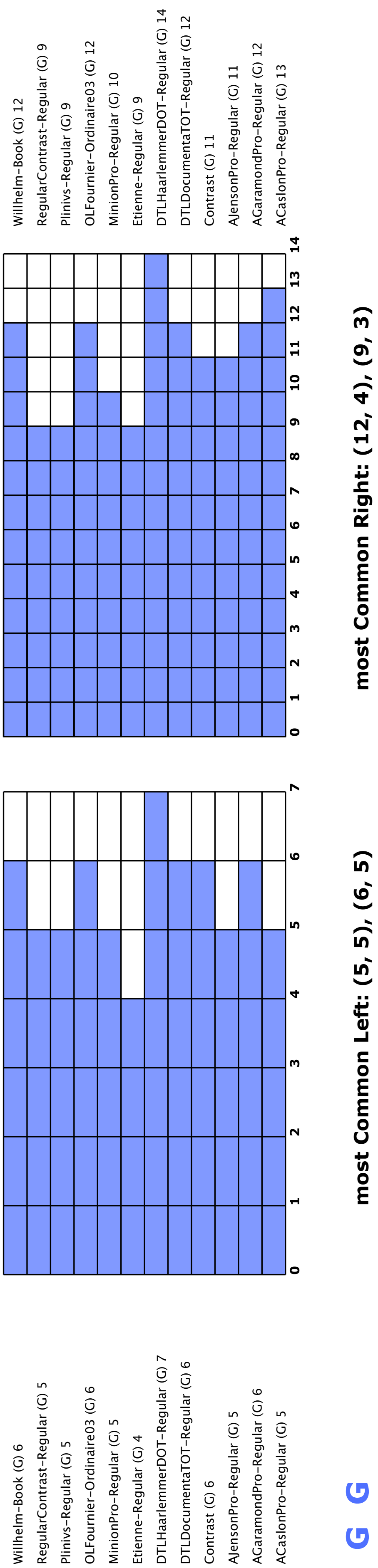

y y
Willhelm-Book (y) -1
RegularContrast-Regular (y) -2
Plinivs-Regular (y) 2
OLFournier-Ordinaire03 (y) 1
MinionPro-Regular (y) 0
Etienne-Regular (y) 0
DTLHaarlemmerDOT-Regular (y) 0
DTLDocumentaTOT-Regular (y) 1
Contrast (y) 1
AJensonPro-Regular (y) 2
AGaramondPro-Regular (y) 0
ACaslonPro-Regular (y) -1
most Common Left: (0, 4), (1, 3)
Willhelm-Book (y) 1
RegularContrast-Regular (y) -1
Plinivs-Regular (y) 2
OLFournier-Ordinaire03 (y) 1
MinionPro-Regular (y) -2
Etienne-Regular (y) 0
DTLHaarlemmerDOT-Regular (y) 2
DTLDocumentaTOT-Regular (y) 1
Contrast (y) 2
AJensonPro-Regular (y) 0
AGaramondPro-Regular (y) -3
ACaslonPro-Regular (y) -3
most Common Right: (1, 3), (2, 3)
z z
Willhelm-Book (z) 4
RegularContrast-Regular (z) 5
Plinivs-Regular (z) 3
OLFournier-Ordinaire03 (z) 5
MinionPro-Regular (z) 3
Etienne-Regular (z) 2
DTLHaarlemmerDOT-Regular (z) 3
DTLDocumentaTOT-Regular (z) 2
Contrast (z) 4
AJensonPro-Regular (z) 3
AGaramondPro-Regular (z) 3
ACaslonPro-Regular (z) 1
most Common Left: (3, 5), (2, 2)
Willhelm-Book (z) 3
RegularContrast-Regular (z) 5
Plinivs-Regular (z) 3
OLFournier-Ordinaire03 (z) 4
MinionPro-Regular (z) 1
Etienne-Regular (z) 3
DTLHaarlemmerDOT-Regular (z) 4
DTLDocumentaTOT-Regular (z) 4
Contrast (z) 4
AJensonPro-Regular (z) 1
AGaramondPro-Regular (z) 0
ACaslonPro-Regular (z) -1
most Common Right: (4, 4), (3, 3)

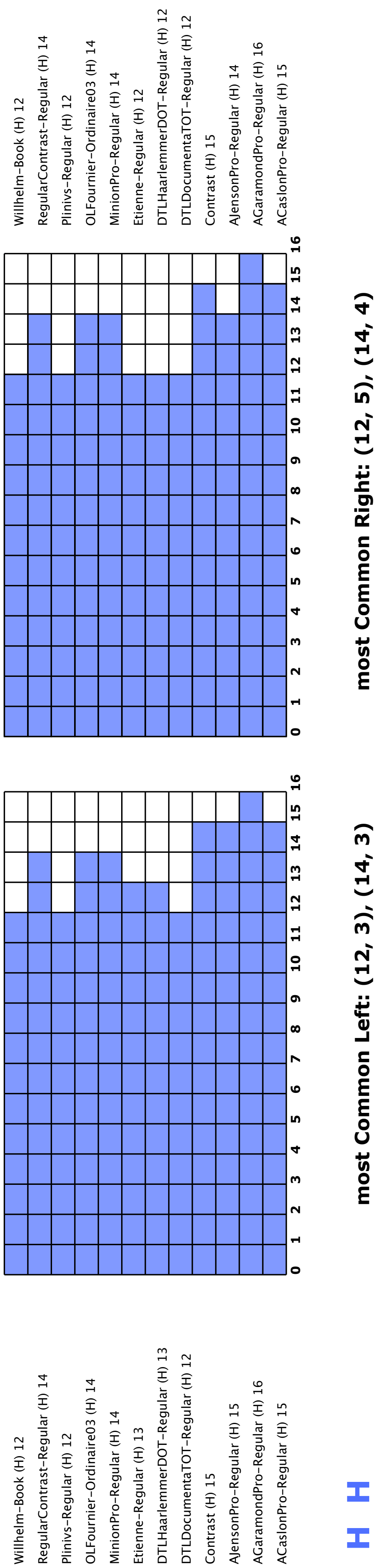

A A
Willhelm-Book (A) 2
RegularContrast-Regular (A) -1
Plinivs-Regular (A) 2
OLFournier-Ordinaire03 (A) 0
MinionPro-Regular (A) 2
Etienne-Regular (A) 0
DTLHaarlemmerDOT-Regular (A) 2
DTLDocumentaTOT-Regular (A) 2
Contrast (A) 2
AJensonPro-Regular (A) 4
AGaramondPro-Regular (A) -3
ACaslonPro-Regular (A) 0
most Common Left: (2, 6), (0, 3)
Willhelm-Book (A) 2
RegularContrast-Regular (A) -1
Plinivs-Regular (A) 2
OLFournier-Ordinaire03 (A) 1
MinionPro-Regular (A) 2
Etienne-Regular (A) 0
DTLHaarlemmerDOT-Regular (A) 1
DTLDocumentaTOT-Regular (A) 2
Contrast (A) 2
AJensonPro-Regular (A) 3
AGaramondPro-Regular (A) -2
ACaslonPro-Regular (A) 0
most Common Right: (2, 5), (0, 2)
B B
Willhelm-Book (B) 12
RegularContrast-Regular (B) 14
Plinivs-Regular (B) 12
OLFournier-Ordinaire03 (B) 14
MinionPro-Regular (B) 14
Etienne-Regular (B) 14
DTLHaarlemmerDOT-Regular (B) 13
DTLDocumentaTOT-Regular (B) 12
Contrast (B) 15
AJensonPro-Regular (B) 14
AGaramondPro-Regular (B) 16
ACaslonPro-Regular (B) 15
most Common Left: (14, 5), (12, 3)
Willhelm-Book (B) 6
RegularContrast-Regular (B) 6
Plinivs-Regular (B) 5
OLFournier-Ordinaire03 (B) 6
MinionPro-Regular (B) 4
Etienne-Regular (B) 3
DTLHaarlemmerDOT-Regular (B) 6
DTLDocumentaTOT-Regular (B) 7
Contrast (B) 6
AJensonPro-Regular (B) 5
AGaramondPro-Regular (B) 6
ACaslonPro-Regular (B) 7
most Common Right: (6, 6), (5, 2)

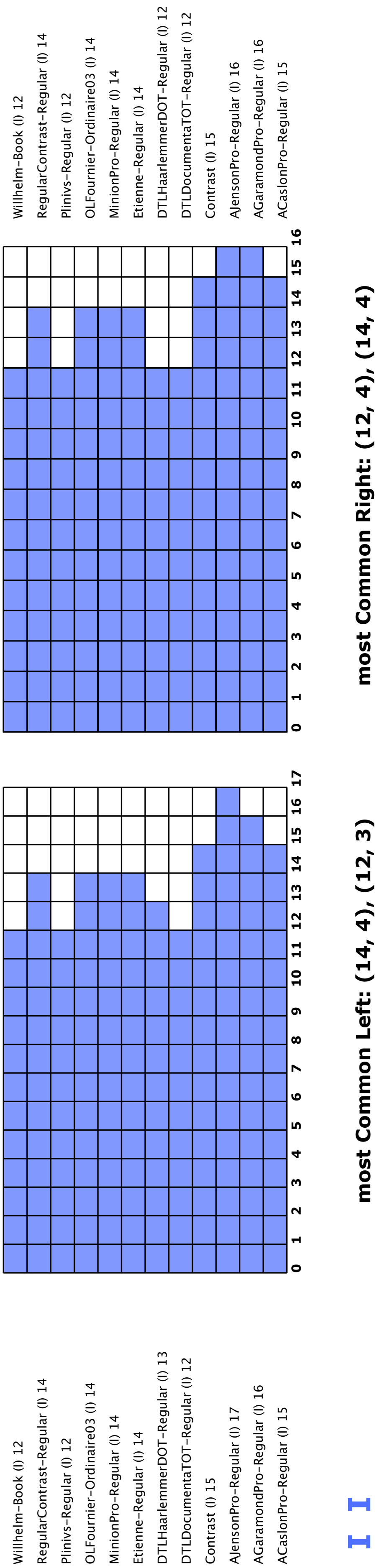

C C
Willhelm–Book (C) 6
RegularContrast–Regular (C) 5
Plinivs–Regular (C) 5
OLFournier–Ordinaire03 (C) 6
MinionPro–Regular (C) 5
Etienne–Regular (C) 4
DTLHaarlemmerDOT–Regular (C) 7
DTLDocumentaTOT–Regular (C) 6
Contrast (C) 6
AJensonPro–Regular (C) 5
AGaramondPro–Regular (C) 6
ACaslonPro–Regular (C) 5
most Common Left: (5, 5), (6, 5)
Willhelm–Book (C) 4
RegularContrast–Regular (C) 7
Plinivs–Regular (C) 3
OLFournier–Ordinaire03 (C) 4
MinionPro–Regular (C) 2
Etienne–Regular (C) 3
DTLHaarlemmerDOT–Regular (C) 7
DTLDocumentaTOT–Regular (C) 4
Contrast (C) 4
AJensonPro–Regular (C) 4
AGaramondPro–Regular (C) 3
ACaslonPro–Regular (C) 4
most Common Right: (4, 6), (3, 3)
D D
Willhelm–Book (D) 12
RegularContrast–Regular (D) 14
Plinivs–Regular (D) 12
OLFournier–Ordinaire03 (D) 14
MinionPro–Regular (D) 14
Etienne–Regular (D) 16
DTLHaarlemmerDOT–Regular (D) 13
DTLDocumentaTOT–Regular (D) 12
Contrast (D) 15
AJensonPro–Regular (D) 14
AGaramondPro–Regular (D) 16
ACaslonPro–Regular (D) 16
most Common Left: (14, 4), (16, 3)
Willhelm–Book (D) 6
RegularContrast–Regular (D) 5
Plinivs–Regular (D) 5
OLFournier–Ordinaire03 (D) 6
MinionPro–Regular (D) 5
Etienne–Regular (D) 4
DTLHaarlemmerDOT–Regular (D) 7
DTLDocumentaTOT–Regular (D) 6
Contrast (D) 6
AJensonPro–Regular (D) 5
AGaramondPro–Regular (D) 6
ACaslonPro–Regular (D) 5
most Common Right: (5, 5), (6, 5)

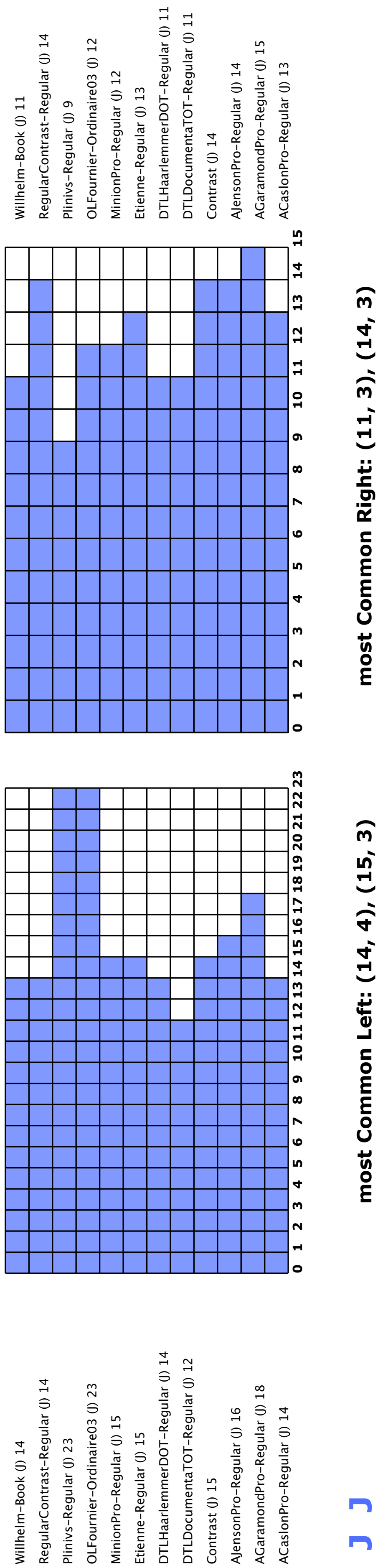

E E
Willhelm-Book (E) 12
RegularContrast-Regular (E) 14
Plinivs-Regular (E) 12
OLFournier-Ordinaire03 (E) 14
MinionPro-Regular (E) 14
Etienne-Regular (E) 13
DTLHaarlemmerDOT-Regular (E) 13
DTLDocumentaTOT-Regular (E) 12
Contrast (E) 15
AJensonPro-Regular (E) 15
AGaramondPro-Regular (E) 16
ACaslonPro-Regular (E) 16
most Common Left: (12, 3), (14, 3)
Willhelm-Book (E) 2
RegularContrast-Regular (E) 8
Plinivs-Regular (E) 3
OLFournier-Ordinaire03 (E) 3
MinionPro-Regular (E) 2
Etienne-Regular (E) 3
DTLHaarlemmerDOT-Regular (E) 5
DTLDocumentaTOT-Regular (E) 4
Contrast (E) 4
AJensonPro-Regular (E) 4
AGaramondPro-Regular (E) 1
ACaslonPro-Regular (E) 3
most Common Right: (3, 4), (4, 3)

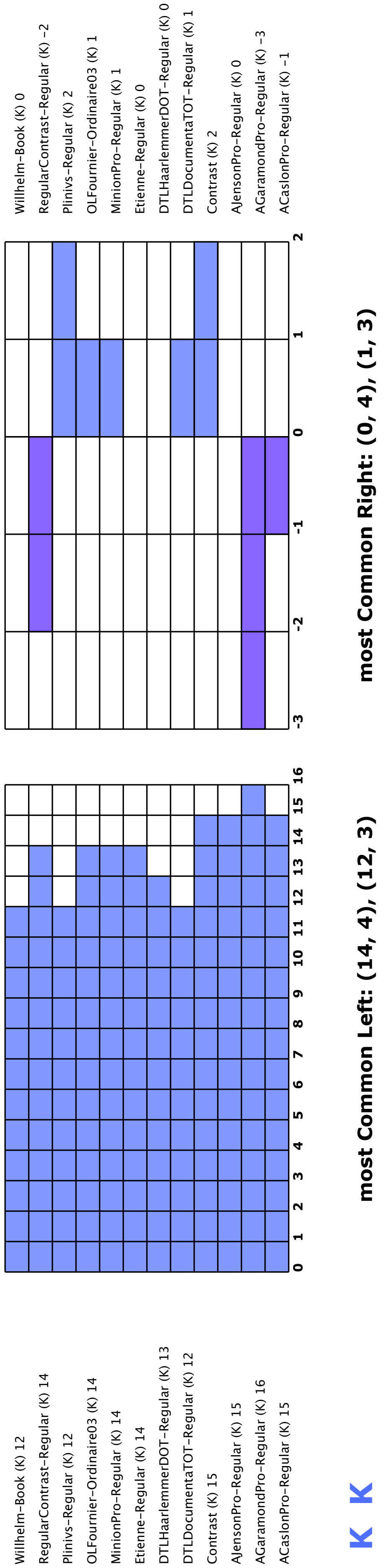

F F
Willhelm-Book (F) 12
RegularContrast-Regular (F) 14
Plinivs-Regular (F) 12
OLFournier-Ordinaire03 (F) 14
MinionPro-Regular (F) 14
Etienne-Regular (F) 13
DTLHaarlemmerDOT-Regular (F) 13
DTLDocumentaTOT-Regular (F) 12
Contrast (F) 15
AJensonPro-Regular (F) 14
AGaramondPro-Regular (F) 16
ACaslonPro-Regular (F) 15
most Common Left: (14, 4), (12, 3)
Willhelm-Book (F) 0
RegularContrast-Regular (F) 5
Plinivs-Regular (F) 3
OLFournier-Ordinaire03 (F) 1
MinionPro-Regular (F) 4
Etienne-Regular (F) 2
DTLHaarlemmerDOT-Regular (F) 2
DTLDocumentaTOT-Regular (F) 1
Contrast (F) 4
AJensonPro-Regular (F) 6
AGaramondPro-Regular (F) 6
ACaslonPro-Regular (F) -1
most Common Right: (1, 2), (2, 2)

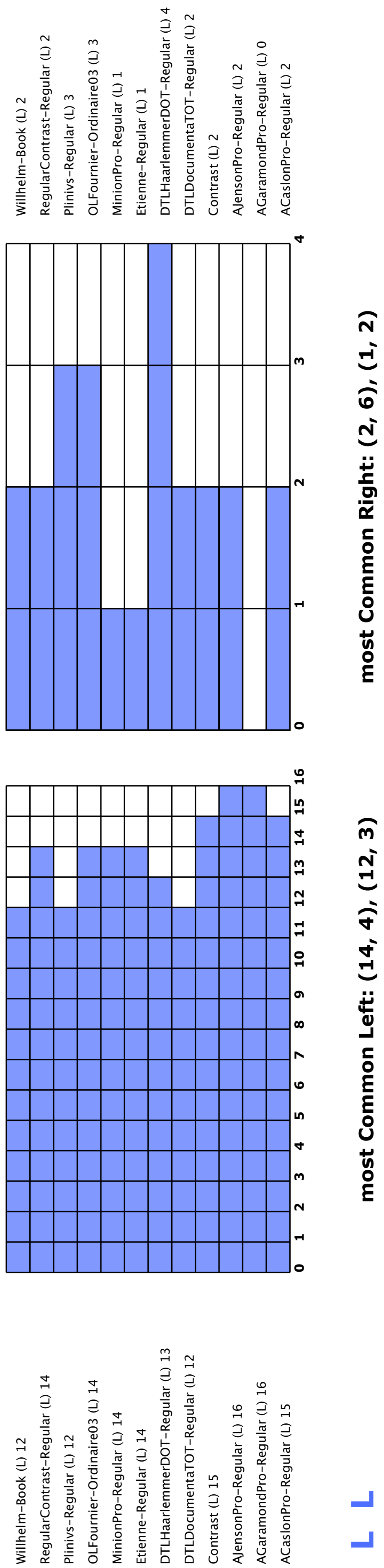

Willhelm-Book (G) 6
RegularContrast-Regular (G) 5
Plinivs-Regular (G) 5
OLFournier-Ordinaire03 (G) 6
MinionPro-Regular (G) 5
Etienne-Regular (G) 4
DTLHaarlemmerDOT-Regular (G) 7
DTLDocumentaTOT-Regular (G) 6
Contrast (G) 6
AJensonPro-Regular (G) 5
AGaramondPro-Regular (G) 6
ACaslonPro-Regular (G) 5
most Common Left: (5, 5), (6, 5)
Willhelm-Book (G) 12
RegularContrast-Regular (G) 9
Plinivs-Regular (G) 9
OLFournier-Ordinaire03 (G) 12
MinionPro-Regular (G) 10
Etienne-Regular (G) 9
DTLHaarlemmerDOT-Regular (G) 14
DTLDocumentaTOT-Regular (G) 12
Contrast (G) 11
AJensonPro-Regular (G) 11
AGaramondPro-Regular (G) 12
ACaslonPro-Regular (G) 13
most Common Right: (12, 4), (9, 3)
G G

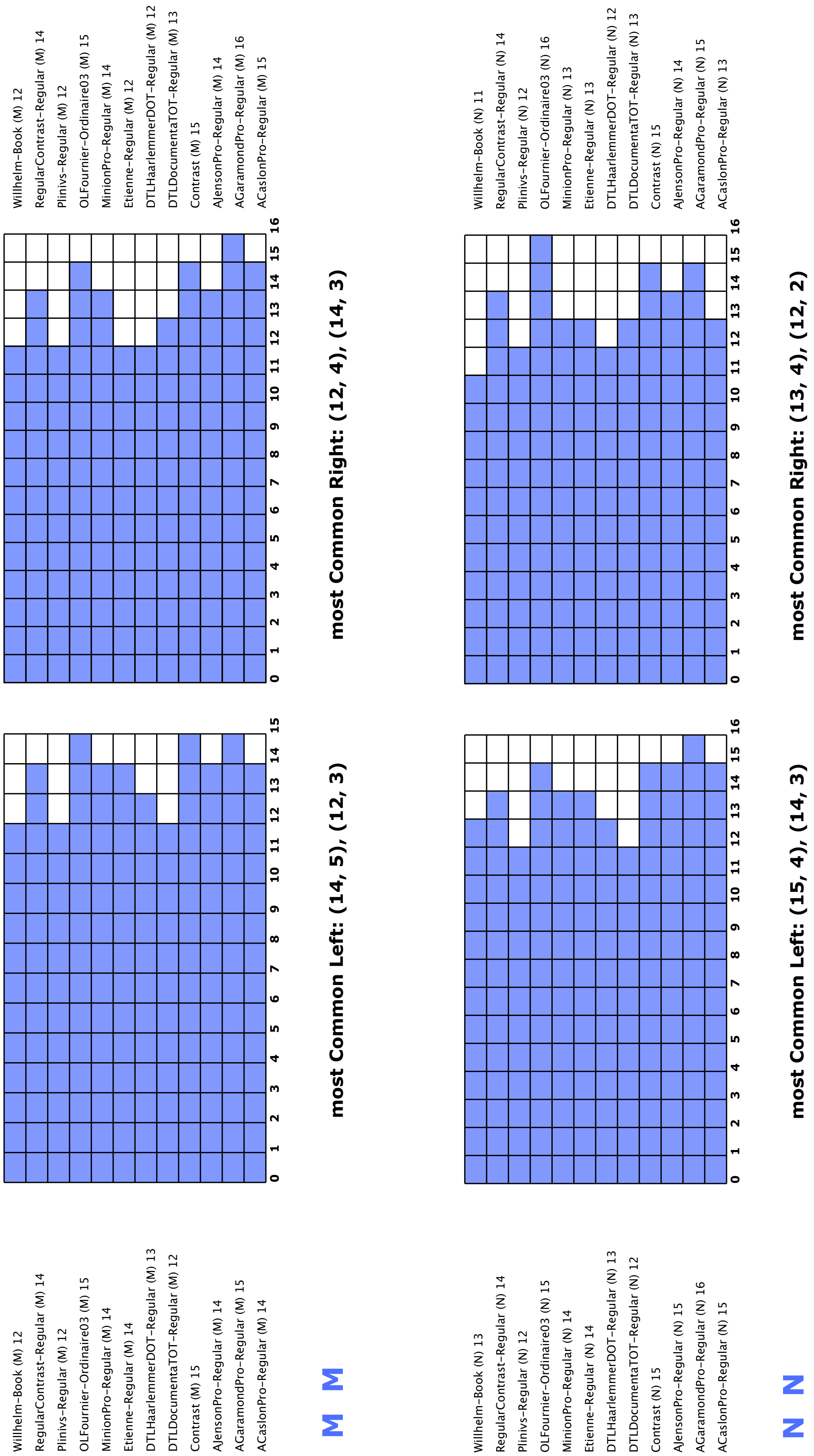

Willhelm-Book (H) 12
RegularContrast-Regular (H) 14
Plinivs-Regular (H) 12
OLFournier-Ordinaire03 (H) 14
MinionPro-Regular (H) 14
Etienne-Regular (H) 13
DTLHaarlemmerDOT-Regular (H) 13
DTLDocumentaTOT-Regular (H) 12
Contrast (H) 15
AJensonPro-Regular (H) 15
AGaramondPro-Regular (H) 16
ACaslonPro-Regular (H) 15
most Common Left: (12, 3), (14, 3)
Willhelm-Book (H) 12
RegularContrast-Regular (H) 14
Plinivs-Regular (H) 12
OLFournier-Ordinaire03 (H) 14
MinionPro-Regular (H) 14
Etienne-Regular (H) 12
DTLHaarlemmerDOT-Regular (H) 12
DTLDocumentaTOT-Regular (H) 12
Contrast (H) 15
AJensonPro-Regular (H) 14
AGaramondPro-Regular (H) 16
ACaslonPro-Regular (H) 15
most Common Right: (12, 5), (14, 4)
H H

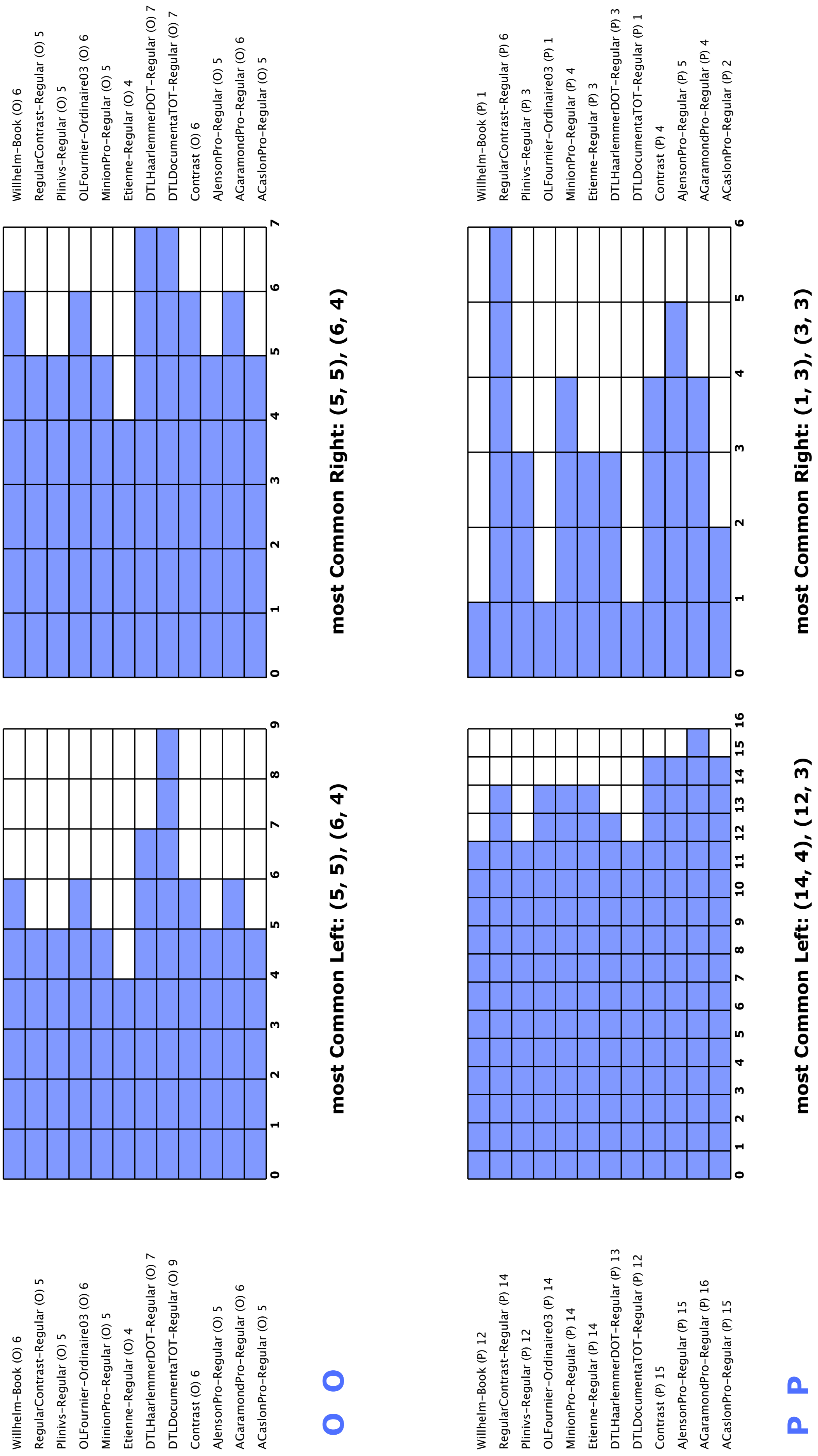

I I
Willhelm-Book (I) 12
RegularContrast-Regular (I) 14
Plinivs-Regular (I) 12
OLFournier-Ordinaire03 (I) 14
MinionPro-Regular (I) 14
Etienne-Regular (I) 14
DTLHaarlemmerDOT-Regular (I) 13
DTLDocumentaTOT-Regular (I) 12
Contrast (I) 15
AJensonPro-Regular (I) 17
AGaramondPro-Regular (I) 16
ACaslonPro-Regular (I) 15
most Common Left: (14, 4), (12, 3)
Willhelm-Book (I) 12
RegularContrast-Regular (I) 14
Plinivs-Regular (I) 12
OLFournier-Ordinaire03 (I) 14
MinionPro-Regular (I) 14
Etienne-Regular (I) 14
DTLHaarlemmerDOT-Regular (I) 12
DTLDocumentaTOT-Regular (I) 12
Contrast (I) 15
AJensonPro-Regular (I) 16
AGaramondPro-Regular (I) 16
ACaslonPro-Regular (I) 15
most Common Right: (12, 4), (14, 4)

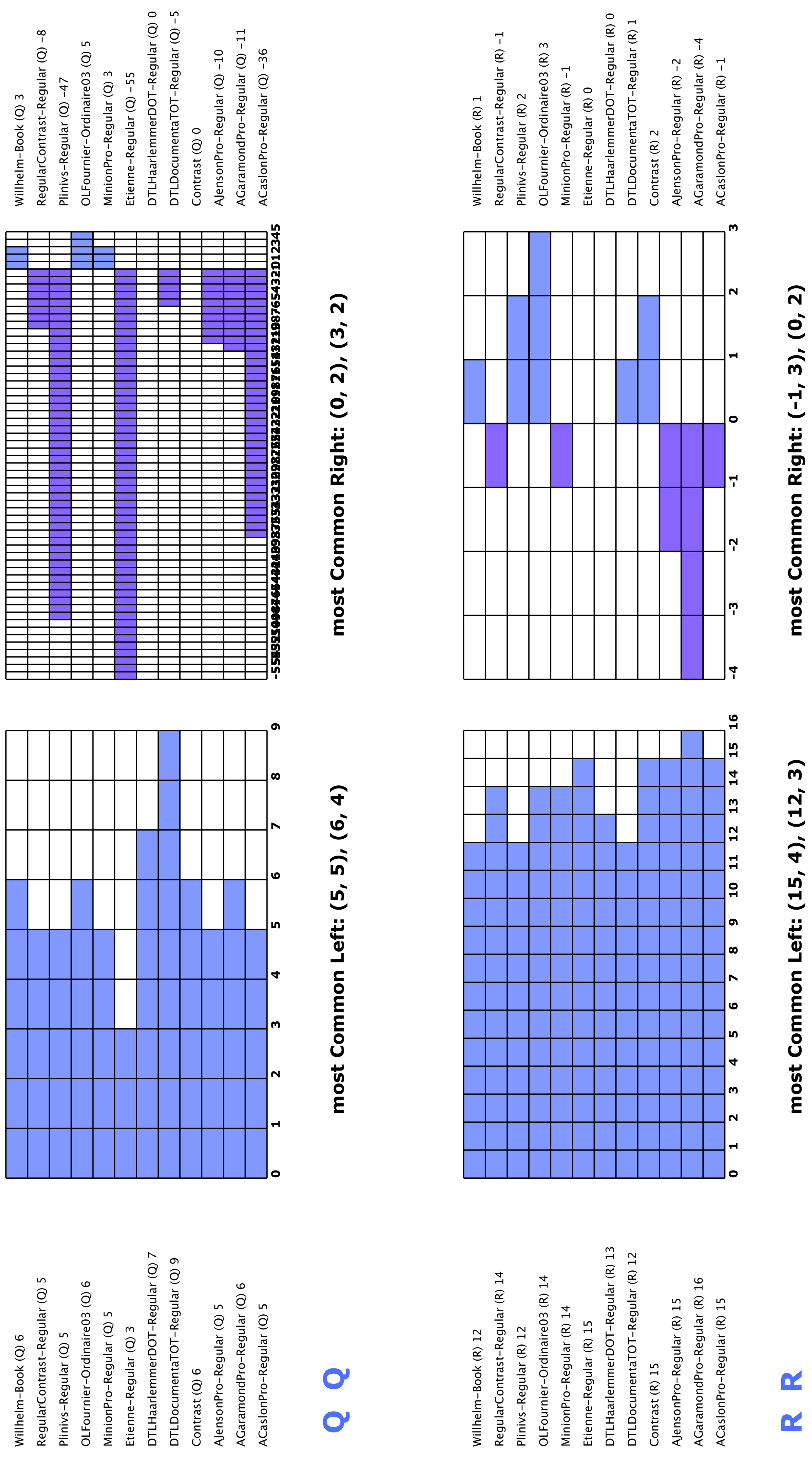

J J
Willhelm-Book (J) 14
RegularContrast-Regular (J) 14
Plinivs-Regular (J) 23
OLFournier-Ordinaire03 (J) 23
MinionPro-Regular (J) 15
Etienne-Regular (J) 15
DTLHaarlemmerDOT-Regular (J) 14
DTLDocumentaTOT-Regular (J) 12
Contrast (J) 15
AJensonPro-Regular (J) 16
AGaramondPro-Regular (J) 18
ACaslonPro-Regular (J) 14
most Common Left: (14, 4), (15, 3)
Willhelm-Book (J) 11
RegularContrast-Regular (J) 14
Plinivs-Regular (J) 9
OLFournier-Ordinaire03 (J) 12
MinionPro-Regular (J) 12
Etienne-Regular (J) 13
DTLHaarlemmerDOT-Regular (J) 11
DTLDocumentaTOT-Regular (J) 11
Contrast (J) 14
AJensonPro-Regular (J) 14
AGaramondPro-Regular (J) 15
ACaslonPro-Regular (J) 13
most Common Right: (11, 3), (14, 3)

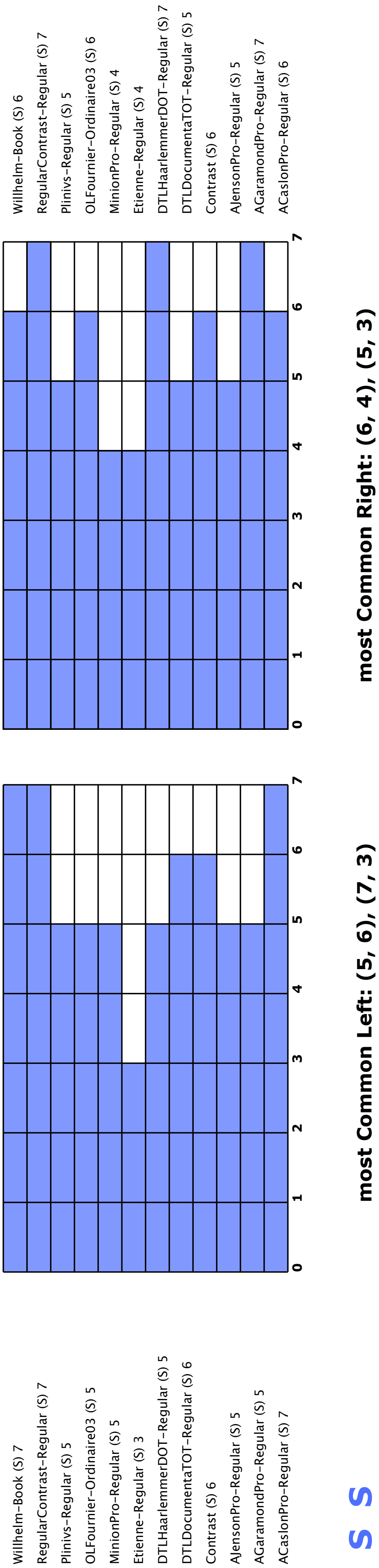

K K
Willhelm-Book (K) 12
RegularContrast-Regular (K) 14
Plinivs-Regular (K) 12
OLFournier-Ordinaire03 (K) 14
MinionPro-Regular (K) 14
Etienne-Regular (K) 14
DTLHaarlemmerDOT-Regular (K) 13
DTLDocumentaTOT-Regular (K) 12
Contrast (K) 15
AJensonPro-Regular (K) 15
AGaramondPro-Regular (K) 16
ACaslonPro-Regular (K) 15
most Common Left: (14, 4), (12, 3)
Willhelm-Book (K) 0
RegularContrast-Regular (K) -2
Plinivs-Regular (K) 2
OLFournier-Ordinaire03 (K) 1
MinionPro-Regular (K) 1
Etienne-Regular (K) 0
DTLHaarlemmerDOT-Regular (K) 0
DTLDocumentaTOT-Regular (K) 1
Contrast (K) 2
AJensonPro-Regular (K) 0
AGaramondPro-Regular (K) -3
ACaslonPro-Regular (K) -1
most Common Right: (0, 4), (1, 3)

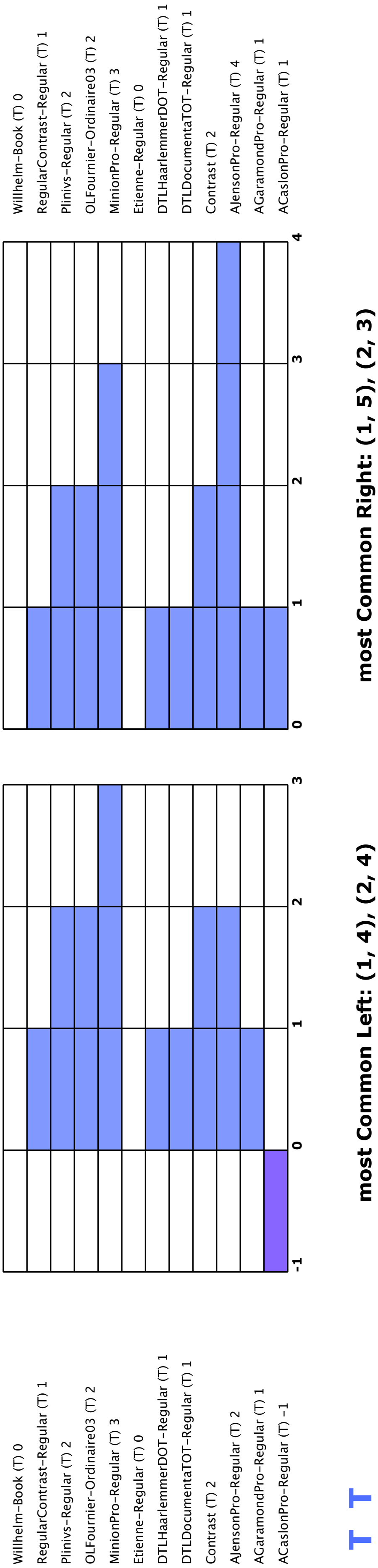

L L
Willhelm-Book (L) 12
RegularContrast-Regular (L) 14
Plinivs-Regular (L) 12
OLFournier-Ordinaire03 (L) 14
MinionPro-Regular (L) 14
Etienne-Regular (L) 14
DTLHaarlemmerDOT-Regular (L) 13
DTLDocumentaTOT-Regular (L) 12
Contrast (L) 15
AJensonPro-Regular (L) 16
AGaramondPro-Regular (L) 16
ACaslonPro-Regular (L) 15
most Common Left: (14, 4), (12, 3)
Willhelm-Book (L) 2
RegularContrast-Regular (L) 2
Plinivs-Regular (L) 3
OLFournier-Ordinaire03 (L) 3
MinionPro-Regular (L) 1
Etienne-Regular (L) 1
DTLHaarlemmerDOT-Regular (L) 4
DTLDocumentaTOT-Regular (L) 2
Contrast (L) 2
AJensonPro-Regular (L) 2
AGaramondPro-Regular (L) 0
ACaslonPro-Regular (L) 2
most Common Right: (2, 6), (1, 2)

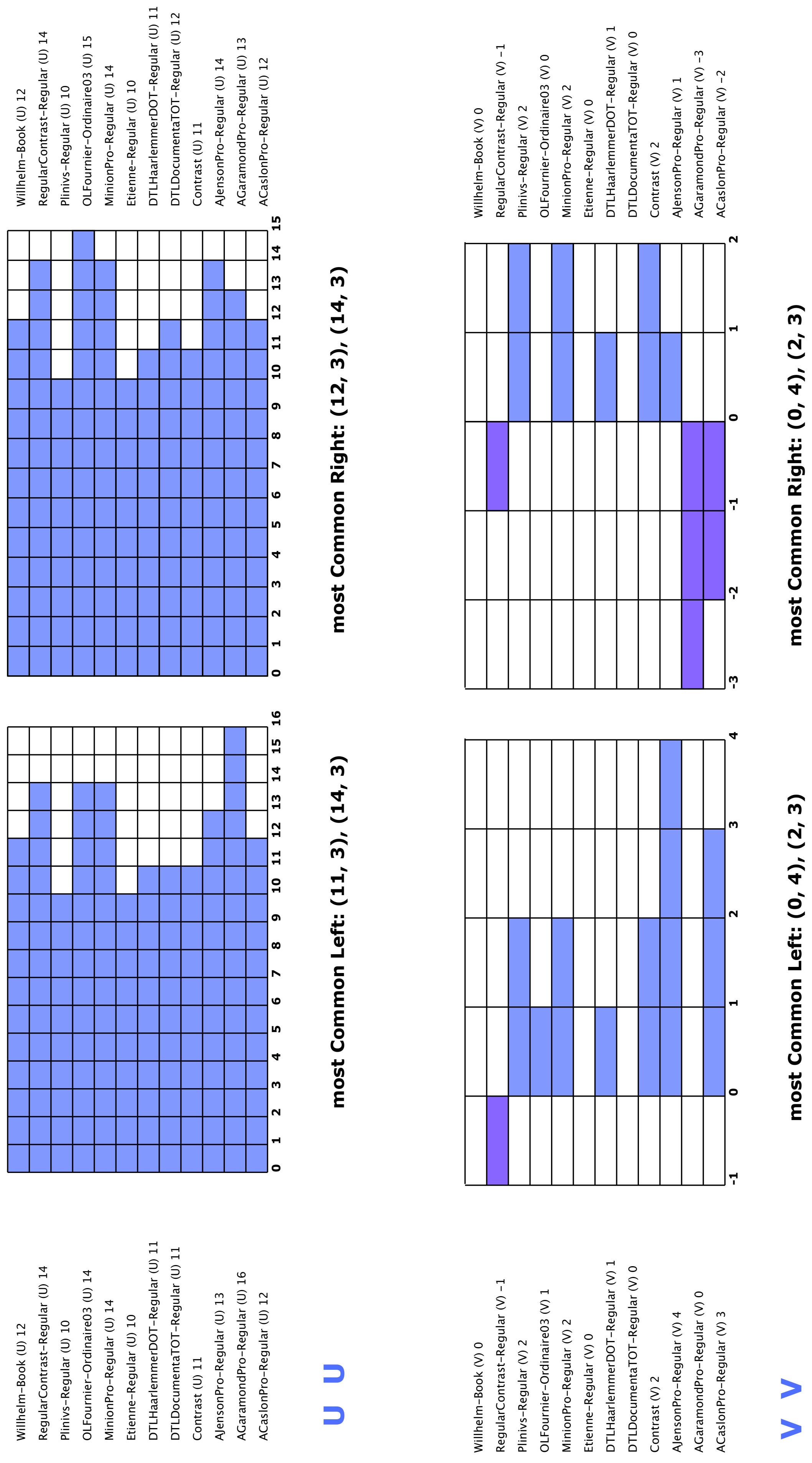

M
Willhelm-Book (M) 12
RegularContrast-Regular (M) 14
Plinivs-Regular (M) 12
OLFournier-Ordinaire03 (M) 15
MinionPro-Regular (M) 14
Etienne-Regular (M) 14
DTLHaarlemmerDOT-Regular (M) 13
DTLDocumentaTOT-Regular (M) 12
Contrast (M) 15
AJensonPro-Regular (M) 14
AGaramondPro-Regular (M) 15
ACaslonPro-Regular (M) 14
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
most Common Left: (14, 5), (12, 3)
Willhelm-Book (M) 12
RegularContrast-Regular (M) 14
Plinivs-Regular (M) 12
OLFournier-Ordinaire03 (M) 15
MinionPro-Regular (M) 14
Etienne-Regular (M) 12
DTLHaarlemmerDOT-Regular (M) 12
DTLDocumentaTOT-Regular (M) 13
Contrast (M) 15
AJensonPro-Regular (M) 14
AGaramondPro-Regular (M) 16
ACaslonPro-Regular (M) 15
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
most Common Right: (12, 4), (14, 3)
N
Willhelm-Book (N) 13
RegularContrast-Regular (N) 14
Plinivs-Regular (N) 12
OLFournier-Ordinaire03 (N) 15
MinionPro-Regular (N) 14
Etienne-Regular (N) 14
DTLHaarlemmerDOT-Regular (N) 13
DTLDocumentaTOT-Regular (N) 12
Contrast (N) 15
AJensonPro-Regular (N) 15
AGaramondPro-Regular (N) 16
ACaslonPro-Regular (N) 15
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
most Common Left: (15, 4), (14, 3)
Willhelm-Book (N) 11
RegularContrast-Regular (N) 14
Plinivs-Regular (N) 12
OLFournier-Ordinaire03 (N) 16
MinionPro-Regular (N) 13
Etienne-Regular (N) 13
DTLHaarlemmerDOT-Regular (N) 12
DTLDocumentaTOT-Regular (N) 13
Contrast (N) 15
AJensonPro-Regular (N) 14
AGaramondPro-Regular (N) 15
ACaslonPro-Regular (N) 13
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
most Common Right: (13, 4), (12, 2)


O O
Wilhelm-Book (O) 6
RegularContrast-Regular (O) 5
Plinivs-Regular (O) 5
OLFournier-Ordinaire03 (O) 6
MinionPro-Regular (O) 5
Etienne-Regular (O) 4
DTLHaarlemmerDOT-Regular (O) 7
DTLDocumentaTOT-Regular (O) 9
Contrast (O) 6
AJensonPro-Regular (O) 5
AGaramondPro-Regular (O) 6
ACaslonPro-Regular (O) 5
most Common Left: (5, 5), (6, 4)
Wilhelm-Book (O) 6
RegularContrast-Regular (O) 5
Plinivs-Regular (O) 5
OLFournier-Ordinaire03 (O) 6
MinionPro-Regular (O) 5
Etienne-Regular (O) 4
DTLHaarlemmerDOT-Regular (O) 7
DTLDocumentaTOT-Regular (O) 7
Contrast (O) 6
AJensonPro-Regular (O) 5
AGaramondPro-Regular (O) 6
ACaslonPro-Regular (O) 5
most Common Right: (5, 5), (6, 4)
P P
Wilhelm-Book (P) 12
RegularContrast-Regular (P) 14
Plinivs-Regular (P) 12
OLFournier-Ordinaire03 (P) 14
MinionPro-Regular (P) 14
Etienne-Regular (P) 14
DTLHaarlemmerDOT-Regular (P) 13
DTLDocumentaTOT-Regular (P) 12
Contrast (P) 15
AJensonPro-Regular (P) 15
AGaramondPro-Regular (P) 16
ACaslonPro-Regular (P) 15
most Common Left: (14, 4), (12, 3)
Wilhelm-Book (P) 1
RegularContrast-Regular (P) 6
Plinivs-Regular (P) 3
OLFournier-Ordinaire03 (P) 1
MinionPro-Regular (P) 4
Etienne-Regular (P) 3
DTLHaarlemmerDOT-Regular (P) 3
DTLDocumentaTOT-Regular (P) 1
Contrast (P) 4
AJensonPro-Regular (P) 5
AGaramondPro-Regular (P) 4
ACaslonPro-Regular (P) 2
most Common Right: (1, 3), (3, 3)

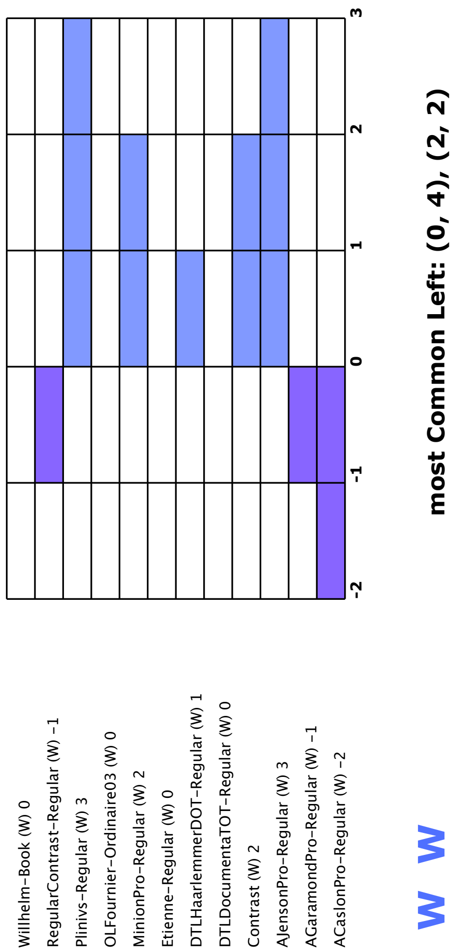

Willhelm-Book (Q) 6
RegularContrast-Regular (Q) 5
Plinivs-Regular (Q) 5
OLFournier-Ordinaire03 (Q) 6
MinionPro-Regular (Q) 5
Etienne-Regular (Q) 3
DTLHaarlemmerDOT-Regular (Q) 7
DTLDocumentaTOT-Regular (Q) 9
Contrast (Q) 6
AJensonPro-Regular (Q) 5
AGaramondPro-Regular (Q) 6
ACaslonPro-Regular (Q) 5
most Common Left: (5, 5), (6, 4)
Willhelm-Book (Q) 3
RegularContrast-Regular (Q) -8
Plinivs-Regular (Q) -47
OLFournier-Ordinaire03 (Q) 5
MinionPro-Regular (Q) 3
Etienne-Regular (Q) -55
DTLHaarlemmerDOT-Regular (Q) 0
DTLDocumentaTOT-Regular (Q) -5
Contrast (Q) 0
AJensonPro-Regular (Q) -10
AGaramondPro-Regular (Q) -11
ACaslonPro-Regular (Q) -36
most Common Right: (0, 2), (3, 2)
Q Q
Willhelm-Book (R) 12
RegularContrast-Regular (R) 14
Plinivs-Regular (R) 12
OLFournier-Ordinaire03 (R) 14
MinionPro-Regular (R) 14
Etienne-Regular (R) 15
DTLHaarlemmerDOT-Regular (R) 13
DTLDocumentaTOT-Regular (R) 12
Contrast (R) 15
AJensonPro-Regular (R) 15
AGaramondPro-Regular (R) 16
ACaslonPro-Regular (R) 15
most Common Left: (15, 4), (12, 3)
Willhelm-Book (R) 1
RegularContrast-Regular (R) -1
Plinivs-Regular (R) 2
OLFournier-Ordinaire03 (R) 3
MinionPro-Regular (R) -1
Etienne-Regular (R) 0
DTLHaarlemmerDOT-Regular (R) 0
DTLDocumentaTOT-Regular (R) 1
Contrast (R) 2
AJensonPro-Regular (R) -2
AGaramondPro-Regular (R) -4
ACaslonPro-Regular (R) -1
most Common Right: (-1, 3), (0, 2)
R R

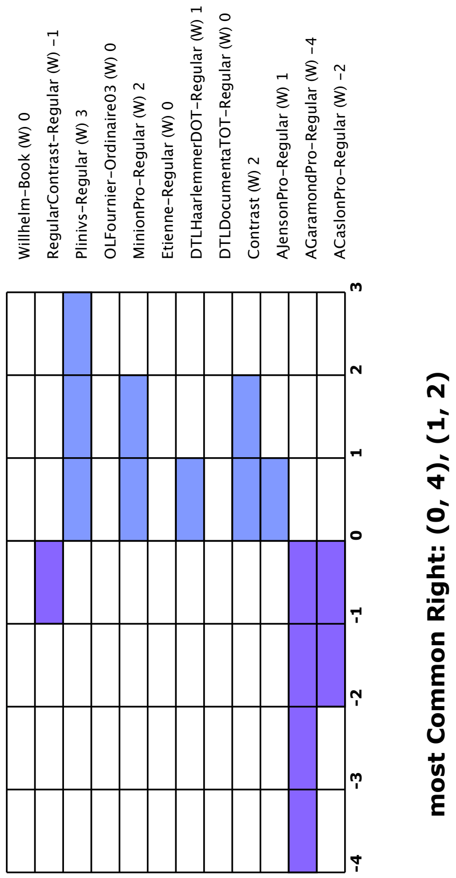

S S
Willhelm–Book (S) 7
RegularContrast–Regular (S) 7
Plinivs–Regular (S) 5
OLFournier–Ordinaire03 (S) 5
MinionPro–Regular (S) 5
Etienne–Regular (S) 3
DTLHaarlemmerDOT–Regular (S) 5
DTLDocumentaTOT–Regular (S) 6
Contrast (S) 6
AJensonPro–Regular (S) 5
AGaramondPro–Regular (S) 5
ACaslonPro–Regular (S) 7
0 1 2 3 4 5 6 7
most Common Left: (5, 6), (7, 3)
Willhelm–Book (S) 6
RegularContrast–Regular (S) 7
Plinivs–Regular (S) 5
OLFournier–Ordinaire03 (S) 6
MinionPro–Regular (S) 4
Etienne–Regular (S) 4
DTLHaarlemmerDOT–Regular (S) 7
DTLDocumentaTOT–Regular (S) 5
Contrast (S) 6
AJensonPro–Regular (S) 5
AGaramondPro–Regular (S) 7
ACaslonPro–Regular (S) 6
0 1 2 3 4 5 6 7
most Common Right: (6, 4), (5, 3)


T T
Willhelm–Book (T) 0
RegularContrast–Regular (T) 1
Plinivs–Regular (T) 2
OLFournier–Ordinaire03 (T) 2
MinionPro–Regular (T) 3
Etienne–Regular (T) 0
DTLHaarlemmerDOT–Regular (T) 1
DTLDocumentaTOT–Regular (T) 1
Contrast (T) 2
AJensonPro–Regular (T) 2
AGaramondPro–Regular (T) 1
ACaslonPro–Regular (T) –1
-1 0 1 2 3
most Common Left: (1, 4), (2, 4)
Willhelm–Book (T) 0
RegularContrast–Regular (T) 1
Plinivs–Regular (T) 2
OLFournier–Ordinaire03 (T) 2
MinionPro–Regular (T) 3
Etienne–Regular (T) 0
DTLHaarlemmerDOT–Regular (T) 1
DTLDocumentaTOT–Regular (T) 1
Contrast (T) 2
AJensonPro–Regular (T) 4
AGaramondPro–Regular (T) 1
ACaslonPro–Regular (T) 1
0 1 2 3 4
most Common Right: (1, 5), (2, 3)

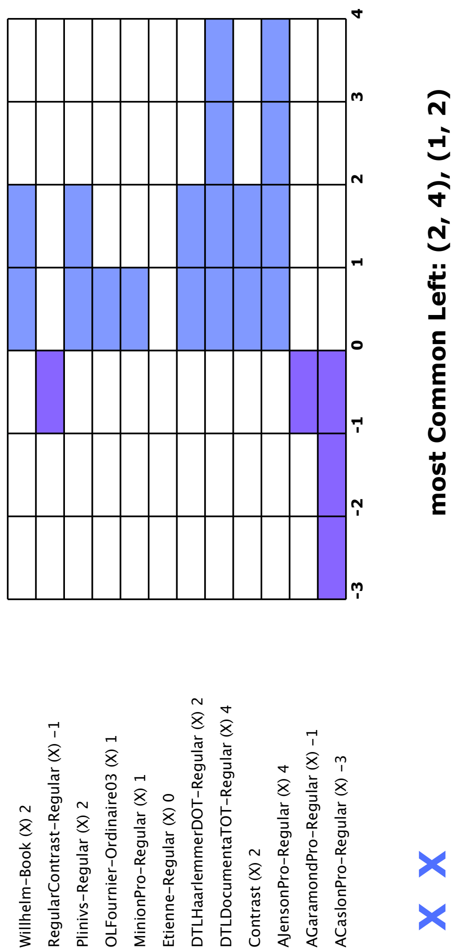

U U
Willhelm-Book (U) 12
RegularContrast-Regular (U) 14
Plinivs-Regular (U) 10
OLFournier-Ordinaire03 (U) 14
MinionPro-Regular (U) 14
Etienne-Regular (U) 10
DTLHaarlemmerDOT-Regular (U) 11
DTLDocumentaTOT-Regular (U) 11
Contrast (U) 11
AJensonPro-Regular (U) 13
AGaramondPro-Regular (U) 16
ACaslonPro-Regular (U) 12
most Common Left: (11, 3), (14, 3)
Willhelm-Book (U) 12
RegularContrast-Regular (U) 14
Plinivs-Regular (U) 10
OLFournier-Ordinaire03 (U) 15
MinionPro-Regular (U) 14
Etienne-Regular (U) 10
DTLHaarlemmerDOT-Regular (U) 11
DTLDocumentaTOT-Regular (U) 12
Contrast (U) 11
AJensonPro-Regular (U) 14
AGaramondPro-Regular (U) 13
ACaslonPro-Regular (U) 12
most Common Right: (12, 3), (14, 3)
V V
Willhelm-Book (V) 0
RegularContrast-Regular (V) −1
Plinivs-Regular (V) 2
OLFournier-Ordinaire03 (V) 1
MinionPro-Regular (V) 2
Etienne-Regular (V) 0
DTLHaarlemmerDOT-Regular (V) 1
DTLDocumentaTOT-Regular (V) 0
Contrast (V) 2
AJensonPro-Regular (V) 4
AGaramondPro-Regular (V) 0
ACaslonPro-Regular (V) 3
most Common Left: (0, 4), (2, 3)
Willhelm-Book (V) 0
RegularContrast-Regular (V) −1
Plinivs-Regular (V) 2
OLFournier-Ordinaire03 (V) 0
MinionPro-Regular (V) 2
Etienne-Regular (V) 0
DTLHaarlemmerDOT-Regular (V) 1
DTLDocumentaTOT-Regular (V) 0
Contrast (V) 2
AJensonPro-Regular (V) 1
AGaramondPro-Regular (V) −3
ACaslonPro-Regular (V) −2
most Common Right: (0, 4), (2, 3)

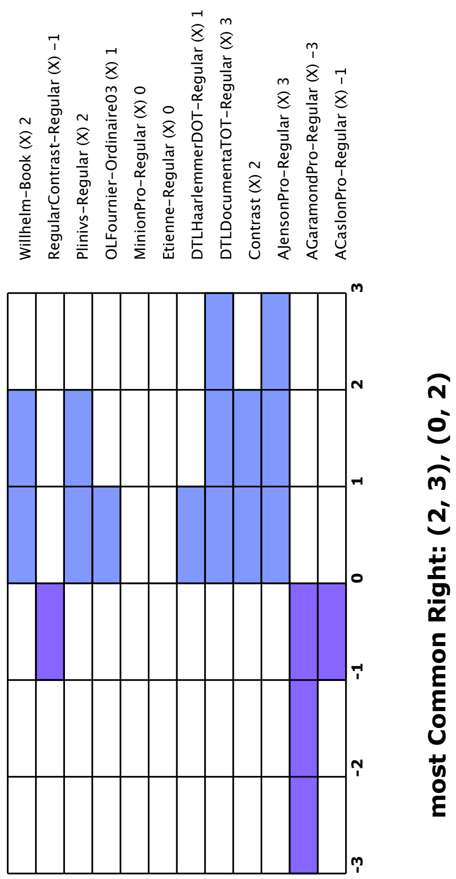
W W

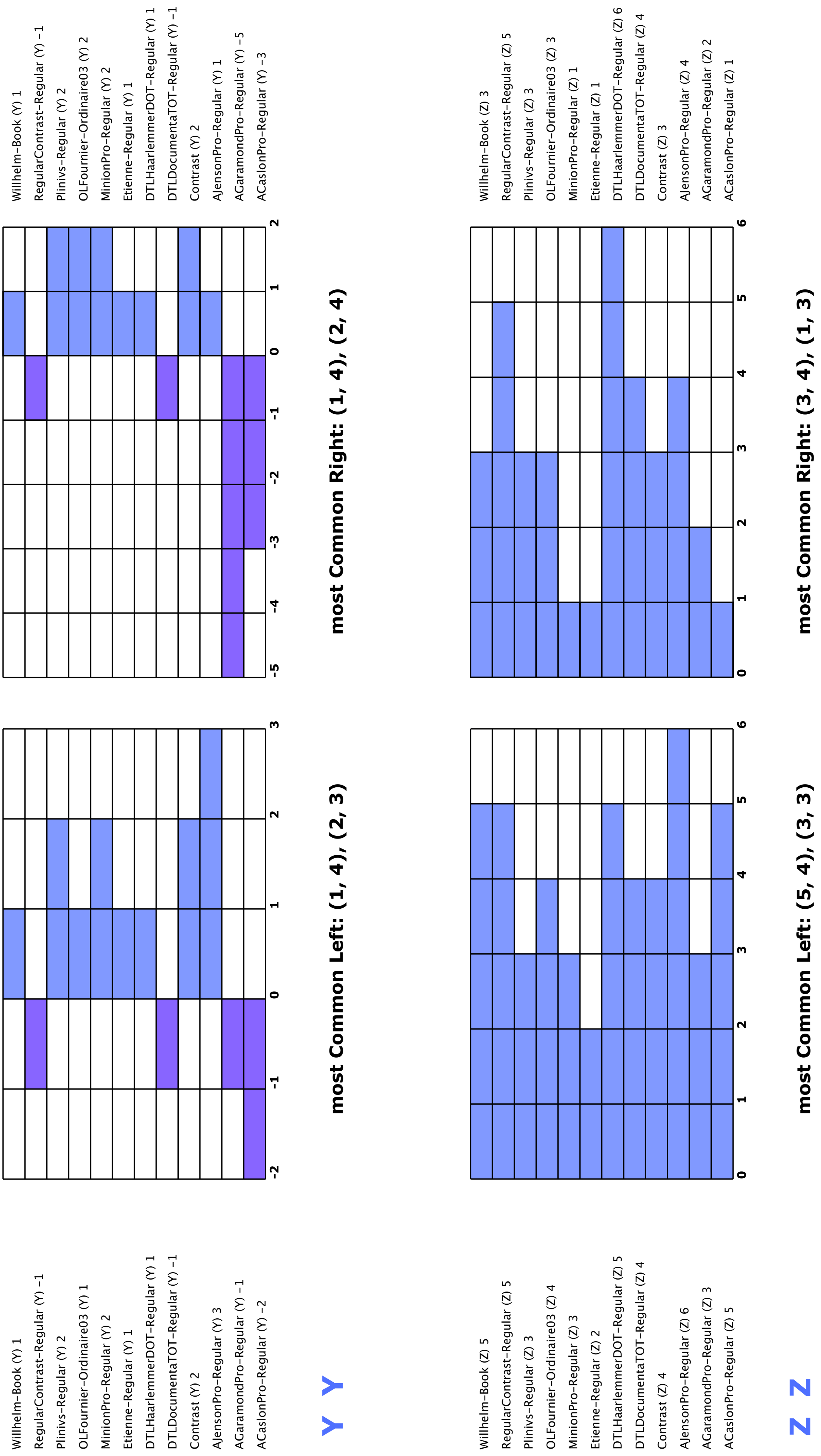

Willhelm–Book (W) 0
RegularContrast–Regular (W) –1
Plinivs–Regular (W) 3
OLFournier–Ordinaire03 (W) 0
MinionPro–Regular (W) 2
Etienne–Regular (W) 0
DTLHaarlemmerDOT–Regular (W) 1
DTLDocumentaTOT–Regular (W) 0
Contrast (W) 2
AJensonPro–Regular (W) 3
AGaramondPro–Regular (W) –1
ACaslonPro–Regular (W) –2
-2 -1 0 1 2 3
most Common Left: (0, 4), (2, 2)


Willhelm–Book (W) 0
RegularContrast–Regular (W) –1
Plinivs–Regular (W) 3
OLFournier–Ordinaire03 (W) 0
MinionPro–Regular (W) 2
Etienne–Regular (W) 0
DTLHaarlemmerDOT–Regular (W) 1
DTLDocumentaTOT–Regular (W) 0
Contrast (W) 2
AJensonPro–Regular (W) 1
AGaramondPro–Regular (W) –4
ACaslonPro–Regular (W) –2
-4 -3 -2 -1 0 1 2 3
most Common Right: (0, 4), (1, 2)

X X


Willhelm–Book (X) 2
RegularContrast–Regular (X) –1
Plinivs–Regular (X) 2
OLFournier–Ordinaire03 (X) 1
MinionPro–Regular (X) 1
Etienne–Regular (X) 0
DTLHaarlemmerDOT–Regular (X) 2
DTLDocumentaTOT–Regular (X) 4
Contrast (X) 2
AJensonPro–Regular (X) 4
AGaramondPro–Regular (X) –1
ACaslonPro–Regular (X) –3
-3 -2 -1 0 1 2 3 4
most Common Left: (2, 4), (1, 2)


Willhelm–Book (X) 2
RegularContrast–Regular (X) –1
Plinivs–Regular (X) 2
OLFournier–Ordinaire03 (X) 1
MinionPro–Regular (X) 0
Etienne–Regular (X) 0
DTLHaarlemmerDOT–Regular (X) 1
DTLDocumentaTOT–Regular (X) 3
Contrast (X) 2
AJensonPro–Regular (X) 3
AGaramondPro–Regular (X) –3
ACaslonPro–Regular (X) –1
-3 -2 -1 0 1 2 3
most Common Right: (2, 3), (0, 2)


Y Y
Wilhelm–Book (Y) 1
RegularContrast–Regular (Y) –1
Plinivs–Regular (Y) 2
OLFournier–Ordinaire03 (Y) 1
MinionPro–Regular (Y) 2
Etienne–Regular (Y) 1
DTLHaarlemmerDOT–Regular (Y) 1
DTLDocumentaTOT–Regular (Y) –1
Contrast (Y) 2
AJensonPro–Regular (Y) 3
AGaramondPro–Regular (Y) –1
ACaslonPro–Regular (Y) –2
most Common Left: (1, 4), (2, 3)
Wilhelm–Book (Y) 1
RegularContrast–Regular (Y) –1
Plinivs–Regular (Y) 2
OLFournier–Ordinaire03 (Y) 2
MinionPro–Regular (Y) 2
Etienne–Regular (Y) 1
DTLHaarlemmerDOT–Regular (Y) 1
DTLDocumentaTOT–Regular (Y) –1
Contrast (Y) 2
AJensonPro–Regular (Y) 1
AGaramondPro–Regular (Y) –5
ACaslonPro–Regular (Y) –3
most Common Right: (1, 4), (2, 4)
Z Z
Wilhelm–Book (Z) 5
RegularContrast–Regular (Z) 5
Plinivs–Regular (Z) 3
OLFournier–Ordinaire03 (Z) 4
MinionPro–Regular (Z) 3
Etienne–Regular (Z) 2
DTLHaarlemmerDOT–Regular (Z) 5
DTLDocumentaTOT–Regular (Z) 4
Contrast (Z) 4
AJensonPro–Regular (Z) 6
AGaramondPro–Regular (Z) 3
ACaslonPro–Regular (Z) 5
most Common Left: (5, 4), (3, 3)
Wilhelm–Book (Z) 3
RegularContrast–Regular (Z) 5
Plinivs–Regular (Z) 3
OLFournier–Ordinaire03 (Z) 3
MinionPro–Regular (Z) 1
Etienne–Regular (Z) 1
DTLHaarlemmerDOT–Regular (Z) 6
DTLDocumentaTOT–Regular (Z) 4
Contrast (Z) 3
AJensonPro–Regular (Z) 4
AGaramondPro–Regular (Z) 2
ACaslonPro–Regular (Z) 1
most Common Right: (3, 4), (1, 3)

BIBLIOGRAPHY

Anderson, Donald M. 'Cresci and His Alphabets', *Visible Language*, Volume v, Number 4 (Cleveland: the Journal, 1971)

Anonymus, 'Pronunciation in Different Nations of Europe', *The Museum of Foreign Literature and Science*, vol. xxvii (New York, 1836)

Barker, Nicolas, et al., *Printing and the Mind of Man* (London: F. W. Bridges & Sons, 1963)

Beaujon, Paul, 'The "Garamond" Types: xvi & xvii Century Sources Considered', *Fleuron Anthology* (London: Ernest Benn Limited, 1973)

Beier, Sofie, *Reading Letters, Designing for Legibility* (Amsterdam: bis Publishers, 2012)

Bigelow, Charles, 'Philosophies of Form in Seriffed Typefaces of Adrian Frutiger', *Fine Print on Type*, (London: Lund Humphries, 1989)

Bohadti, Gustav, *Von der Romain du Roi zu den Schriften J.G. Justus Erich Walbaums* (Berlin/Stuttgart: H. Berthold ag, 1957)

Boyle, Leonard E., 'The Emergence of Gothic Handwriting', *Visible Language*, Volume iv, Number 4 (Cleveland: the Journal, 1970)

Bringhurst, Robert, *The Elements of Typographic Style* (Vancouver: Hartley & Marks Publishers, 1996)

Brown, Horatio Forbes, *The Venetian Printing Press* (New York: G.P. Putnam's Sons, 1891)

Burke, Edmund, ed. Phillips, Adam, *A Philosophical Enquiry into the Origin of our Ideas of the Sublime and Beautiful* (Oxford: Oxford University Press, 2008)

Burnhill, Peter, *Type Spaces* (London: Hyphen Press, 2003)

Carter, Harry, *A View of Early Typography: Up to About 1600* (Oxford: Clarendon Press, 1969)

Carter, Harry, *Fournier on Typefounding* (New York: Burt Franklin, 1973)

Catich, Edward M., *The Origin of the Serif: Brush Writing & Roman Letters* (Davenport: Catich Gallery, 1991)

Cook, B.F., *Greek Inscriptions* (London: British Museum Publications, 1987)

Crouwel, Wim, 'Type Design for the Computer Age', *Visible Language*, Volume iv, Number 1 (Cleveland: the Journal, 1970)

Daniels, Peter T., and Bright, William, (eds.), *The World's Writing Systems* (New York/Oxford: Oxford University Press, 1996)

Davies, Martin, *Aldus Manutius, Printer and Publisher of Renaissance Venice* (London: The British Library, 1995)

De Vinne, Theodore Low, *The Invention of Printing: a Collection of Facts and Opinions* (New York: Francis Hart & Co., 1876)

De Vinne, Theodore Low, *The Practice of Typography* (New York: The Century Co., 1900)

Diringer, David, *The Book before Printing* (New York: Dover Publications, 1982)

Doede, Werner, *Schön schreiben, eine Kunst: Johann Neudörffer und die Kalligraphie des Barock* (München: Prestel Verlag, 1988)

Dooijes, Dick, *Dossier A–Z 73: Association Typographique Internationale* (Belgium: Remy Magrermans, 1973)

Dreyfus, John, *The Work of Jan van Krimpen* (Haarlem/Utrecht: Joh. Enschedé en Zonen/W. de Haan, 1952)

Eisenstein, Elizabeth Lewisohn, *The Printing Revolution in Early Modern Europe* (Cambridge: Cambridge University Press, 2005)

Elam, Kimberly, *Geometry of Design: Studies in Proportion and Composition* (New York: Princeton Architectural Press, 2001)

Elliot, R.C., 'The "Monotype" from infancy to maturity' *the Monotype Recorder*, No. 243 Vol. XXXI (London: The Monotype Corporation Ltd., 1931)

Frutiger, Adrian, *Zur Geschichte der linearen, serifenlosen Schriften* (Bad Homburg: Linotype AG, ca.1986)

Funch, Bjarne Sode, *The Psychology of Art Appreciation* (Copenhagen: Museum Tusculanum Press, 1997)

Fux, Johann Joseph , ed. Mann, Alfred, *The Study of Counterpoint: from Johann Joseph Fux's Gradus Ad Parnassum* (New York: W. W. Norton & Company, 1971)

Gill, Eric, *An Essay on Typography* (London: Lund Humphries, 1988)

Gill, Eric, *Autobiography* (New York: Biblo & Tannen Publishers, 1968)

Goldthwaite, Richard A., *The Building of Renaissance Florence: An Economic and Social History* (Baltimore/London: The John Hopkins University Press, 1982)

Gombrich, Ernst Hans Josef, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (Oxford: Phaidon, 1987)

Goudy, Frederic William, *The Alphabet: and Elements of Lettering* (London: Dover Publications, 1989)

Goudy, Frederic William, *Typologia; Studies in Type Design and Type Making* (Berkeley: University of California Press, 1977)

Gough, Philip B., 'One Second of Reading', *Visible Language*, Volume VI, Number 4 (Cleveland: the Journal, 1972)

Grasby, Richard D., *Processes in the Making of Roman Inscriptions* (Oxford: Centre for the Study of Ancient Documents, 2009)

Groenewege, M.,R., and Man, W.C. de, *Schrift Schrijven Schrijfonderwijs: Handleiding voor aanstaande onderwijzers* (Leiden: Spruyt, Van Mantgen & De Does, 1975)

Hermersdorf, Martin, *Wie ein Druckbuchstabe entsteht* (Seebruck am Chiemsee: Heering-Verlag, 1952)

Horne, Thomas Hartwell, *An Introduction to the Study of Bibliography* (London: T. Cadell and W. Davies, 1814)

Huntley, H.E., *The Divine Proportion* (New York: Dover Publications, 1970)

Hutt, Allen, *Fournier, the Compleat Typographer* (London: Frederick Muller, 1972)

Ilardi, Vincent, *Renaissance Vision from Spectacles to Telescopes* (Philadelphia: American Philosophical Society, 2007)

Isaacs, Alan, and Martin, Elizabeth, (ed.), Dictionary of Music (London: Hamlyn, 1982)

Jammes, André, 'Académisme et Typographie, The Making of the Romain du Roi', *Journal of the Printing Historical Society*, Number 1, (London, 1965)

Jessen, Peter, *Masterpieces of Calligraphy: 261 Examples, 1500–1800* (New York: Dover Publications, 1981)

Johnston, Edward, ed. Child, Heather, and Howes, Justin, *Lessons in Formal Writing* (London: Lund Humphries, 1986)

Johnston, Edward, ed. Child, Heather, *Formal Penmanship and Other Papers* (London: Lund Humphries, 1971)

Johnston, Edward, *Writing and Illuminating & Lettering* (London: Sir Isaac Pitman & Sons Ltd., 1945)

Käch, Walter, *Rhythm and Proportion in Lettering [Rhythmus und Proportion in der Schrift]* (Olten: Otto Walter Ltd., 1956)

Kapr, Albert, *Johannes Gutenberg: Persönlichkeit und Leistung* (München: C.H. Beck, 1988)

Kapr, Albert, *The Art of Lettering: The History, Anatomy, and Æsthetics of the Roman Letter Forms* (München: K.G. Saur, 1983)

Karow, Peter, *Typeface Statistics* (Hamburg: URW Verlag, 1993)

Kindersley, David, *Optical Letter Spacing: for New Printing Systems* (London: The Wynkyn de Worde Society, 1976)

Kinross, Robin, *Modern Typography* (London: Hyphen Press, 2004)

Krimpen, Huib van, *Boek: over het maken van boeken* (Veenendaal: Gaade Uitgevers, 1986)

Krimpen, Jan van, ed. Dreyfus, John, *A Letter to Philip Hofer on Certain Problems Connected with the Mechanical Cutting of Punches* (Cambridge, Boston: Harvard College Library, 1972)

Krimpen, Jan van, 'Memorandum', *The Monotype Recorder*, New series/Volume 9 ('s-Hertogenbosch: Dutch Type Library, 1996)

Krimpen, Jan van, *On Designing and Devising Type* (New York: The Typophiles, 1957)

Lawson, Alexander, *Anatomy of a Typeface* (London: Hamish Hamilton, 1990)

Lommen, Mathieu, *Jan van Krimpen & Bruce Rogers* ('s-Hertogenbosch: Dutch Type Library, 1994)

Lowry, Martin, *Nicolas Jenson and the Rise of Venetian Publishing in Renaissance Europe* (Oxford: Basil Blackwell, 1991)

Lowry, Martin, *The World of Aldus Manutius: Business and Scholarship in Renaissance Venice* (Oxford: Basil Blackwell, 1979)

Luckombe, P., *The History and Art of Printing* (London: J. Johnson, 1771)

Lunde, Ken, *CJKV Information Processing* (Sebastopol: O'Reilly, 2008)

Man, John, *Gutenberg, How One Man Remade the World with Words* (New York: John Wiley and Sons, 2002)

Mardersteig, Giovanni, 'Alberti and the Revival of the Roman Letter', *Typography Papers 6* (London: Hyphen Press, 2005)

Mardersteig, Giovanni, *The Remarkable Story of a Book Made in Padua in 1477: Gentile da Foligno's 'Commentary on Avicenna' printed by Petrus Maufer* (London: Nattali & Maurice Ltd., 1967)

Meiss, Millard, 'The First Alphabetical Treatises in the Renaissance', *Visible Language*, Volume III, Number 1 (Cleveland: the Journal 1969)

Mengel, Willi, *Die Linotype erreichte das Ziel* (Berlin/Frankfurt: Linotype GmBH, 1955)

Morison, Stanley, *A Tally of Types: Cut for Machine Composition and Introduced at the University Press, Cambridge 1922–1932* (Cambridge: Cambridge University Press, 1953)

Morison, Stanley, and Day, Kenneth, *The Typographic Book 1450–1935* (London: Ernest Benn Ltd., 1963)

Morison, Stanley, *Early Italian Writing -Books: Renaissance to Baroque* (Verona/London: Edizioni Valdonega/The British Library, 1990)

Morison, Stanley, *Four Centuries of Fine Printing* (London: Ernest Benn Ltd., 1949)

Morison, Stanley, *Letter Forms: Typographic and Scriptorial* (New York: The Typophiles, 1968)

Morison, Stanley, *Pacioli's Classic Roman Alphabet* (New York: Dover Publications, 1994)

Morison, Stanley, *The Fell Types*

: the Roman, Italic & Black Letter Bequeathed to the University of Oxford by Dr. John Fell (Oxford: The Typophiles, 1951)

Morison, Stanley, *Type Designs of the Past and Present* (London: The Fleuron, 1926)

Mosley, James, 'Giovan Francesco Cresci and the Baroque Letter in Rome', *Typography Papers 6* (London: Hyphen Press, 2005)

Moxon, Joseph, ed. De Vinne, Theodore Low, *Mechanick Exercises: or the Doctrine of Handy-Works Applied to the Art of Printing* (New York: The Typothetæ of the City of New York, 1896)

Moxon, Joseph, *Mechanick Exercises on the Whole Art of Printing (1683–4)*, ed. Davis, Herbert, and Carter, Harry (New York: Dover Publications, 1978)

Murray, Peter and Linda, *The Penguin Dictionary of Art and Artists* (London: Penguin Books, 1989)

Nelson, Stan, 'Cutting Anglo-Saxon Sorts', *Fine Print on Type* (London: Humphries, 1989)

Noordzij, Gerrit, 'A Program for Teaching Letterforms', *Dossier A–Z 73: Association Typographique Internationale* (Belgium: Remy Magrermans, 1973)

Noordzij, Gerrit, 'The Shape of the Stroke', *Raster Imaging and Digital Typography 2* (New York: Cambridge University Press, 1991)

Noordzij, Gerrit, *De handen van de zeven zusters* (Amsterdam: G.A. van Oorschot, 2000)

Noordzij, Gerrit, *De staart van de kat: de vorm van het boek in opstellen* (Leersum: GHMUitgeverij, 1988)

Noordzij, Gerrit, *Letterletter* (Vancouver: Hartley & Marks, 2000)

Noordzij, Gerrit, *The Stroke of the Pen: Fundamental Aspects of Western Writing* (The Hague: Koninklijke Academie van Beeldende Kunsten, 1982)

Noordzij, Gerrit, *The Stroke: Theory of Writing* (London: Hyphen Press, 2005)

Ong, Walter Jackson, 'Comment: Voice, Print, and Culture', *Visible Language*, Volume IV, Number 1 (Cleveland: the Journal, 1970)

Osley, Arthur S., *Scribes and Sources: Handbook of the Chancery Hand in the Sixteenth Century* (Boston: David R. Godine, 1980)

Osterer, Heidrun, and Stamm, Philipp, *Adrian Frutiger – Typefaces: The Complete Works* (Basel: Birkhäuser Architecture, 2008)

Parker, Mike, 'Early Typefounders' Moulds at the Plantin-Moretus Museum', *The Library*, Fifth Series, Volume XXIX, No.1, (Oxford, Oxford University Press, 1974)

Perkins, Tom, 'The Geometry of Roman lettering', *Font* (Ditchling: Ditchling Museum & the Edward Johnston Foundation, 2000)

Plantin, Christopher, *Calligraphy & Printing in the Sixteenth Century*, ed. Nash, Ray (Antwerp: Plantin-Moretus Museum, 1964)

Ploos van Amstel, Cornelis and Jacob, *Beschrijving der letter-gieterij.* (Amsterdam: De Wed. van K. van Tongerlo en Zoon, 1768)

Rädisch, Paul Helmuth, *A tot Z: een autobiografie van P.H. Rädisch, staalstempelsnijder* (Haarlem: De Priegelboekerij, 1979)

Rogers, Bruce, *Pi: a Hodge-Podge of Letters, Papers, Addresses Written During a Period of 60 Years* (Cleveland: World Publishing Co., 1953)

Roi, Loys le, *On Printing* (Loughborough: The Plough Press, 1974)

Scholderer, Victor, *Johann Gutenberg: The Inventor of Printing* (London: The Trustees of the British Museum, 1970)

Smeijers, Fred, *Counterpunch: Making Type in the Sixteenth Century, Designing Typefaces Now* (London: Hyphen Press, 1996)

Stone, Sumner , 'Hans Eduard Meier's Syntax-Antiqua', *Fine Print on Type*, (London: Lund Humphries, 1989)

The Monotype System (Philadelphia: Lanston Monotype Machine Company, 1912)

Thompson, Edward Maunde, *An Introduction to Greek and Latin Palaeography* (Oxford: The Clarendon Press, 1912)

Tommy Thompson, *How to Render Roman Letter Forms* (New York: Holme Press, 1946)

Tinker, Miles Albert, *Bases for Effective Reading* (Minneapolis: University of Minnesota Press, 1966)

Tracy, Walter, *Letters of Credit: A View of Type Design* (Boston: David R. Godine, 1986)

Tschichold, Jan, *Letterkennis* (Amsterdam: De Arbeiderspers, 1950)

Tschichold, Jan, *Treasury of Alphabets and Lettering* (Ware, Hertfordshire: Omega Books, 1985)

Ullman, Berthold Louis, *Ancient Writing and its Influence* (New York: Cooper Square Publishers, 1963)

Ullman, Berthold Louis, *The Origin and Development of Humanistic Script* (Roma: Edizioni di Storia e letteratura, 1960)

Unger, Gerard, *Typography as Vehicle of Science* (Amsterdam: De Buitenkant, 2007)

Unger, Gerard, *While You're Reading* (New York: Mark Batty Publisher, 2007)

Updike, Daniel Berkeley, *Printing Types: Their History, Forms and Use* (Cambridge, MA: Harvard University Press, 1937)

Vervliet, Hendrik Désiré Louis, 'The Garamond Types of Christopher Plantin', *Journal of the Printing Historical Society*, Number 1, (London, 1965)

Vervliet, Hendrik Désiré Louis, and Carter, Harry, *Type Specimen Facsimiles 2* (London: The Bodley Head Ltd, 1972)

Vervliet, Hendrik Désiré Louis, *French Renaissance Printing Types* (New Castle: Oak Knoll Press, 2010)

Vervliet, Hendrik Désiré Louis, *Sixteenth-Century Printing Types of the Low Countries* (Amsterdam: Menno Herzberger & Co, 1968)

Vervliet, Hendrik Désiré Louis, *The Palaeotypography of the French Renaissance* (Leiden: Brill, 2008)

Voet, Leon (et al.), *Inventory of the Plantin-Moretus Museum –Punches and Matrices* (Antwerp: Museum Plantin-Moretus, 1960)

Voet, Leon, *The Golden Compasses* (Amsterdam: VanGendt & Co, 1969–1972)

Weel, Adriaan van der, *Changing our Textual Minds* (Manchester: Manchester University Press, 2011)

Whalley, Joyce Irene, *The Art of Calligraphy* (London: Bloomsbury Books, 1980)

Wotzkow, Helm, *The Art of Hand Lettering* (New York: Dover Publications, 1967)

Young, Greg, *Alfred Wegener: Pioneer of Plate Tectonics* (Mankato: Compass Point Books, 2009)

Zapf, Hermann, *About Alphabets* (Cambridge, Massachusetts: MIT Press, 1970)

Zapf, Hermann, *Alphabetgeschichten : eine Chronik technischer Entwicklungen* (Bad Homburg/ Rochester: Mergenthaler Edition, Linotype GmbH/ RIT Cary Graphic Arts Press, 2007)

CURRICULUM VITÆ

Frank Eduard Blokland (Leiden, 1959) studied Graphic and Typographic design at the Royal Academy of Art in The Hague (KABK) from 1978 until 1983. As student he founded the working group Letters].

During the 1980s, Blokland designed the lettering of a number of monuments, amongst which the Homomonument near the Westerkerk in Amsterdam, and the Bulthuismonument for the Dutch post (PTT) in Bergum. He also designed the lettering for a couple of monuments, which the sculptor Frans de Wit made for the city of Leiden, such as the memorial plaque for the seventeenth-century professor of jurisprudence Gerard Noodt, the plaque for the Hooglandse kerk, and the plaque for the former Jewish Orphanage. From 2004 till 2011 Blokland designed the lettering of the newly restored stained glass windows of the choir of the Pieterskerk in Leiden.[490]

Blokland wrote the book for the television course *Kalligrafie, de kunst van het schoonschrijven* (‘Calligraphy, the art of beautiful handwriting’) in 1989/1990.[491] April 2013 Blokland designed the calligraphic lettering of H.M. Queen Beatrix’s Abdication Act. The letters on the act, in Humanistic minuscule and italic hands – with all their contextual letter-variants– were written by Blokland and transferred by himself into two digital fonts: Abdicatie Regular and Abdicatie Italic using the DTL FontMaster tools. The text was subsequently silkscreened on parchment.

Since the 1980s he has written some 150 articles on type design and font production for various graphic and design magazines, like *Compres*, *Pers*, *PrintBuyer*, *Hamburger Satzspiegel*, and *Page*.

After years of preparation, in 1990 Blokland founded the Dutch Type Library (DTL), the first and nowadays largest producer and publisher of digital typefaces in the Netherlands.[492] Blokland has designed typefaces such as DTL Documenta, DTL Documenta Sans, DTL Haarlemmer (on the basis of drawings by Jan van Krimpen), DTL Haarlemmer Sans, DTL Romulus (also based on drawings by Van Krimpen) and DTL VandenKeere. His typefaces are nationally and internationally renowned for their quality. In the Low Countries DTL Documenta was for instance for more than a decade the corporate identity type of the city of Amsterdam and of the Rijksmuseum. DTL Documenta has been applied in

---

490 <http://www.youtube.com/watch?v=6QDZniK-v4U>
491 16,000 copies went over the counter.
492 <http://www.dtl.nl>

Gotteslob, the new prayer and songbook of the Catholic church in Germany and Austria, which was published early 2014. The production of the 3.6 million copies (1,300 pages each) required eight tons of red ink and roughly 3,000 tons of light-weight paper (40 grams). End of 2016 the new *Luther Bibel* for the Evangelische Kirche in Germany, which is typeset in DTL Documenta (in combination with DTL Caspari), will be released. DTL Haarlemmer was for a long time the corporate-identity type of Museum Boijmans Van Beuningen in Rotterdam and of Teylers Museum in Haarlem. DTL Haarlemmer is in use for the street signs in city of Haarlem since 2010. DTL VandenKeere is the corporate-identity typeface of the city of Antwerp and the Museum Plantin-Moretus. Blokland was also responsible for the production of all typefaces released by the Dutch Type Library and he actively contributed to the character sets of each one of these.

A couple of years after founding the Dutch Type Library, Blokland initiated and supervised the development of DTL FontMaster, a set of batch-oriented utilities for professional font production, jointly developed by the Dutch Type Library and the German based company URW++ Design & Development.[493] Together with Dr. Jürgen Willrodt, Blokland wrote the manual for the DTL FontMaster utilities.

In 2003 he initiated the 'Dr. Peter Karow Award for Font Technology & Digital Typography', an award that is presented every five years to people who made a special and innovative contribution to the development of font related technology and digital typography. Blokland organized a couple of conferences on font technology at Castle Maurick in Vught and one at the Steigenberger Kurhaus Hotel in Scheveningen.

When Gerrit Noordzij retired in 1987 from the Royal Academy of Art in The Hague, Blokland was the first of the younger generation to succeed him. As Senior Lecturer he now teaches writing, letter-drawing and type design/font production at the graduate and post-graduate courses of the Graphic Design department.

In 1995 Blokland was invited to become professor at the Plantin Society in Antwerp. He has lectured as a guest professor at institutes like the Technical University of Delft, the University of Reading and Lahti Polytechnic University and he was speaker at several events, including editions of the ATypI Conference and its sibling the TypeTech Forum.

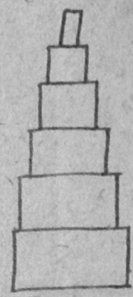
---

[493] <http://www.fonttools.org>

Registre pour 3. fourmes bonnes de la Descendiane flamende pour Christoffle Plantin.

a	3300
b	1327
c	2652
d	3900
e‡	11289
f	1011
g	1629
h	3200
i	4830
k	1402
l	2518
m	2166
n	5112
o	3121
p	1141
q	480
r	3844
ꝛ	1185
ſ	1811
s	1343
t	4202
v	1172
u	2214
w	1175
y	980
x	1550
z	645

ã	194
ẽ	876
ĩ	150
õ	211
ũ	121
ñ	787
ſt	650
ſſ	171
ff	130
ÿ	860
ĳ	257
ð	130
v̈	119
.	2150
:	290
/	2330
=	1007
?	542
(	150
¶	000
1	287
2	225
3	188
4	200
5	190
6	129
7	143
8	113
9	127
0	113
ſl	66
fl	65



1010
889
645
423
440
424

Espaces deliees
2468.
Espaces espesses.
12400.

18699.

Somma sommarum.
106163.

Lesquelles montent a huyct patars le mille 42. flo. 9. patars / Et pese en tout 343 ℔. poidz de mestre / qui monte a 2. pats ¼. la libvre aint la carrage a 38. florins 11. pa. ¼. Et pour les corbeilles cordes et maculatures 10. patars / vault ensemble

81. fl. 10. pa. ¼.

A	194
B	180
C	273
D	315
E	334
F	271
G	217
H	255
I	339
K	220
L	283
M	353
N	296
O	298
P	150
Q	175
R	210
S	203
T	232
V	198
W	152
X	35
Y	40
Z	70

6 Dec 1570 see p 214 M.P.

ACKNOWLEDGEMENTS

I would like to thank the Museum Plantin-Moretus and its director Iris Kockelbergh for the cooperation during my investigation and measurements of French Renaissance punches, matrices, and foundry type from the museum's inventory. I am especially grateful to Guy Hutsebaut for his invaluable assistance during my investigation of French Renaissance type-foundry material, and for the joint casting from sixteenth-century matrices at the museum.

I would also like to thank Prof. Emeritus Charles Bigelow (formerly Rochester Institute of Technology) for his comments on my research and for openly supporting my investigations from the start. Furthermore, I am indebted to Dr. Jürgen Willrodt and Axel Stoltenberg for the ongoing development of the LetterModeller application. Also I would like to thank Dave Crossland and Øyvind Kolås for their contributions to the development of the analysing and spacing tool based on my theories and measurements, named Kernagic, and Lukas Schneider for the related –and also still ongoing– joint development of the Python-based LS Cadencer and LS Cadenculator tools. Finally I would like to thank Nicolas Portnoï for the use of his phototographs and Sophie Boisvert-Hearn for her copy editing.

Without the persevering support by my wife and without the patience of my daughter the accomplishment of this dissertation would not have been possible.


185
84
83