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# Using Corpus Linguistics to Analyse how Design Research Frames 'Design Thinking'

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Academic research communities create knowledge which helps them to claim authority over their investigative domain. The knowledge is not necessarily objectively true—often it is skewed to help communities to claim legitimacy. This paper investigates how the design research community frames 'Design Thinking', a key concept in design research. Existing literature identifies skewed methods which the community uses when framing Design Thinking. The literature suggests that creating an artificial separation between the ways that designers and scientists think helps the community to claim knowledge on Design Thinking. To further investigate how the community creates knowledge, this paper subjects abstracts from peer-reviewed journal papers which focus on Design Thinking to empirical analysis using Corpus Linguistics methods. The study suggests that use of 'nominals' and the creation of 'meta-knowledge' helps researchers to claim authority on Design Thinking. These practices appear however to perpetuate an artificial separation between Design Thinking and other design domains.

Keywords: Design Thinking, Corpus Linguistics, Discourse, Discourse Communities, Ways of Speaking

## Introduction

The linguist John Flowerdew (2013) argues that knowledge claimed by given groups or institutions is never objectively true. Rather it is produced in a subjective manner. The knowledge is always skewed to suit the aims and objectives of the group (Swales, 1990; Rabinow, 1991). The term *discourse* is used to describe the skewed knowledge disseminated by a given social group (Flowerdew, 2013). The term *discourse community* denotes the collection of individuals making up such a group (Flowerdew, 2013; Swales, 1990). A discourse community creates discourse with the aim of occupying a particular intellectual territory termed a *domain* (Rabinow 1991). Members of discourse communities use written or spoken language to disseminate discourse (Flowerdew, 2013). Theorists use the term *ways of speaking* to characterise the language used by discourse communities when they are creating their discourse (Finken, 2003).

A discourse community is only sustainable if it can maintain its perception of truth and its hold over the production of knowledge (Rabinow, 1991). To do this, it must reject knowledge which threatens to undermine its position. In practice this means rejecting knowledge produced by other discourse communities which may compete for ownership of a given domain (Finken, 2003; Foucault, 1980). If successful, the process of knowledge creation undertaken by a given discourse community undermines the validity of knowledge



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created by other discourse communities (Foucault, 1971). The process of knowledge formation enables a community to claim legitimacy and wield power (Rabinow 1991; Foucault, 1971). The importance of ways of speaking is such that theorists tend to define discourse communities by the ways in which they speak on issues which are key to the community (Flowerdew 2013). Researchers may, for example refer to, the *discourse of managerialism*, the *discourse of advertising* or *Christian discourse* (Flowerdew, 2013). It does not necessarily follow that members of a discourse community disseminate ways of speaking with the intent of being intentionally deceitful. Members tend to be immersed in the community's discourse and may not recognise that their claims may not be objectively true (Rabinow, 1991).

### *Academic Discourse Communities*

The concept of discourse communities applies in academic fields. The sociologists Becher and Trowler (2001) have investigated the way in which academic disciplines construct discipline-specific discourse. Becher and Trowler (2001) argue that academic disciplines function as—in their terms—*tribes*<sup>1</sup>. In the main, tribe-members cement their identity through their ways of speaking: “the professional language of a disciplinary group plays a key role in establishing its cultural identity” (Becher and Trowler, 2001, p.46). This is not to say that academic disciplines are entirely homogeneous. The way that principles within a discipline are taught can differ from institution to institution (Becher and Trowler, 2001). There are also regional differences within academic tribes. Academics in certain nations may focus on creating knowledge on certain aspects of a discipline over others. Indeed, Becher and Trowler (2001, p.44, original emphasis) argue that “national stereotypes of a conventional (and relatively crude) kind” can influence some perceived differences in ways of working. However, despite regional differences, “strong resemblances persist between different branches of the same [academic discipline]” (Becher and Trowler, 2001, p.44). In this respect, disciplines have specific ways of speaking on knowledge associated with their domain. Historians tend to use the term “masterly” to commend a piece of research, whereas sociologists often term good research “thought-provoking” (Becher and Trowler, 2001, p.46). Ways of speaking allow members of academic discourse communities to cement the knowledge claimed by the tribe and to differentiate their field from other domains. Analysis conducted by Thompson and Hunston (2003) illustrate this process in action. Thompson and Hunston reflect on how a researcher in the field of *applied* linguistics cements the value of research conducted in his tribe whilst differentiating it from the field of *theoretical* linguistics. The researcher of the applied linguist (John Swales) is published in a journal which specialises in disseminating research on applied linguistics. In differentiating between his area and that of theoretical linguistics, Swales infers that “Both types of research are valid but applied [linguistics] research is more significant” (Thompson and Hunston, 2003, p7). This helps the applied linguist underscore the legitimacy and importance of his field whilst differentiating it from theoretical linguistics. His ways of speaking also invoke a sense of camaraderie with other members of the community, “precisely [because members of the applied linguistic community] write and read papers like this” (Thompson and Hunston, 2003, p7). Thompson and Hunston’s (2003) research illustrates how members of academic discourse communities create skewed ways of speaking which reflect the aims of the tribe.

This paper examines ways of speaking the design research discourse community use when claiming knowledge on Design Thinking. To begin with, the author identifies existing literature which suggests the presence of skewed ways of speaking. The paper then uses a method termed *corpus linguistics* to uncover skewed ways of speaking in a data set of design research papers.

## **Existing Signs of Skewed Ways of Speaking in Design Thinking Research**

The design research community commonly uses the term Design Thinking to describe the cognitive process used by designers when they are engaged in solving design problems. Design researchers often claim that Design Thinking differs from problem-solving processes used by natural scientists (Cross, 2004, 2011; Dorst, 2011, 2010). The work of Nigel Cross (2004; 2011) illustrates the position commonly taken in the design research community. Cross (2004) claims that scientists attempt to identify a problem fully and then work to solve it. Indeed, the focus on identifying a problem leads Cross to term scientific thinking a *problem-focussed* process. Cross argues that once scientists have identified the problem, they engage in trying to solve it. For

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<sup>1</sup> Indeed, the title of Becher and Trowler’s (2001) book is *Academic Tribes and Territories*

Cross (2004, 2011) the movement from identifying a problem to attempting to solve it implies that scientific problem-solving is *linear* in nature.

A host of design researchers claim that the linear, problem-focussed way of thinking used by scientists limits both exploration of problems and idea generation and can therefore produce unsatisfactory solutions (e.g. Cross, 2004, 2011; Dorst, 2011, 2010; Oxman, 2002; Stempfle and Badke-Schaub, 2002). Design Thinking researchers argue that designers do not attempt to identify a problem prior to beginning to solve it. Instead, designers work to understand a problem as they attempt to solve it (Cross, 2004). Therefore, rather than focusing on a problem, designers focus on finding the solution. This trait leads Cross (2004) to term Design Thinking a *solution-focussed* process. Dorst (2010, 2011) claims that designers work to identify the problem through undertaking a series of cyclic steps in which they iteratively return to the problem in order understand different elements of it. The presence of cyclic steps indicates that Design Thinking is *non-linear* in nature. Dorst claims that this non-linear, solution-focussed way of thinking enables design solutions to evolve progressively, allowing opportunity for reflective practice:

*“[Designers] know that bringing the full force of evaluation to bear upon a fledgling idea is a very effective way of killing it, blocking any further exploration and stifling any progress in the project”.*  
(Dorst, 2010, p.133)

The discussion within the design research community on *problem-focussed* and *solution-focussed* problem-solvers and *linear* and *non-linear* methods suggests that design research commonly constructs a dichotomy between scientific thinking and Design Thinking. Maciver et al. (2016) illustrate this dichotomy in the form of a table (Figure 1). In expanding on the dichotomy, Maciver et al. (2016) suggest that designers focus on using the *left* hemisphere of the brain whilst scientists predominantly use the *right* side; scientists employ *logic* to solve problems, whilst designers use their *intuition*.

<b>Sciences</b>	<b>Arts</b>
Mathematics, physics, engineering	Creativity, language
Logic	Intuition, subjectivity
Left brain	Right brain
Linear, sequential	Holistic, chaotic, divergent
Reductionist enquiry	Naturalistic enquiry
Facts, figures, formulae	Interpretive forms, subjective expression
One correct answer	Many solutions
<b>Technologists</b> - computer scientists, software engineers, information science experts, coders...	<b>Designers</b> - product designers, interface designers, design researchers, graphic designers...

Figure 1: The Dichotomy between Scientific Thinking and Design Thinking. Taken from Maciver et al. (2016, p.3)

A small body of research questions the validity of the dichotomy between Design Thinking and scientific thinking. Research on *wicked problems* provides an example of this critique. The idea of wicked problems was famously developed by Rittel and Webber (1973). Rittel and Webber describe problems as being wicked when they involve many stakeholders. Rittel and Webber claim that the presence of many stakeholders makes problems very difficult to solve using scientific ways of thinking. Originally, Rittel and Webber applied the concept of wicked problems to town planning issue. More latterly, design researchers have tended to argue that a range of design problems can be thought of as being wicked (Downton, 1993; Cross, 2011). Design researchers often claim that designers’ ability to use Design Thinking enables them to tackle wicked problems (Buchanan, 1992). Farrell and Hooker (2013) challenge the idea that designers can tackle wicked problems more effectively than scientists. Indeed, Farrell and Hooker argue that scientists commonly tackle wicked problems. They claim that negotiation between stakeholders was key in allowing natural scientists to diagnose the illness termed *chronic fatigue syndrome*:

*It was [...] initially unclear whether chronic fatigue syndrome was caused by a bacterium or virus, a fungus or mould, in each case perhaps deeply embedded in tissue, or was due to a psycho-somatic condition, with any of these options difficult and resource demanding to pursue. Then, just as with design, the issue becomes which few of these possibilities is currently most worth pursuing and in which specific forms. Various options will be developed in more detail, their resource demands and risks analysed and their merits spelled out for consideration. During that process more specific versions of the initial general problem will be developed, some of them (e.g. the psycho-somatic option) perhaps requiring a significant reformulation of both what the problem is and what criteria a solution would need to meet. A critical debate will develop about these options, the upshot being that one or two of them will be selected to pursue, perhaps by individual laboratories, perhaps as cooperative ventures. (Farrell and Hooker, 2013, pp. 688-689)*

Farrell and Hooker (2013, p.701) suggest there exists an intrinsic relationship between the way designers and scientists think, for both are the “product of a common core cognitive process”. In critiquing the dichotomy between Design Thinking and scientific thinking which is such a prominent feature of design research, Farrell and Hooker (2013, p.683) argue that influential work on Design Thinking is “fundamentally flawed”.

New and Kimbell (2013) contribute a further criticism of the dichotomy which design researchers construct between Design Thinking and scientific ways of thinking. New and Kimbell (2013) reject the oft-stated argument that Design Thinking is unlike scientific thinking. In evidencing their position, New and Kimbell argue that, commonly, Design Thinking research does not present a true representation of scientific approaches to problem-solving. Rather, design research commonly presents a skewed interpretation. New and Kimbell claim that in Design Thinking research, the ways that designers think is mistakenly “repeatedly characterized in opposition to a caricature of rationalist, analytical 'orthodox' approaches” (New and Kimbell, 2013, p.139; original emphases). To illustrate their argument, New and Kimbell (2013) criticise the position taken in design research on the issue of *empathy*. New and Kimbell illustrate how design research commonly frames the way in which designers generate empathy. New and Kimbell use the example of a hypothetical study in which designers try to create empathy with wheelchair users:

*...design practice would perhaps involve the designer themselves using a wheelchair, or collecting data on the overall travel experience, and look [sic] for interactions with the wider process. (New and Kimbell, 2013, p.144; original emphases)*

New and Kimbell argue that this form of empathy is not unique to designers. Rather they suggest it has parallels with the form of empathy developed through a scientific, analytical approach to problem solving:

*This type of empathy, however, might still only be 'cognitive'. For 'affective' empathy to be involved the process of seeing through others' eyes requires a deeper engagement: this requires sharing the emotional response of the other. In the wheelchair example, it would require the designer to share, perhaps, the level of anxiety that a user might experience in the situation, or anger [...] It is not that one can rationally appreciate the fact of another's emotions, but that one has the emotions oneself. (New and Kimbell, 2013, p.145; original emphases)*

New and Kimbell (2013) therefore argue that when it comes to generating empathy, the way designers think is similar to the way scientists think.

Both New and Kimbell (2013) and Farrell and Hooker (2013) provide some insight into skewed ways of speaking in the Design Thinking research community. However, neither New and Kimbell's (2013) nor Farrell and Hooker's (2013) research makes use of empirical, analytical methods which are specifically designed to investigate ways of speaking in texts. This limits the potential value of their insights. This paper contributes to filling this gap in knowledge by subjecting a data set of abstracts from peer-reviewed journal papers which focus on Design Thinking to critical analysis with *Corpus Linguistics* methods. Corpus linguistics tools are specifically designed to investigate ways of speaking in texts and are commonly used in the social sciences to facilitate critical analysis of claims made by a range of discourse communities (e.g. Baker, 2006; Mautner, 2009; Hoey and O'Donnell, 2008). So far, the use of corpus linguistics in design research has been limited to only 2 small studies (Blythe, 2014; AUTHOR, 2016). Therefore, in addition to unpicking ways of speaking on Design Thinking, this paper further embeds the use of corpus linguistics in design research.

## An Introduction to Corpus Linguistics

The field of corpus linguistics is a branch of linguistics. Corpus linguists analyse data sets consisting of spoken or written language. Corpus linguists argue that people “express[] an ideological position” (Stubbs, 1996, p.107) when choosing words or terms to use. Researchers therefore look for patterns in word use in the data set. Evidence of patterns can create cohesive insights into ways of speaking on the research domain (Hoey and O’Donnell, 2008).

Corpus Linguistics research began in the late 1960s. The British linguist John Sinclair (1933 – 2007) is credited as being a pioneer in this field (Hoey and O’Donnell, 2008). Sinclair’s work came in reaction to an idea which was dominant during the era in which he worked, namely that investigation into patterns of word use could not provide insight into ways of speaking. Instead, in the 1960s, it was commonly thought that cognitive development dictated which words a person chooses to use (Carter, 2004). To illustrate, Chomsky (1969) argued that people prefer to use words which are easier to remember than those which are more difficult to recall. This, thought researchers in the 1960s, is why people tend to favour using shorter words over longer words. It was therefore commonly assumed that analysis of spoken or written language can only create knowledge on the physiological structure of the human brain (Carter, 2004). In the latter half of the 1960s, this dominant school of thought was challenged by Sinclair and a handful of other academics (Hoey and O’Donnell, 2008). Sinclair argued that humans choose to use words which reflect their affiliation with discourse communities (Sinclair interview cited in Teubert, 2004). Sinclair’s research into ways of speaking overturned the prominent view and as a result there are centres for corpus linguistics in universities worldwide.

Corpus linguistics research often provides insights into how discourse communities exercise their power and the ramifications of these ways of speaking. Rule and Levine (2011) analyse ways of speaking in the world of high-end modern art. To do this, they research a corpus consisting of artists’ statements. Artists’ statements consist of texts which often accompany artwork displayed in galleries. Written by artists or their representatives, these statements summarise the artist’s influences and the aims and objectives of the artwork. Analysis reveals that high-profile modern artists tend to be concerned with what they believe to be important human and environmental issues. The artists do not aim to solve these issues, instead, they aim to raise awareness of them. Artists use terms such as “interrogate”, “problematize” and “blur boundaries” in the context of raising awareness (Rule and Levine, 2011, unpagged). Rule and Levine argue that use of these terms helps artists to consistently frame the political ruling classes as failing to confront pressing human and environmental issues. In this way, artists’ statements tend to “convey[] the sense of political tragedy” (Rule and Levine, 2011, unpagged). Interestingly, artists’ statements often contain noun-forms of words. To illustrate:

*visual becomes visuality, global becomes globality, potential becomes potentiality, experience becomes experiencability. (Rule and Levine, 2011, unpagged)*

Rule and Levine (2011, unpagged) argue the use of these noun-forms mimics a form of “highbrow written French” used by French poststructuralist philosophers such as Jacques Derrida. According to Rule and Levine, their use represents attempts to elevate elite fine art gallery practice and to imbue it with a sense of intellectual authority and legitimacy. These ways of speaking enable modern artists to discuss global political issues with an assumed air of authority (Rule and Levine, 2011).

### Concordancers

Corpus linguistics analysis is facilitated by specialised software termed *concordancers*. Examples include *AntConc* (Gries, 2009), *WordSmith* (Scott, 2014) and *Sketch Engine* (Brezina and Gablasova, 2015). Texts which are to be analysed are uploaded into the concordancer. Concordancers can only process text which has been converted to a Unicode format termed UTF-8 (McEnery and Xiao, 2005). UTF-8 files contain a homogenised form of text: UTF-8 supports only one font, one text size and a single font colour. In addition, it cannot support images—converting data to UTF-8 causes loss of images. Conversion also deactivates any embedded web-links. The resulting file is termed the *research corpus*. The format of the research corpus can make it more difficult for a researcher to identify the origins of text. This may help researchers to analyse texts in a more neutral manner, contributing to less biased analyses (Baker 2012).

## Corpus Linguistics Tools

The field of Corpus Linguistics contains a large toolkit of quantitative and qualitative methods which facilitate critical analysis. (See, e.g. McEnry and Wilson (2001) for an excellent overview of the range of available tools.) Because of limited space, this paper only discusses tools which are used in the forthcoming empirical study. The tools are *Keyword Analysis* and *Concordance Analysis*. Both are used extensively—and in combination—in Corpus Linguistics research (McEnry and Wilson, 2001).

- Keyword Analysis

When creating discourse, communities tend to focus on using terms which are important in allowing them to construct skewed knowledge. The terms vary from discourse community to discourse community. (In the aforementioned example of modern art discourse, terms like *visuality*, *globality*, and *potentiality* help artists create their discourse). Such terms are therefore *key* in helping the community to form its discourse. The process termed *keyword analysis* aims to identify these terms.

To measure keyness, it is necessary to compare the frequency of appearance of terms in the research corpus with their occurrence in another corpus. This ‘other’ corpus acts as a ‘norm’ by which to judge word frequency in the research corpus. The norm is termed the *reference corpus* (Baker, 2004). Concordancers contain examples of reference corpora which facilitate the comparative analysis. One example is the *British National Corpus* (University of Oxford, 2010), a reference corpus containing 100 million words taken from a broad range of sources. Keyword analysis involves statistical measurement. Sketch Engine uses the following formula<sup>2</sup> (Figure 2) to calculate the keyness of a term in the research corpus:

$$\frac{fpm_{focus} + n}{fpm_{ref} + n}$$

Figure 2: The Formula used by the concordancer Sketch Engine to calculate keyness.  
Taken from *Lexical Computing*, (2005, unpagged).

Concordancers represent the keyness of words as a numerical figure in keyword lists in descending order of keyness. Figure 3 provides an example of a keyword list. The list shows keywords associated with an article on the subject of ‘software’ found on Wikipedia. The reference corpus is a large corpus of standard English. The term *microsoft* is a highly-ranked keyword, indicating that the company ‘Microsoft’ is strongly associated with the domain of software.

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<sup>2</sup> The author is not a statistician. Because of this, the author asked a statistician to re-write the formula in a way that a non-statistician could better understand. The formula can be written more clearly, as follows:

$$\frac{[\text{Frequency of word in research corpus if it were comprised of 1million words}] + 1}{[\text{Frequency of word in reference corpus if it were comprised of 1million words}] + 1}$$

WORD	FREQUENCY	KEYWORDNESS_SCORE
software	157	225.188706
hardware	20	50.452344
microsoft	15	47.498688
programming	11	28.355465
application	21	27.617109
operating	13	27.261984
applications	13	22.428778
programs	16	21.760401
apis	6	19.720981
licence	8	19.362902
documentation	7	18.498769
windows	7	18.153837
data	23	17.982899
systems	14	17.858611

Figure 3: Example of a Keyword List, taken from Sketch Engine (n.d., unpagged)

When evaluating keyness scores, it is necessary to choose a tolerance to work to. The tolerance represents the likelihood that a particular word is actually key to the data set. Words with keyness scores above the level of tolerance are considered to be keywords (Baker, 2004). Often researchers work to a 95% likelihood of keyness (Gries, 2009). In statistical annotation, level of likelihood is described with a p-value (where ‘p’ stands for probability (Lancaster University, n.d.)). 95% likelihood is written as  $p < 0.05$ .  $P < 0.05$  is associated with a minimum keyword score of 3.84 (Lancaster University, n.d.). Therefore, commonly, researchers will disregard keywords with a keyness score below 3.84.

Though keyword analysis helps researchers to identify terms which are important in enabling communities to create discourse, this tool does not provide insight into the context in which these terms are used. *Concordance analysis* provides contextual insights.

- Concordance Analysis

Qualitative analysis into the terms which accompany keywords in a given data set provides contextual insight into how keywords help to form discourse. In corpus linguistics terminology, qualitative investigation is termed *concordance analysis*. Concordance software facilitate concordance analysis by showing how keywords reside within sentences. Figure 4 illustrates an example from Hunston (2007). Figure 4 provides contextual insight into how the term *persistent* is used in a research corpus.

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1 seats has volunteered despite persistent arm twisting by regional
2 were having to defend against persistent Bradford attacking. In the fir
3 heel of this administration: its persistent determination always to look
4 oard for a grant to rehabilitate persistent drug users, ex-offenders and
5 on thin ice at 4-115 against a persistent England attack. Bevan survived
6 industry, charging it with persistent errors in consumers' details,
7 dentified. <p> Whether it is the persistent intimidation that takes place,
8 ringing in tougher sentences for persistent offenders and ensuring that al
9 of the Ten Hours Bill, which met persistent opposition from government and
10 considerations, thus creating a persistent paradox. Ainerica's dilemma
11 t unfortunately I can't." After persistent rain, which reached stair-rod
12 story about one particularly persistent recruiter. <p> Michael
13 plus the Shamir government's persistent refusal to give any ground on
14 later this year. Despite persistent reports of opposition to the
15 th of it. They said there was a persistent rumour that Mary was actually
16 he practice of folk swayed by a persistent sense of wonder, chance, and
17 ranssexual an individual with a persistent sense of discomfort with his o
18 hat this situation is a sign of persistent sexism, while optimists say th
19 te of the hospital but the most persistent talk of the more able-bodied
20 e spent on health and pensions. Persistent unemployment is keeping spendi

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Figure 4: An example of concordances, adapted from Hunston (2007, p.254-255).

In addition to providing insight into how keywords reside in sentences (as in Figure 4), concordancers allow researchers to view more expanded sections of text which contain keywords. This facilitates more in-depth qualitative analysis. The combination of quantitative and qualitative analysis associated with corpus linguistics provides a logical approach to analysing ways of speaking in discourse communities (Baker, 2004).



## The Data Set and Method

Conceivably, as the concept of Design Thinking has been important in design research for over 2 decades, it would be possible to analyse ways of speaking found in virtually any design paper, book or book chapter from the last few years. There is however comparatively little value in analysing texts which may mention 'Design Thinking' in passing. This practice would produce a diluted study with very limited insights. To increase the likelihood of creating valuable insights, it is more valuable to analyse a more homogenous sample which focusses on the research domain (Guest et al., 2006). In this study, this meant analysing papers which *focus* on Design Thinking. To do this, this study analysed papers which include the term 'Design Thinking' in the title of the paper. This strategy was used as researchers tend to rely on article title as the "main source of information" for judging article relevance (Jamali and Nikzad, 2011, p.653). Technology also supports searches conducted by article title. When using an online search engine to hunt for articles it is necessary to input terms which are relevant to the research domain. Search engines tend to prioritise searching for articles which contain these terms in the article title (Nagano, 2015; Beel et al, 2009). Users are more likely to access these results than results further down the results list (Nagano, 2015). These results are therefore more likely to contribute to the discourse of an academic community than articles which are found further down the list.

The widespread interest in Design Thinking means that articles which focus on this process are found in areas as diverse as *children's spirituality* (see, Tan and Wong, 2012), *medicine* (see, Patel et al, 2014) and *food science* (see, Olsen, 2015). Analysing papers which are published in a range of fields would however not provide insight into ways of speaking produced by the design research discourse community. One distinguishing feature of academic discourse communities is the specific avenues where members publish their work (Thompson and Hunston, 2003). This study analyses papers published in journals which include the term *design* in their remit. Design is characteristically a multidisciplinary area of research. Reflecting this, many design journals have multidisciplinary remits. This study analyses papers published in journals whose remits include *design*, *design and art* or *design and architecture*. The study does not include papers published in journals whose remit combines *design* with *engineering*. This decision results from the aforementioned idea that design researchers attempt to create a distinction between Design Thinking and scientific thinking. The author reasoned that including articles published in design engineering journals may reduce the likelihood of gaining focused insight into the design research discourse. The decision to exclude papers published in design engineering journals underscores the difficulty associated with creating a data set whose purpose is to uncover ways of speaking in a multidisciplinary discipline like design research.

The study does not include papers published in design conferences. Design researchers often publish in conferences with a view to extending the contribution to a journal article. Analysing journal papers may provide more of a definitive insight into ways of speaking than the process of investigating conference papers. In addition, the study only analyses papers which are published in peer-reviewed journals. The process of peer-review provides a definitive quality-check of research in an academic discourse community (Cope and Kalantzis, 2009). Because of this, analysis of peer-reviewed papers provides a more valuable insight into ways of speaking on Design Thinking than does investigation of non-peer-reviewed texts.

o optimise the search for data, the study makes use of 2 search engines: 'Google Scholar' and 'Locate'. The latter is available only at the author's workplace. Use of 2 search engines helped the author to find articles that either one of the search engines may have missed. The search for peer-reviewed journal articles was undertaken between 30th June and 7th July 2016. It identified 45 suitable papers.

### *Analysis of Abstracts*

This study analyses only the abstracts of the papers in the data set. The purpose of the abstract in academic articles is to "reflect fully and accurately the work reported" in the paper (Pitkin et al., 1999, p.1110). Academic discourse is condensed in abstracts, because of this they can provide a rich source of data for researchers aiming to analysing ways of speaking (Thompson and Hunston, 2003). Indeed, analysis of abstracts have been used to investigate discourse in academic fields (e.g. Hyland and Tse, 2005; Blythe, 2014; Nagano, 2014; Ghassan, 2016).

## Method

38 of the 45 papers contained abstracts. The individual abstracts were saved as UTF-8 files and uploaded into the concordancer *Sketch Engine*. Henceforth, the resulting data set is termed the *Design Thinking Data Set*. This corpus contains 5800 words. Keyword analysis and subsequent concordance analysis of keywords was conducted on the Design Thinking Data Set. The keyword analysis made use of a sub-corpus of the aforementioned British National Corpus as the reference corpus. The sub-corpus (termed ‘Written Academic’) contains a range of texts found in the “the ‘Short Loan’ collections of seven University libraries” (Burnard, 2007, unpagged; original emphasis). Short loan collections consist of academic texts which are core in their respective fields (Burnard, 2007). They therefore contain ways of speaking which are core to specific academic tribes. Specifically, the Written Academic sub-corpus consists of text from the following areas: humanities; medicine; natural sciences; politics; law; education; social and behavioural sciences; technology; computing; engineering. The corpus does not include text from art or design-based subjects. Therefore, using the Written Academic sub-corpus the reference corpus provides a good opportunity to uncover keywords used by the design research discourse community. The keywords analysis uses a tolerance of  $p < 0.05$ .

## Results and Discussion

Figure 5 shows terms with a keyword score which is associated with a 95th percentile certainty of significance. To display the list effectively it is divided it into 2 columns.

word	frequency	Score	word	frequency	Score
DT	13	2022.1	process	29	11.3
students'	5	778.4	skills	9	11.3
designer's	5	778.4	criteria	6	10.4
designers	25	548.0	employed	5	9.9
Thinking	9	350.9	contemporary	5	9.9
design	211	266.6	search	6	9.7
constructivist	5	239.0	theoretical	5	9.4
designing	10	214.2	ideas	9	8.2
Design	14	198.2	ways	12	8.1
explores	6	169.3	student	5	8.1
thinkers	8	151.4	literature	5	8.1
pedagogy	6	145.5	processes	7	8.0
thinking	86	139.8	development	21	7.9
digital	8	124.8	research	15	7.8
educators	6	118.4	traditional	7	7.7
architectural	5	101.6	style	5	7.6
solving	9	98.6	thought	12	7.4
innovation	11	83.8	environment	5	7.3
innovative	5	77.2	practical	5	7.2
architecture	5	52.1	study	22	7.1
situated	5	51.3	art	5	7.0
paper	32	41.0	science	6	6.9
styles	5	33.3	identified	6	6.7
students	34	33.1	key	5	6.3
explore	5	28.5	presented	5	6.2
reasoning	6	28.4	concept	6	6.1
learning	31	28.0	how	22	6.1
conceptual	6	25.6	knowledge	12	6.0
representations	6	24.7	related	7	5.6
framework	10	20.7	writing	5	5.5
classroom	6	18.0	practice	11	5.2
offers	5	17.8	education	12	5.0
article	9	16.5	current	5	4.9
organizations	5	16.5	term	7	4.9
interaction	7	16.0	teaching	5	4.8
argues	6	14.9	We	14	4.6
concepts	7	14.8	problem	11	4.6
media	8	14.6	questions	6	4.6
domain	5	14.4	activities	5	4.6
project	8	13.8	results	7	4.1
author	5	13.1	using	8	4.1
understanding	14	13.1	better	5	4.1
perspective	6	12.9	role	8	4.1
strategies	5	12.3	through	15	4.0
practices	8	11.6			

Figure 5: Keywords for the Design Thinking Data Set

The keyword analysis uncovered 89 keywords, however space limitations prevent discussion on all these. The following discussion focusses on themes which relate to the aims of this paper. These themes are 'Creating meta-knowledge' and 'Speaking on Design'.

### *Creating Metaknowledge*

The keywords **reasoning**, **framework**, **criteria**, **process**, **processes** and **practices** are used by researchers when putting forward broadly applicable descriptions of Design Thinking or Design Thinking steps. To illustrate, one researcher "*recognize[s] multifaceted **criteria** in the design process*"; another views "*design thinking as a **process** comprised of both linear and non-linear aspects*". A further researcher notes a "*contingent set of **practices** carried out by professional designers*". The tendency for researchers across academic disciplines to construct broadly applicable descriptions has been well documented (Kalfoglou et al, 2000). The pattern for researchers in the Design Thinking Data Set to create broadly applicable descriptions echoes this theme. When claiming broadly applicable descriptions, researchers across academic disciplines create what is termed *meta-knowledge* (Kalfoglou et al, 2000). To understand the importance of meta-knowledge in research fields, it is important to reflect on how academic discourse communities build an impression of legitimacy. Research communities attempt to describe and classify an intellectual territory which is associated with their domain (Betcher and Trowler, 2001). Creating broadly applicable descriptions of elements contained within the domain helps communities to claim more concrete ownership of the domain than do descriptions with a very limited application (Betcher and Trowler, 2001; Kalfoglou et al, 2000). In the Design Thinking Data Set, use of the keywords **reasoning**, **framework**, **criteria**, **process**, **processes** and **practices** helps researchers to make broadly applicable claims over the intellectual territory of 'Design Thinking'. Researchers in the data set are therefore creating meta-knowledge on their domain.

To recall, these keywords emerge from comparing the Design Thinking data set with a reference corpus comprised of texts from a range of academic disciplines. The presence of a host of keywords which enable researchers to claim meta-knowledge suggests that the Design Thinking research community may be particularly focussed on creating broadly applicable descriptions to engender a sense of legitimacy.

### *Speaking on 'Design'*

The term 'design' can be used to refer to a verb (e.g. designing an object or service) or a noun (e.g. an undergraduate design course). The keyword **design** is used once as a verb in data set: "*graphic designers are increasingly asked to **design** innovative solutions*". When professional designers or design students tackle a design brief, they tend to create a specific 2D or 3D artefact or service. Interestingly, in the data set, the verb-form of the term *design* does not refer to a specific object or service. Rather it refers to more abstract ideas—"*innovative solutions*". This pattern is also seen when researchers use other forms of the verb *to design*. The highly ranked keyword *designing* (present tense) consistently refers to general and abstract ideas. Separate researchers refer to "*a model of **designing***" and "*the different forms of thinking which can be observed in **designing***". Focussing on general or abstract ideas allows researchers in the data set to make broadly applicable claims when using the verb-form of the term *design*. Use of the verb-form of *design* therefore appears to help these researchers construct meta-knowledge on Design Thinking, further cementing their claims to ownership over the domain.

The process of speaking in abstract—rather than specific—terms may provide another function. It may allow researchers to separate the 'act of designing' associated with Design Thinking from the 'act of designing' associated with day-to-day design practice in professional studios and in classrooms. Put in a more distilled manner, the way of speaking on design 'as a doing word' may allow researchers to separate the domain of Design Thinking from those of design practice or design education. Framing the 'act of designing' as being associated with Design Thinking may further amplify researchers' claims to authority over their investigative domain.

Overwhelmingly, the pattern in the data set is for researchers to use the term **design** as a noun. Researchers use the term to signal a range of aspects as 'belonging to design'. It is possible to subdivide the issue of 'belonging to design' into 3 sub-categories: conceptual and intellectual ideas; practice-related classifications; people. Conceptual and intellectual ideas include "*the design process*", "*design ideas*" and "*conceptions of*

*design*"; practice-related classifications include "*design disciplines*", "*design professions*", "*design tools*"; people with design-oriented affiliations include "*design teams*", "*design experts*" and "*design professors*". Betcher and Trowler (2001) argue that academic research communities use the strategy of sub-classification to deepen their claim to ownership over their domain. In keeping with Betcher and Trowler's (2001) theory, the use of the noun-form of the term *design* to create 3 sub-classifications may help researchers to deepen their claim to intellectual territory which they associate with the domain of Design Thinking. The process appears to allow researchers to overwhelmingly frame design as an intellectual domain (a 'thing') rather than as a practice (something that people do). This further underscores the idea that researchers may create a distinction between Design Thinking and design practice.

The overwhelming pattern for researchers to use the noun form of the term *design* echoes observations made by critical theorists who study how research communities claim authority over their domain. Billig (2008) reports a strong tendency for researchers across academia to focus on using the noun-form of words. This strategy (termed *nominalisation*) instils classifications or descriptions put forward by researchers with a sense of authority:

*By turning verbs into nouns, speakers/writers can convey that the entities, denoted by nominalization, have a real and necessary existence (Billig, 2008, unpagged; original emphasis)*

The idea that nominalised descriptions come with a perceived sense of authority helps academics to frame an idea which is subjective as an objectively valid phenomenon: "speakers/writers turn processes into entities and typically assume the existence of such entities." (Billig, 2008, unpagged, original emphasis). This in turn affects how readers understand texts—readers can fall into the habit of assuming that nominalised descriptions are objectively correct (Billig, 2008). The term *market forces* is an example of a nominal in the field of economics. The term is used to denote fluctuations in finances without taking into account the actions of individual actors in financial systems. In this way, market forces have a life of their own, distinct from the actions of people who buy and sell commodities, products and services (Billig, 2008). Use of the term *market forces* has enabled economists to claim authoritative knowledge on financial systems without needing to defend the fact that they may not take into account the full range of transactions between people which create monetary systems. Use of the term *market forces* therefore enables economists to write this financial process into existence. Returning to the findings in the Design Thinking study, it is important to note that different design disciplines do not necessarily share "*design ideas*", "*conceptions of design*" or "*design tools*". To illustrate, fashion designers have different conceptions of design practice and use different design tools to automotive designers or interface designers. Furthermore, concepts like "*design ideas*" and "*design tools*" vary within a particular design discipline. Differences in design processes in the field which I teach—Automotive Design—illustrate this. Typically, in a vehicle design studio owned by a large, international manufacturer, the complete design of a vehicle is not carried out by any one particular professional. Instead, several different professionals with different specialist skills sets each work on different aspects of the overall design of a vehicle. The initial design phase is carried out by specialists who use sketching to undertake a 2D design process. Other specialists then use 3D CAD tools at a high level to create accurate 3D versions of the 2D designs. Therefore, there exists a *range* of design processes—the characterisation of each is dependent on where the specialist fits in within the overall workflow cycle and which tools he or she uses. Focussing on the noun-form of design enables researchers in the data set to frame these subjective concepts as objectively valid nominals which apply broadly across 'design' when they do not.

The results suggest that the use of nominals and the creation of meta-knowledge may enable researchers in the Design Thinking Data Set to claim authority over their investigative domain. However, the practice of claiming authority appears to require researchers to artificially separate Design Thinking and design practices when, logically, they must be intrinsically linked. The findings make it possible to speculate that use of skewed ways of speaking may help the design research discourse community to write 'Design Thinking' into existence.

## Conclusion

Existing research suggests that creating a skewed separation between the way that designers think and the way that scientists think helps the design research discourse community to claim knowledge and intellectual territory on Design Thinking. This paper has used corpus linguistics tools to further investigate ways of

speaking that the design research discourse community use when claiming knowledge on Design Thinking. The findings in this paper suggest that use of nominals and the creation of meta-knowledge helps researchers to construct the domain of Design Thinking and claim authority over it. These strategies appear to have helped to create an artificial separation between Design Thinking and the domains of design practice and education. The findings raise the possibility that the community is writing 'Design Thinking' into existence.

Kimbell (2011) has argued that critical analysis of Design Thinking research is in its infancy. This is worrying given the influence of Design Thinking both within design research and in a range of wider fields. A lack of empirical enquiry using methods which are specifically designed to investigate ways of speaking may have contributed to the lack of critical analysis. This study has demonstrated the value of using one such method (corpus linguistics) in unpicking ways of speaking used in Design Thinking research. The author hopes that the findings help to enable design researchers to reflect further on how they may contribute to creating knowledge on Design Thinking in the future. The findings may also provide a valuable avenue for readers to reflect on existing Design Thinking research. The findings indicate the need for more empirical analysis of ways of speaking which are associated with Design Thinking research.

A limited amount of insight can be gleaned from analysing abstracts using corpus linguistics. Though condensed, abstracts represent only a proportion of the overall paper. In addition, corpus linguistics tools can ignore some extent contexts which do not relate to keywords and do not involve qualitative analysis of whole sets of data. The research in this paper represents part of a wider study which the author has conducted as part of their PhD. The wider study overcomes these issues.

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