Loughborough Design School

Pot throwing: An investigation into the real-time cognitive and physical processes involved in a craft performance.

by

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Abstract

Pot throwing: An investigation into the real-time cognitive and physical processes involved in a craft performance.

The ancient pot throwing craft skill involves three elements, maker, material, and technology. It is in the meeting of these three elements that features a complex, dynamic, and constantly changing point of real-time cognitive and physical contact.

The research should be of interest to, novice potters learning the skills involved in a pot throwing performance, practitioners wishing to refine their skills through ergonomic study to optimise their pot throwing performance, and educators wishing to enhance their knowledge to add to their teaching skills.

The aim of this investigation is to provide pot throwing practitioners and educators with a better understanding of aspects involved in a pot throwing process/ performance, to enable a more inclusive approach in training; and to signpost ways of enabling a safer more efficient, ergonomic and time saving acquisition of complex craft skills.

Little academic literature has been written about the pot throwing process, in the context of real-time making and even less on the consideration of pot throwing as a performance. Data was collected, from a purposively-sampled participant population, through the use of verbal protocol, biophysical measures, digital visual observation, and a self-reporting review. Tools from both qualitative and quantitative research methods were combined to form a mixed and integrated research study. The analysis of data from the study shows explicit knowledge that a throwing performance has elements. It is in exeptional and unique tacit responses from individuals that new knowledge can be termed.

- In pre-performance activities.
- Micro reflective moments. during the throwing performance, and,
- Physical stature and muscle bulk affecting the style of throwing and sequence of defined actions e.g. frequency of adding water and

wheel rotational speed, grip pattern and posture.

The study considered the concept of expertise and the elements that make an expert. The findings of this study leads onto future research into specific pre-performance preparation based on sports metrics and biomechanical analysis associated with fingertip pressure and haptic feedback.

Keywords

Craft skill, knowledge, expertise, task analysis, mixed methods.

Acknowledgements

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Proceedings from Design Research Society EKSIG (Experiential Knowledge Interest Group) International Conference

Knowing Inside Out 2013 4th-5th July 2013, Loughborough University UK

pp271-288

Palmer,G.R.; Torrens,G.E.; Scott, D. (2012) Pot throwing: *Can an ancient experiential experience be evaluated? A study assessing experiential and tacit knowledge*.

Making: An International Conference on Materiality and Knowledge 24th-28th September 2012 Telemark University, Norway

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Glossary

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EBacc	English Baccalaureate	8
EL	Experiential Learning	70
FraIM	Framework for Integrated Methods	97
HOPI	Human, Object Physical Interraction	129
HSE	Health and Safety executive	141
HTA	Hierarchical Task Analysis	87
NSEAD	National Society for Education in Art and Design	11
RULA	Rapid Upper Limb Assessment	87
STEM	Science, Technology, English and Mathematics	7

1 : Introduction.

1.1 Research

This research contributes to finding ways in which all practitioners, whether proficient or novice; will be able to access or hone a craft experience. The author believes that the exploration of an experience through learning a skill in the craft and design world should be pleasurable. This experience could follow a journey from original design intent through to the manipulation of materials to an outcome. The experience should provoke an emotional response of individual agency to a truly original piece of craft work.

This study provides an insight into the complex craft skill of throwing a pot. It can offer awareness of the skills needed to efficiently learn the complex process of throwing a pot. As a result, more individuals may find talent in this direction and wish to pursue a career engaged in designing, throwing, and selling their ware in the craft market, contributing to the economy.

Once having learned the skills to throw a pot, there are benefits for the individual. These skills could be used in terms of health and well-being, by purely throwing a pot for pleasure in a leisure activity. An impact may have psychological benefits of an increased feeling of well-being with individuals immersing themselves in a making activity that potentially could bring economic advantages.

Alternatively, the skills could be enhanced and developed to a professional point. An individual could then engage in a positive, successful, and economic creative enterprise. This, in turn, would empower individuals with feelings of well-being, confidence and increased self-esteem.

It is important to note that this study is not seeking to take expression away from the creative process, with regards to individuals creating an art form or craft artefact. It is intended to be a structure from where the creative practitioner can perform with efficient automaticity. Which; in this study, would free the proficient pot throwing potter from concentrating on basic practical performance events. A practitioner could then perform with a greater degree of creativity.

The origins of this research began, under an umbrella term 'Action Research' using the definition that, a problem is experienced and a solution is needed (Bell, 2010, p. 6; Kumar, 2010, p. 131). The insights from this study may inform Art and Design education and craft industry sectors.

1.1.1 The author

From the author's 20 years of experience of teaching arts and crafts and design, it is felt that there is a need to learn through doing: to work with one's hands in order to explore not only the world in terms of materials, but with concepts, such as, shape, space, speed and physical forces and emotions. During extensive work of more than 10 years in an additional needs environment, it was evident that students needed clear and unequivocal instructions when learning a craft skill such as sewing a simple item or creating a pot in clay. The students would then be encouraged to apply the skills to a craft project. Individual agency is important for self-learning.

The questions that brought the author to undertake this study were:

1. What exactly happens as a potter throws a pot on the potter's wheel?
2. Which skills are needed for the throwing process in real time?
3. What is needed for an efficient and ergonomically, effective transmission of skills, for all who wish to throw pots through this method?

Questions

Kogan Page discusses the need for research questions 'Research is concerned with seeking solutions to problems or answers to questions' (Allison *et al.*, 1996, p. 4).

Therefore, research needs a question which then constitutes the research topic. The discussion then continues to elaborate about questions which are then raised within the research topic. Each will need an answer. Whereas Kumar (2010, p. 20) terms the question element a research problem. Fink states that 'A research question is a precisely stated question that guides the literature review'(2010). Cohen et al discuss questions, and the type that could be asked, open, closed, long, short, the suggestion is that a research question should be 'open', requiring more than a 'yes/no' answer, and should be lengthy, providing scope for full answers (Cohen, Mannion and Morrison, 2007).

The author is curious about the combination of mind, body, material, and technology in a craft skill as complex as pot throwing. The interactions between the elements and the relationship responses of body to material and body to machine connected with the mind at key points during the process.

1.1.2 Research Aim

The following research aim is based on current knowledge and has been developed throughout the duration of this study.

'The aim of this investigation is to provide pot throwing practitioners and educators with a better understanding of aspects involved in a pot throwing process/ performance, to enable a more inclusive approach in training; and to signpost ways of enabling a safer more efficient, ergonomic and time saving acquisition of complex craft skills.'

This compound overarching aim can be simplified by identifying separate elements:

- Amplified understanding of the throwing process for pot throwing practitioners and educators.
- To signpost key elements in a throwing performance to enable individuals to experience the learning of a complex craft skill in an efficient, ergonomic, and timely manner.
- Increased understanding of the role of decision-making in a complex performance.

The elements of the overarching aim can be investigated through research questions. By defining the elements of the pot throwing process; there will be a better understanding of the throwing process and associated decision-making. The elements can then be adapted as to enable inclusivity.

How the aim may be achieved, is by a series of objectives. By investigating the pottery throwing process specifically; observing and defining the interaction between potter material and technology. Skills, pressures, and forces involved may be analysed, with a view to adapting the process information gained from observations. This may give insights to making the process both inclusive and accessible. It would need to enable the feeling of craft skills, the essence of making, using clay, by formatting as closely to a potters' activity as a real-time craft activity. The outcomes can then be used with the education sector and be useful and informative to the industrial sector; as well as impacting on the Art, Craft and Design sector.

1. Define attributes involved in the physical performance of pot throwing; by observation of the movements of a potter whilst engaged in a pot throwing performance.
2. Identify critical moments in a pot throwing performance, which will then be investigated more completely, in order to ascertain the elements needing explanation.
3. To explore tacit and heuristic decisions made by a potter when engaged in the real time activity of throwing a pot.

1.1.3 Objectives

These initial three objectives will enable the outcome objectives.

- To enable practitioners to perfect their skills to improve efficiency thereby allowing freedom for greater creativity.
- To aid educators in the transferring of pot throwing skills objectively and efficiently to the next generation of potters, to be as time and energy efficient so as to be increasingly conservative in energy use.
- To detail body posture during a craft performance.

Figure 1-1 details the research aim, questions, objectives, and outcomes in chart form.

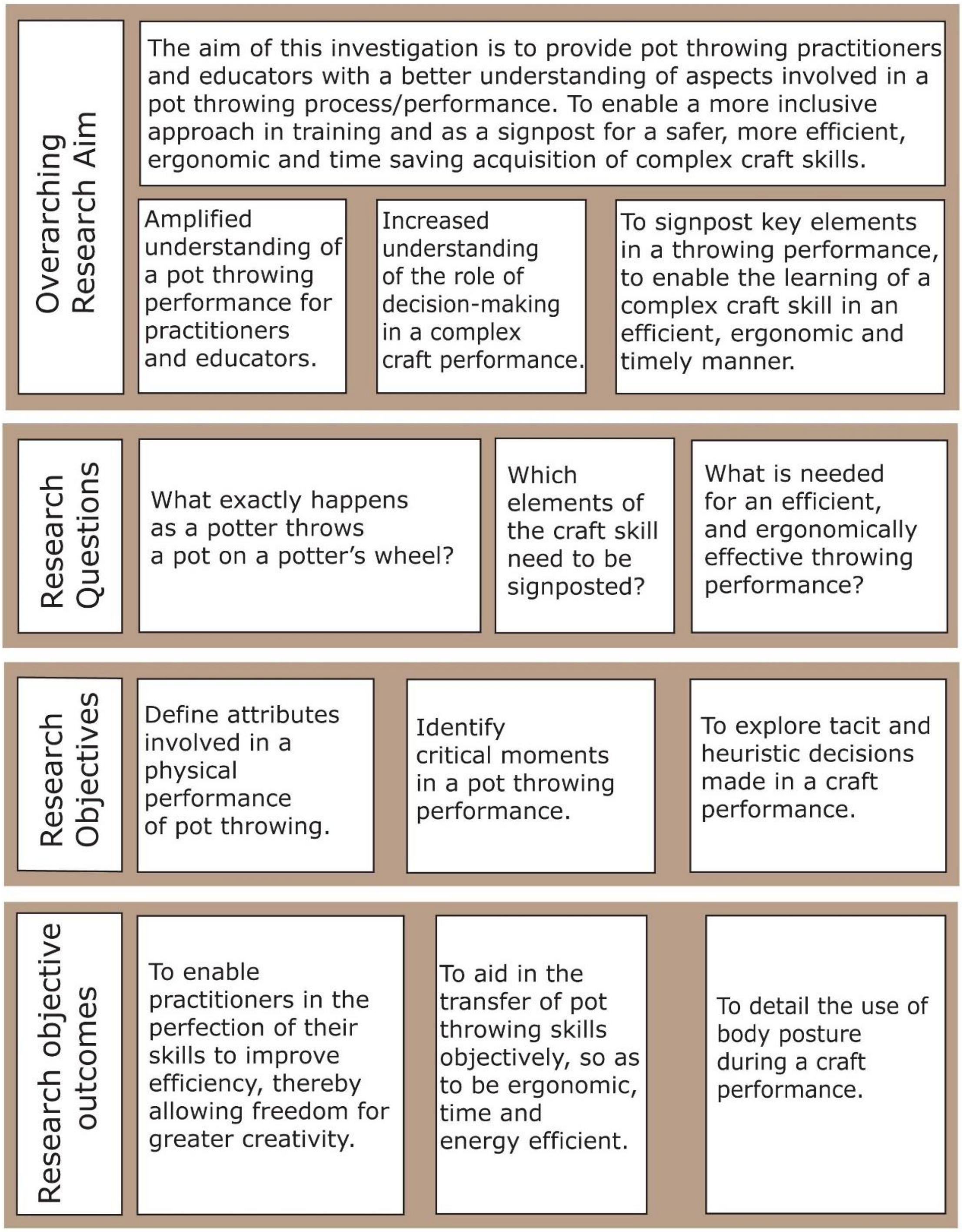

Figure 1-1:Research Aim, objectives and questions.

1.1.4 Scope of the research

This study covers the throwing method of production of a cylinder ceramic pot. The focus of this study is throwing a pot using an electrically powered potter's wheel. Figure 1-2 outlines where this method of ceramics production is placed, in context, of other methods of pot making. The outcomes of the research could be applicable to other techniques of making, but due to time and research constraints, the research project is restricted to a western method of pot throwing as taught and practiced on electrically powered potter's wheels in England.

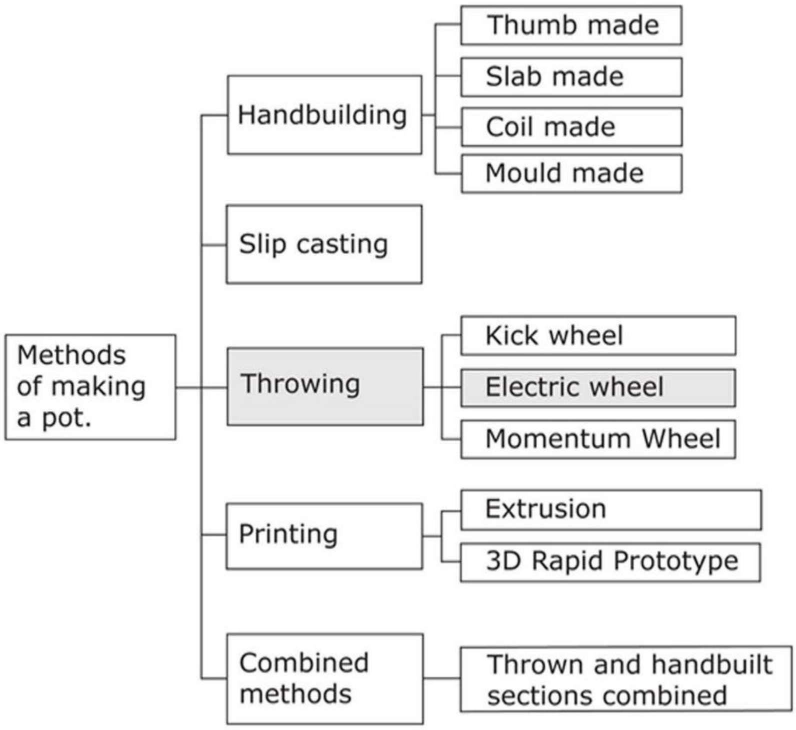

Figure 1-2:Common methods of pot making compiled from Scott 1998.

1.1.5 Research audience

The research should be of interest to:

- Novice potters learning the skills involved in a pot throwing performance
- Practitioners wishing to refine their skills through ergonomic study to optimise their pot throwing performance.
- Educators wishing to enhance their teaching of skills involved in pot throwing.
- Industry, to refine semi-automated and automated processes.

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1.2 State of Arts, Crafts and Design

This section discusses, Art, Crafts and Design in Education, continuing to consider the creative economy.

1.2.1 Education

There has been a steady government-led decline in the teaching of craft skills in compulsory education up to the age of 18. STEM subjects are favoured in school attainment. Compulsory Education in the maintained local authority sector is divided into five Key Stages. Table 1-1 outlines key stages in compulsory education. Art and Design has space in the curriculum until the end of year 9 and then they become optional creative subjects.

Table 1-1:Key stages in compulsory education.

	Year Group	Ages	Comments
Early Years	Foundation	4-5 years	EYFS (Early Years Foundation studies)
Key Stage 1	Years 1 and 2	5-7 years	End of Key Stage attainments.
Key Stage 2	Years 3 to 6	7-11 years	End of Key Stage attainments
Key Stage 3	Years 7 to 9	11-14years	End of compulsory Art and Design studies
Key Stage 4	Years 10 and 11	14-16 years	Optional Level 1 / 2 qualifications e.g.GCSE, BTEC
Key Stage 5	Years 12 and 13	16-17 years	Optional level 1 /2 /3 qualifications e.g.GCE A levels, BTEC, GCSE
	Years 14 +	18-21 years	Available in Special Education

The Art and Design curriculum area was developed to a peak in 2007. It was with this review that the curriculum was being made to be more meaningful to the students. Creativity was included in the Art and Design curriculum, recognising it was a sought-after skill needed in the workplace. A creative curriculum briefly emerged with lesser prescriptive elements than previous curricula Thus, the Key Stage 3 curriculum was transformed into key concepts, which enveloped some previously undefined areas, encompassing the strands of: competence, creativity, cultural understanding, and critical understanding. As the government changed, the curriculum focus shifted away in an opposite direction away from the arts to traditional academic subjects, the subject has suffered a decline in depth and creativity, indicating that students should 'develop their ideas and increase in proficiency in their execution'. They should also develop 'critical understanding of artists, architects and designers, expressing reasoned judgements' (Department for Education, 2013). With the statutory 2013 curriculum orders, the arts subjects had been omitted from the proposed 'EBacc', which included solely traditional academic curriculum subjects (Department for Education, 2011). This action would potentially damage both training opportunities and entrepreneurial activity in the creative sector. However, as education is cyclical there is the possibility of Art, Craft and Design being taught comprehensively again. There will be generations who will not will not have had the opportunity to be creative.

Art, Craft and Design are three interconnected areas. Surrounding Fine and Applied Arts and Design are 'skills' needed to create and work in these fields. Their skills are overlapping; but each community has differing vocabulary terms. Figure 1-3 shows the considerable overlap of these fields and aids the clarification of the position and context of pot throwing in the arena of creative industries. The three main strands displayed in the diagram are defined as:

- Fine Arts, the making and studying of arts for its' aesthetic and intellectual value.
- Applied Arts, the application of design and aesthetics to primarily functional objects and everyday use sometimes termed 'Crafts'; and,
- Design, this is the area linking creativity and innovation. Design may be described as creativity deployed to a specific end. (Cox, 2005)

Craft overlaps Applied Arts and Design and highlighting ceramics as the clay material can be used in both areas with potentially differing purposes. There are other materials used in crafts which are used in a similar fashion, e.g. wood, metal, stone, and glass, which would have different purposes in design.

Applied Art bridges the area between Fine Art and Design, as it incorporates, aspects of both fields. It is defined as 'arts that are put to practical use' (Collins English Dictionary, 2013).

There is no precise definition of the term 'craft'. Pye explains that the current understanding to the term 'craft' 'has been deeply coloured by the Arts and Crafts movement' (Pye, 1968, p. 27), which was an uprising against the industrial revolution of 'machine dominated production', to producing objects with more integrity (Victoria and Albert Museum). Although craft, is understood to be 'an activity involving skill in making things by hand'. The Crafts Council has collated several definitions and interpretations from individuals working in the industry. There seems to be a lack of consensus for a single encompassing definition.

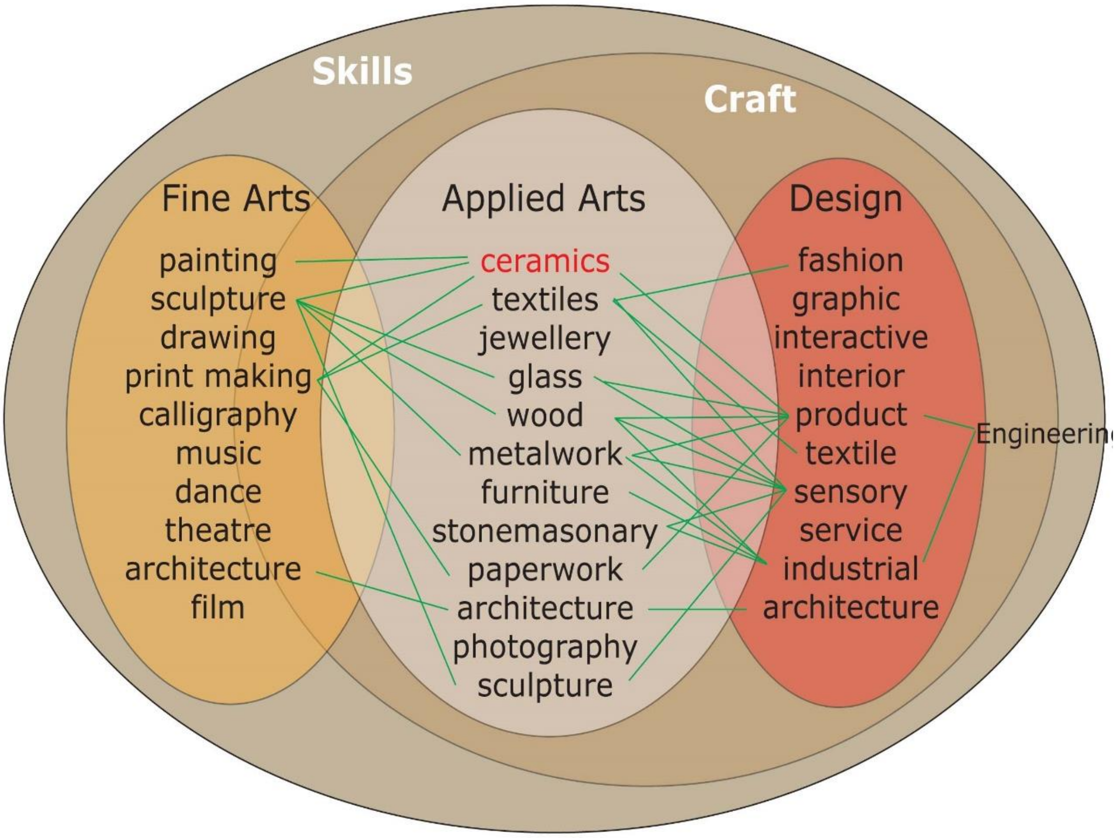

Figure 1-3:Area of Fine Arts, Applied Arts, Craft, and Design.

Figure 1-4 illustrates the collection of interpretations and definitions. The larger the word the more times it has been mentioned in the definitions and comments. Key important vocabulary words from the word cloud, 'Wordle$_{TM}$' commence with craft, materials, making, knowledge, objects, design, meaning and processes.

Figure 1-4:A Wordle$_{Tm}$ of definitions of craft.(Crafts Council 2010).

Figure 1-5 displays analysed craft definitions resulting in links between similar words by NVivo10. Some pairs of words are more abstract links for some pairings, e.g. hand-made and innovative and critical enquiry, and workmanship. This is an alternative method of expressing themes of categorised the definitions and interpretations. Making and process have been linked for similarities, as have creativity and expression. There is an interesting link made between 'hand-made' and 'innovative' which suggests that crafts are original and novel. There is a key link made between material and processes, which is also linked with, skills, materials, knowledge, aesthetic, and technology. All are integral with craft activities. A curious link for word similarity is between 'Genre based practice' and the pairing of both 'Critical enquiry and Workmanship' and 'Physical and Selling' based on definitions of craft.

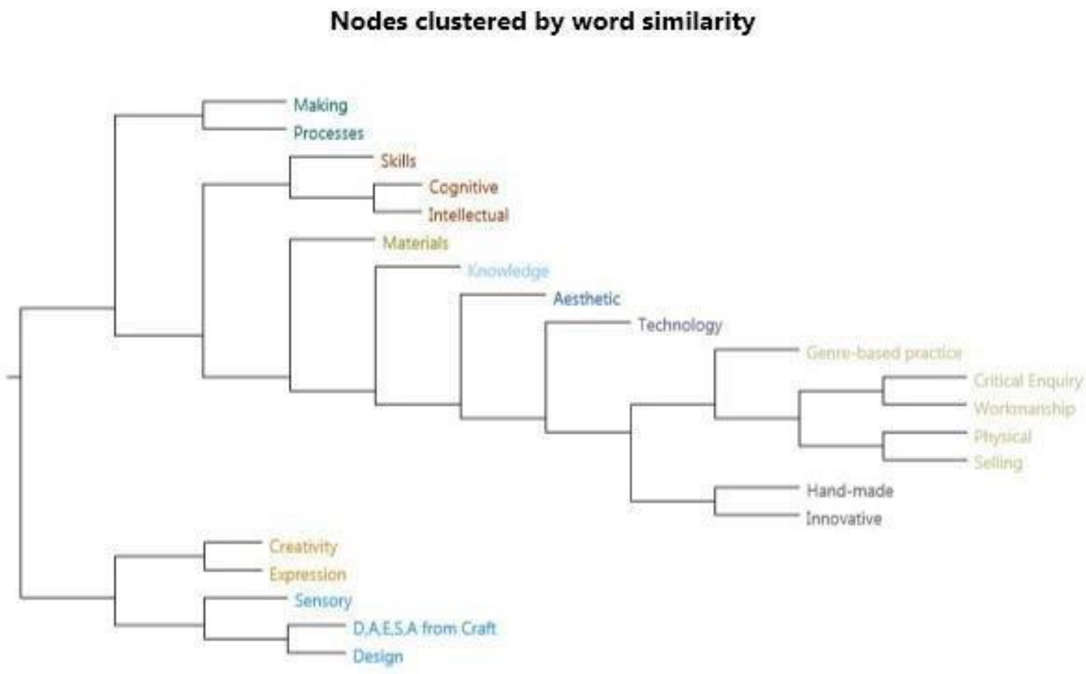

Figure 1-5:Definition words analysed by NVivo10.

The National Society for Education in Art and Design has worked on a definition of craft, which captures the essence of craft.

> *'Craft can be defined as intelligent making. It is technically, materially, and culturally informed. Craft is the designing and making of individual artefacts or objects, encouraging the development of the intellectual, creative and practical skills, visual sensitivity and a working knowledge of tools, materials and systems'* (NSEAD, 2013).

1.2.2 The Creative Industries Economic Sector

This section outlines the wider economic background for a potter to be economically viable. Should there be few opportunities to contribute economically, this would then transform an outcome of this project, of being of interest and informing industry. Research projects have been undertaken, focussing on the creative industries sector by the Crafts Council and the government of the United Kingdom (UK). These confirm there are prospects of an economic contribution to be made from pot throwing businesses.

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The UK is an international hub for 'creativity and commerce' as outlined in 'Best of British' (Department for Business Innovation and Skills, 2010). Crafts has been a difficult area to quantify as data has been problematic to gather. There are many small craft 'units' or craft businesses which do not fulfil the data collection criteria, based on statistics of size, number of employees and income (Department for Culture, 2010) and therefore are not recognised. A Crafts Council research document, Making Value', redresses recognition by describing craft as sitting 'squarely within the creative economy' and that craft has a unique role to play in a changing economy and society (Schwartz and Yair, 2010, p. 4). .'Making Value' collected craft data using a selected proportion of grounded theory methodology (ibid, 2010, p. 118), rather from a statistical return employed by governmental figures. The research reports findings that the craft sector contributes over 6.2% to the UK economy (Department for Business Innovation and Skills, 2010) realising a £3 billion contribution for the UK (Yair *et al,* 2012). The wider creative sector competes in a global market, realising 7% of global Gross Domestic Product (GDP) (Department for Business Innovation and Skills, 2010). 13% of the UK workforce is employed within the creative industries sector, which translates to approximately 2 million individuals engaging in creative sector employment (ibid, 2010).

Partly creating the £3 billion contribution to the UK, are 11.3 million consumers of original pieces of craft (Schwartz and Yair, 2010, p. 4). These original pieces of craft include hand-made and not mass-produced items, pieces of woodwork, pottery, glasswork, textiles, and sculpture. This short list is not a complete inventory of UK crafts. The craft community has many more consumers, than for example, Fine Art. When the Crafts Council report, 'Craft in an Age of Change' researched into practitioner craftsmen, those individuals who make craft to earn a living, rather than crafters who make and sell as a hobby. It was discovered that the sector is dominated by 'small well-established businesses' and that the characteristics of makers have changed little since the early 2000's. The report highlights that craft sales remain generally locally focussed with few exports. These businesses, despite being successful have a turnover too small to be recognised in governmental data collection mechanisms.

1.2.3 The UK craft sector to 2013

It is important to discuss, here, the wider economic issues of, innovative activity, exploring different avenues of making, in the craft sector. Often traditional practices are mixed with new technology. The craft sector market has survived recessional times, from 2008 when firstly, there was a global financial crisis, followed by a European crisis and then a UK financial crisis. The revenue raised from the wider creative sector is a similar total to the financial services sector (Department for Business Innovation and Skills, 2010). Some potters work on a small local scale, others nationally and a few have international recognition. Industrially, the ceramic industry has seen much production taken over by foreign owners and transferred abroad, where fabrication costs are less expensive. Some factories have remained in native control, retaining traditional fabrication methods. ‘Emma Bridgewater’ is one such firm; their specialism is in domestic pottery ware (Bridgewater, 2010).

The expanding technological market has had a significant impact within the last decade on what can be described as ‘craft’. Previous thinking is now being questioned and explored, and boundaries are tried, tested, and extended with the involvements of research methods. Some practicing potters are investigating the use of digital technologies in their work. Figure 1-6 displays an early digital piece from Michael Eden (2010). He had been a ‘traditional’ studio potter. Eden started a research study, which has resulted in his pots being created by a method totally alien to craft potters. He created by drawing, then using 3D software, traditional hand skills and digital technology, including rapid manufacture and non-fired ceramic materials in the development of this work. He approached a traditional classical shaped vessel from the Wedgwood Collection (ibid, 2010) and reconfigured the making of the vessel from traditional methods to using digital designing and printing technology.

Figure 1-6:Wedgwoodn't © Michael Eden with permission from Adrian Sassoon.

Another traditional potter, Matthew Tyas, has innovated through research. An example of his work is shown in Figure 1-7. is a direct result of research. Tyas was investigating how digital technologies might impact on traditional craftsmanship and how outcomes may be achieved (Tyas, 2014). He worked alongside Leach Pottery in St.Ives (Leach Pottery, 2015).

Figure 1-7:'Echoes of Leach' © Matthew Tyas.

Jonathan Keep (2013) has embraced digital technology in the form of utilising the method of 3D printing technologies to develop his range of printed ware. On a larger scale Denby$_{TM}$ Potteries (2013) has collaborated with the Centre for Fine Print at the University of West England, to develop digital capabilities for designing new ranges of tableware, especially during the prototype stages.

1.2.4 Summary

In this initial chapter, the background to the study has been discussed including the important concept of individual agency. The area in which crafts are outlined and expressed. An overall view of the financial attributes was discussed, showing there could be economic viability of a career within the creative industry. Education and training at present, are not indicative or reflective of positive industrial possibilities. The outcomes from this research should guide towards a more efficient method of throwing a basic cylinder pot, allowing increased creativity to flourish, secure in the knowledge that throwing practices are safe and sustainable, using maximum creativity with a minimum impact on the body. This would be of interest to novice throwing potters, experienced potters and educators transferring the knowledge of this intricate crafts skill.

1.3 Outline of thesis

Chapter 1 provides the setting for this research study in terms of economic validity, a continuing creative sector, education provision for craft education. It sets out research aims, objectives and defines preliminary research questions. Research questions pertinent to the original premise for the study and gaps in knowledge as highlighted from the comprehensive literature review.

Chapter 2 begins with an extensive explanation of a literature review strategy. It explains a scaffold for a thorough efficient, narrative literature review. This structure can be applied to both small- and large-scale research projects. The Literature review has been grouped into sections of literature pertinent to the pot throwing process.

Chapter 3 reviews and considers qualitative and quantitative research methods. It provides an explanation of which mixed methods were selected,

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providing a rational for the study.

Chapter 4 initiates a discussion of findings from study, analysing research results from the study participants. Physical results are discussed and performance data of timings and wheel speed.

Chapter 5 compares and contrasts elements of anthropometric and performance data between participants and genders searching for patterns in the data.

Chapter 6 reviews Research methodology, the use and efficacy and limitations..

Chapter 7 concludes in terms of rationalising research aim, objectives and questions using performance data details. It suggests areas for future research.

2 : Literature Review

'You cannot open a book without learning something'.

Confucius

The quotation is apt to begin a chapter about literature. All literature, whether paper or digital has some facet of detail which can increase knowledge.

This chapter will explore a systematic structure of a literature review. It will then provide descriptive findings in a literature review focussing on an extensive review of literature aspects concerning a pot throwing performance. Figure 2-1 outlines the groupings of literature themes, creative literature, equipment and ergonomic sources, material and throwing process texts. These are then followed by human aspect literature, knowledge, skills and experience, texts concluding the review with task analysis and health and safety information literature.

2.1 Literature Review strategy

This section addresses and outlines a method or structure by which a systematic and focussed literature review may be achieved in the craft field of pot throwing.

Firstly, there was a review of popular and academic literature concerning aspects of a pot throwing performance. The search extended widely across diverse subject areas of craft, to enable a definition, neurology to investigate sensory aspects of touch and sensory connections. Physiology was considered to inform anatomy enquiries, biomechanics was included to inform about body structure and movement in particular, as outlined in Figure 2-1.

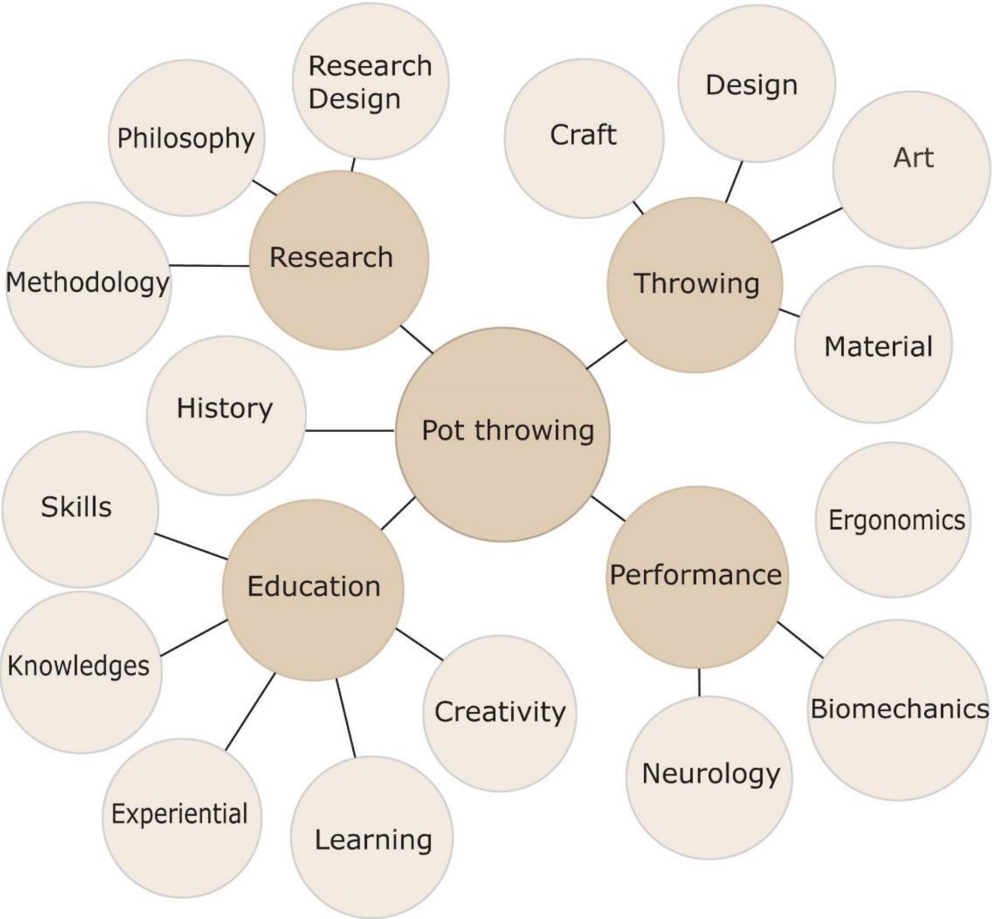

Figure 2-1:Subject areas included in the literature review.

In order to review a maximum of relevant literature, a systematic structure was necessary. Fink (2010), Hart (2001),Bell (2010) and Kumar (2010) provided a skeleton structure for the literature review. Figure 2-2 displays the literature review structure utilised by this research study.

Three areas need to be defined at the start of a literature review, the research question area, the search terms, and bibliographic databases. Without these elements, the review may wander rather than be methodical. Once these are in place a ‘practical screen’ is applied. The purpose of a practical screen is to define the parameters of the search. For example, literature published prior to 1940 might be excluded from the search, or perhaps literature published in other languages apart from English might be excluded (Fink, 2010, p. 59). A methodological screen was then applied.

This considers the screened literature for structure, quality, and validity (ibid, 2010, p. 63).

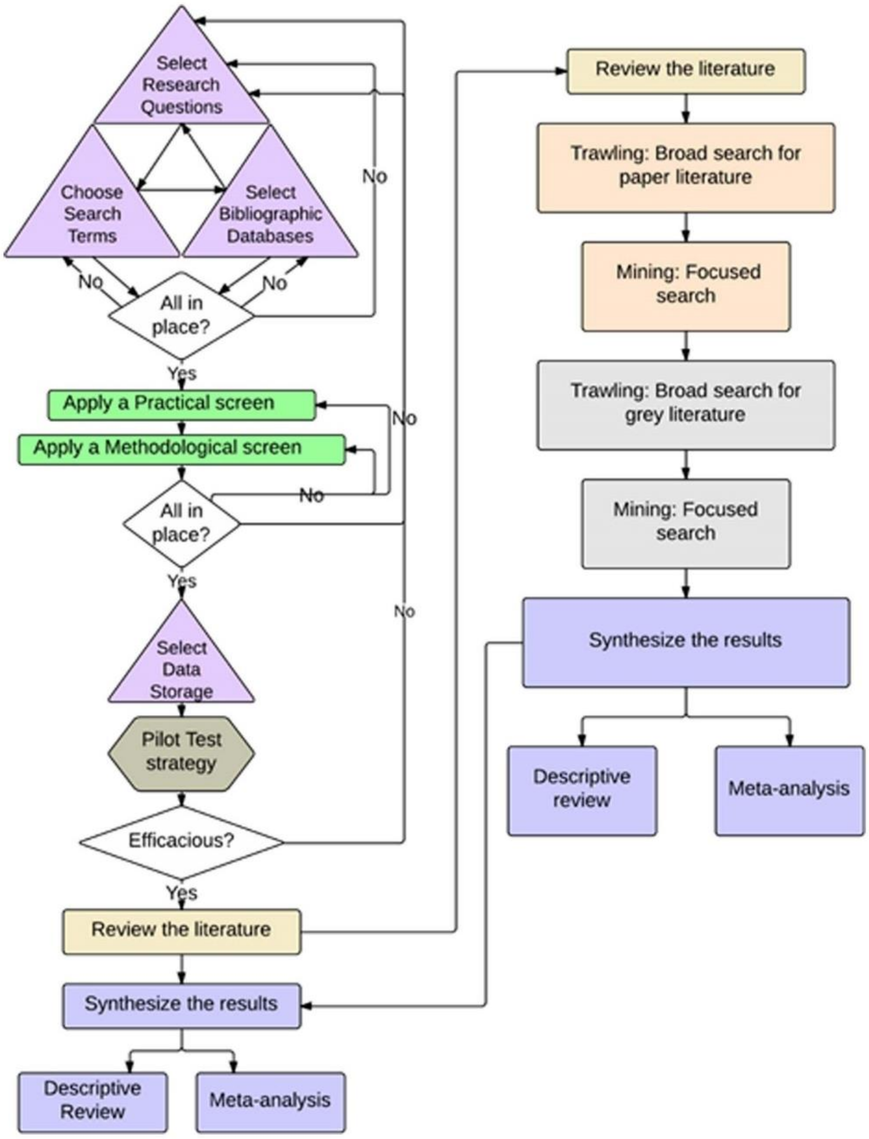

Figure 2-2:Structure of the literature review with combined elements.

Consideration was given to a method of literature recording before a pilot run of the structure was tested. At any point, each element can be reviewed and modified as necessary, checking again the elements are appropriate with another pilot run of selecting literature data. When all appeared to be satisfactory, the literature review commenced. There are periods where the literature was trawled for relevancy and then mined to eliminate any unnecessary items and leads followed gained through bibliographic data. The process was repeated with digital and electronic data, using the techniques of both trawling and mining.

Trawling occurred with a wide sweep of appropriate literature, from a variety of sources. Mining followed lines of enquiry through reference material and bibliography detail. Figure 2-3 outlines a system for trawling and mining literature as described by Hart (2001, p. 29). The literature review concludes with a synthesizing of the focussed material into a narrative review and where appropriate a meta-analysis. A meta-analysis is 'simply the analysis of other analyses' (Cohen, Mannion and Morrison, 2007, p. 291).

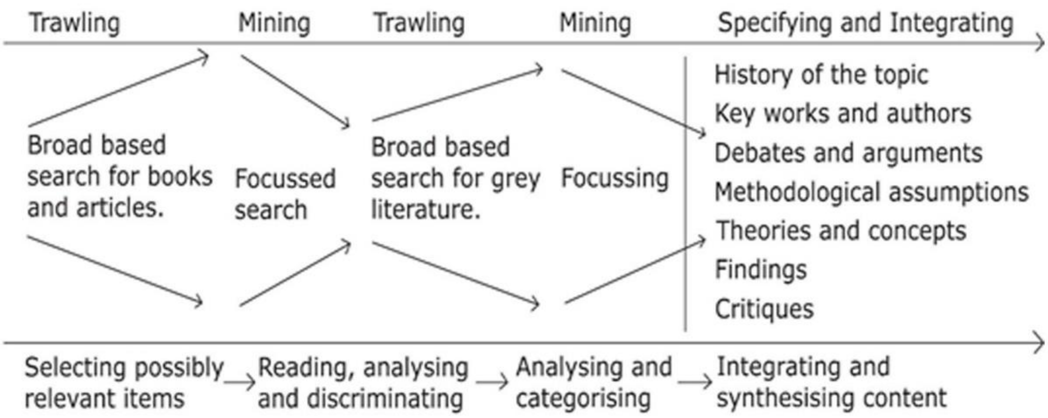

Figure 2-3:Trawling and mining of literature (adapted from Hart).

For this study, a strict meta-analysis has not been achieved due to the lack of research studies in the area for comparison. However, a review has been completed on the availability of relevant craft literature.

Bell (2010), explains that any question posed, must mean the same to all respondents involved. Kumar (2005, p. 46) discusses making lists of questions for each area of the project, selecting the most personally interesting to follow. The questions formulated for this study have taken the views of all three authors, Hart, Kumar, and Fink, into consideration.

2.1.1 Phase 1: Choosing search terms and keywords

Fink suggested finding bibliographic databases. Initially, it was found easier, by the author, to select search terms prior to deciding upon bibliographic databases and websites. The author understood certain terms and knowledge e.g. ceramic art, bodies, and pot anatomy, whereas information about bibliographic databases was less well known.

Keywords are an important part of a literature search process, as Bell discusses that time can be wasted on irrelevant items especially when terms and keywords are roughly refined (2010, p. 84). When chosen keywords return few documents, Hart (2001, p. 10) suggests using a thesaurus to expand keyword search terms or when too many documents, a thesaurus may be used as a refinement for a keyword search term. Fink (2010, p. 20) suggests using terms found from academic papers to inform a keyword search. Kumar (2005, p. 32) barely touches on the need for keywords in literature searches; but suggests that by balancing a search with a subject / library catalogue search and a theoretical framework literature can be found. Torrey et al (2009) discuss challenges of finding the exact keyword to return desired information when searching digitally. Problems, faced here, were of language, not being certain of terms used for either process or tools in other areas. An example that can be used in this instance is the term 'ceramics.' The word 'ceramics' has many uses in both artistic and industrial settings, but differing meanings, although dealing with essentially the same material, but in vastly different ways. The understanding within the arts and crafts communities, is that the term 'ceramics' can be used acceptably to define artistic work with clay. 'Ceramics' in industry has a hugely different meaning, which resulted in the author discovering a tangential and wide variety of literature concerning thermal ceramics and their applications within an industrial setting. Figure 2-4 demonstrates the changes in keywords.

The phrase 'pot throwing' resulted in more acceptable targeted literature, however; it is not a term frequently used by the craft community for the activity of throwing a pot on the wheel.

Keywords were selected from the feasibility research statement. The original keyword list was throwing, ceramics, inclusive, ergonomics, impairment, and pot throwing. These keywords were then used for searching literature. The keywords changed and adapted as the research developed.

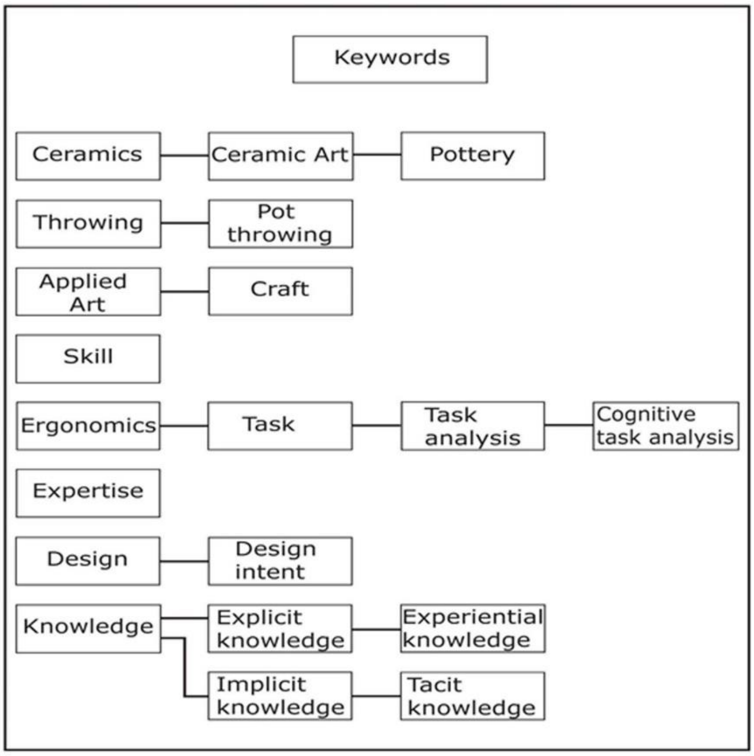

Figure 2-4:The development of keywords.

2.1.2 Selection of bibliographic databases

The 'Catalogue Plus' section of the Pilkington Library site provides access to a variety of bibliographic databases. These are categorised both as possible types of material in which to search and a department specific number of databases which can proffer relevant material, e.g. British Library, Science Direct (Elsevier) and JSTOR.

2.1.3 Boolean search

A Boolean search is a well-recognised system of logic used in literature searches. It uses three words; OR, AND NOT to instruct data bases and search engines which words to include and/or exclude which then expand or focus the research area. The term OR increases the number of search results using a keyword and an alternative possible keyword. The use of AND reduces the number of search results, having limited scope of the search to include a keyword. A NOT term again restricts the search possibilities by eliminating a specific word from the list of results. Furthermore, each search can have combinations of the three terms used, (Phelps and Fisher, 2007, p. 132). During the search of available and pertinent literature, a need arose for a database, to be able to locate and access references, both easily and quickly. When searching if there were any questions, search terms or bibliographic databases seeming to be ineffective, the strategy allows for tweaking measures or to rethink behaviour by referring to the point of selection. Then proceeding through the elements until satisfied. Once satisfied, the application process can commence.

2.1.4 Phase 2: The application of a practical screen process.

When applying a practical screen, one is limiting and setting boundaries for the terms of the search, including, or excluding literature perhaps in age of reference, publication language or research design. Hart (2001, p. 31), Fink (2010, p. 59) and Bell (2010, p. 83) discuss setting boundaries for a project. An example of such boundaries can be seen in Table 2-1. This practical screen serves as a lens to focus on literature relevant to the research.

Table 2-1:Setting review boundaries for this study.

Screen tools	Application
Temporal parameters of research	*Literature published after 1940*
Publication language	*English*
Research Design	*Observation: Phenomenological*
Time	*Limited to 1 researcher*

A methodological screen, according to Fink, screens for relevant research methods and research design, considering how participants, e.g. are organised, and measured. A brief search of the term 'methodological screening' resulted in Fink (2010, p. 62) being the sole name mentioned in connection with the thesis step in the strategy.

This screen was less easy to apply with the focus of the current study, due to being neither wholly qualitative nor quantitative; and, using the strategy of 'mixed method' research where both complement the other, providing a more satisfactory informed result. There were no examples from craft studies; some discussion from Teddlie (2009) used an example from sociological studies.

Should screens need modification, then there is opportunity to do so at this point. Once satisfied that the structure is in place for the strategy pilot test, the question of data storage needs to be decided.

For the purposes of this research, the information is stored in 'OneNote 2010'. 'OneNote' is an idea processor, a notebook, an information organiser from the Microsoft Office suite (Microsoft, 2010). The programme has workbooks which can be customised for use. Pages contained in the file folder can be used for storing references found from searches and can be organised e.g. in subject, use order or date order. Paper notebooks were utilised for pen and paper notes storage.

Refworks (Proquest LLC, 2009) and Mendeley (2014) were used as database storage of references, both easily accessible from a variety of devices. The reference database recommended by Loughborough University is 'Refworks', an online research management system. It is with this framework that sources are categorised, stored, and cross-referenced and can be shared.

Literature can be categorised not only by subject but also by source. Figures 2-5 and 2-6 demonstrate by outlining 'Paper literature' and 'Digital literature' sources. The literature searches extended beyond the Pilkington library at Loughborough University, through to other library catalogues including the British Library collection, for both paper and electronic sources of information. SCONUL access was also utilised.

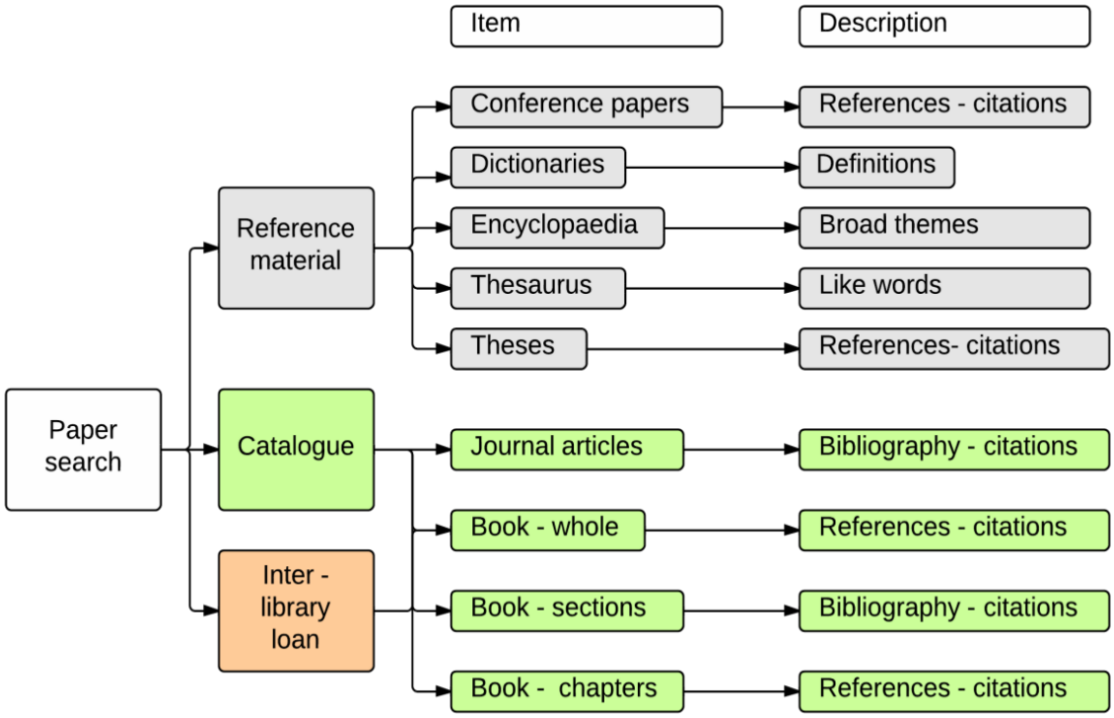

Figure 2-5:Paper literature searches.

2.1.5 Phase 3: Pilot testing.

Pilot testing, also referred as, a feasibility study or exploratory study, Kumar explains, is carried out to 'develop, refine and/or to test measurement tools and procedures' (2005, p. 10). Therefore, it has been necessary that the reviewing process was pilot tested. With the introduction of each new screen criteria of inclusion or exclusion, the process was pilot tested, to test the validity of each action. Pilot testing has been more effective and productive, with each developing are of literature.

Paper sources are becoming digitised, although there are paper copies and paper books, the same content is becoming accessible online.

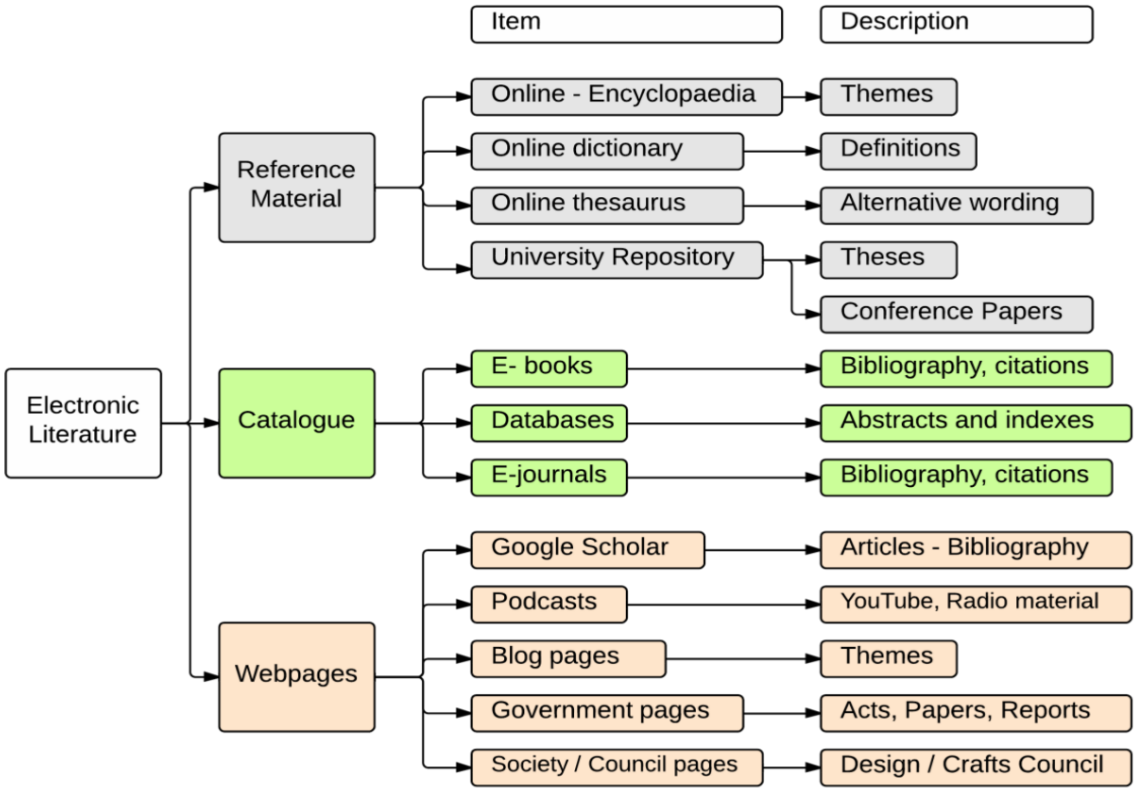

Figure 2-6:Digital literature searches.

Paper approaches to completing a literature review is a requisite of most literature concerned with the subject of completing a research project. Digital searches are able to access wide range of worldwide literature.

2.1.6 Phase 4: Reviewing the literature.

The author has found the process of review to be a cyclical process. The initial review revealed there was a gap in knowledge. The second and final review updated and expanded the initial review. The focus changed from a basic review to one with a more searching focus. Quality of literature, being compiled, was constantly monitored. Peer reviewed journals and, quality books were selected, also, web pages and digital documents were sourced, carefully. This stage went through a structure of trawling and mining as seen in Table 2-2. Trawling occurs as a researcher is looking for material from a keyword. When mining occurs, the search becomes more discriminating following links and themes.

Table 2-2:Example of trawling and mining literature, adapted from Hart (2001).

Stage	Trawling / Mining	Example
Broad literature search through books and articles	Trawling	Ceramic Arts from 1940
Focussed search	Mining	Following authors and citations
Digital literature search	Trawling	Craft / pottery
Focussed search	Mining	Authors / webpages
Specify and integrate	Categorising pertinent literature	

2.1.7 Phase 5: Synthesising results

When synthesising results from a literature review, Fink suggests two outcomes, the first, a descriptive review outlining and discussing current themes and the quality of the material, concluding whether there is need for further research. The second outcome, a meta analyses of material available 'to reach conclusions from a body of research' and to uphold the methods applied to the literature review. Cohen and Manion (2007, p. 291) define meta-analysis as being 'simply the analysis of other analyses'.

The use of the term 'meta-analysis' here, reflects the source categories of material, the age of the material and the themes of material. Figure 2-7 indicates there are far more journal papers than materials from other sources, making up 58% of literature. These have been sourced in paper form and digitally.

1940 was the starting time limit for this literature review. Publishing was depressed throughout World War II but started to re-emerge as demand outstripped the ability to publish (Feather, 2006, p. 194). Feather also noted that certain themes were popular e.g. agriculture and animal husbandry, whereas others such as naval and military matters were not (ibid, 2006, p. 194). It could be supposed that after the war the public wished to supplement rationing by 'growing their own'. Art, craft and making books would have increased in popularity for help in making clothes and knitted items, in post-war Great Britain.

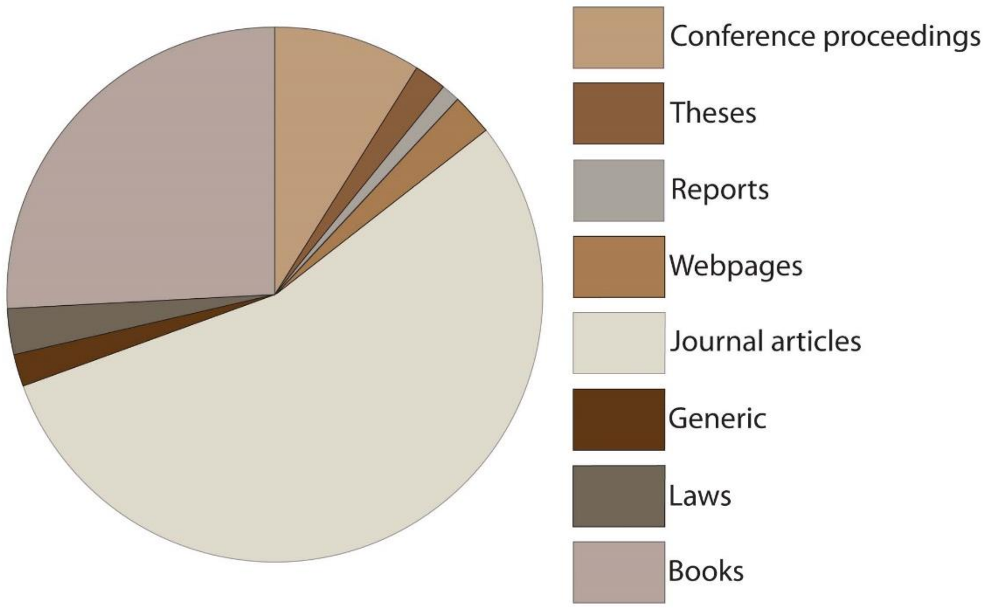

Figure 2-7:Sources of literature.

The availability of published academic books, in this review, increased in availability from 1965 onwards, culminating at a peak in 2009-2010. This may be bias, on the part of the author, from seeking current published material. Certainly, pottery books were widely published, post 1965, three examples among many explaining the technique of throwing (Colbeck, 1969; Clark, 1970; Leach, 1976).

Figure 2-8 demonstrates the temporal spread of reviewed published literature. Alongside the expansion of printed texts from different interests, was the gathering of broadcast material, culminating in a digital explosion with the introduction of podcasts in 2005 (Rowell, 2011). Podcast material complemented the availability of literature. At this time, research within the crafts area was expanding. The Crafts Council research projects became available to view in the 'online hub' section of their webpage. These feature general crafts industry topics for example 'Crafting futures' (Hunt, Ball and

Pollard, 2010). Arts Council England researches nationwide impact of Arts and Culture, and addresses areas of need e.g. young people needing more opportunities to become engaged in the Arts. ADIT, (Sheffield Hallam University, 2006), Art and Design Index to Theses, lists thesis titles of published works from 1950's to present, but few titles have been contributed since 2006. There were no studies included in the list investigated the craft skill of throwing a pot.

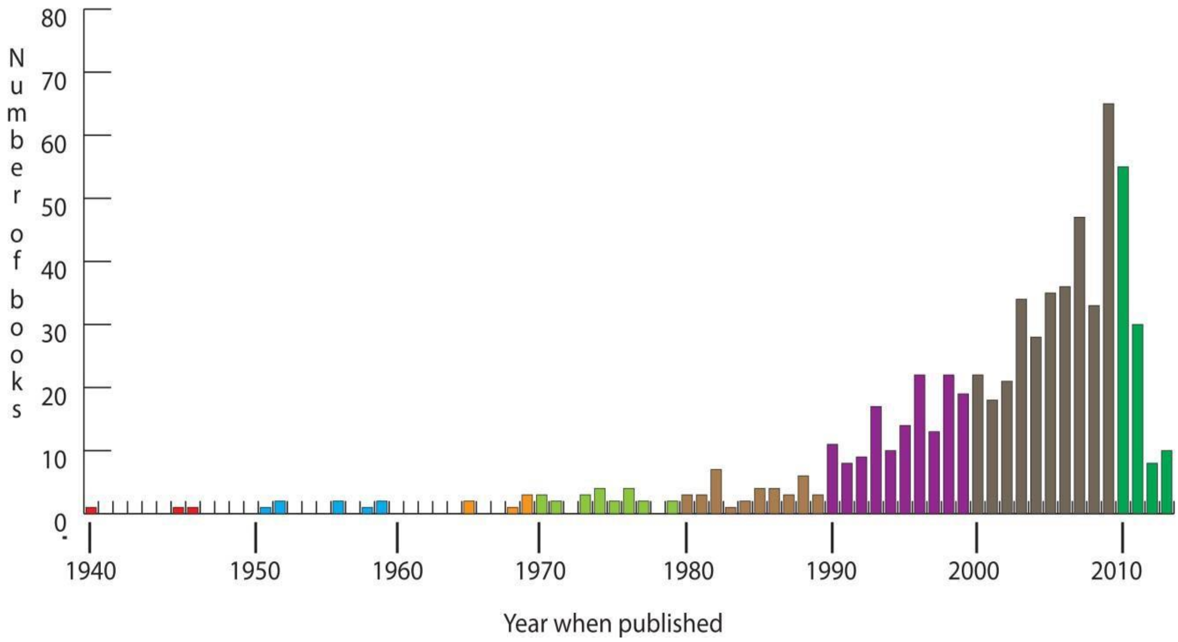

Figure 2-8:Age of paper and digital resources from Refworks database.

2.1.8 The scope of the Literature Review

References have been reviewed from 1940 to the present 2015; and limited to English language only. Another limiting factor was the subject focus; there appears to be a scarcity of objective analytical literature concerning the objective view of a pot throwing performance and the arts with a focus on pottery making. However, the review of the literature was an iterative process through research reports at key points in the study. This literature review is the culmination of each of the prior literature reviews, a final summary of literature within the area to date.

2.2 Creative Literature.

2.2.1 Design

Design impacts on life. The design community is no different to other creative communities in discussions about the definition of their crucial term in this case 'design'. The Design Council states that 'the single word 'design' encompasses a great area, and that is why the understandable search for a single definition leads to a lengthy debate at least.' Continuing with 'There are broad definitions or specific ones – both have drawbacks. Either they are too general to be meaningful or they exclude too much (Design Council, 2014). This definition from Archer, Baynes, and Roberts is extensive, attempting to satisfy all aspects of the term.

> *'Design is directed towards meeting a particular need, producing a practicable result and embodying a set of technological, economic, marketing, aesthetic, ecological, cultural and ethical values determined by its functional, commercial and social context.' (Archer, Baynes and Roberts, 1992, p. 8)*

Cross is economical with his definition of design as a system, 'the arts of planning, inventing, making and doing' (2007a, p. 19). Industry offers BS7000-10:2008, a definition of design, outlined in Figure 2-9.

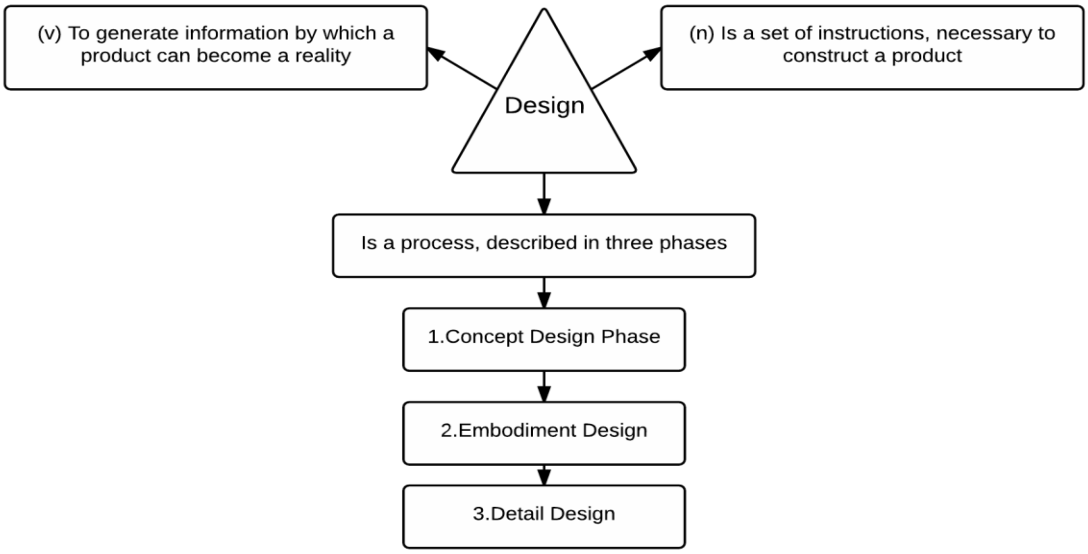

Figure 2-9:Defining Design, adapted from BS7000-10:2008.

Design is associated and intertwined with Applied Art and Fine Art areas because the areas 'interact with us in our daily lives…they give pleasure that is aesthetic and nostalgic' (Lewis and Lewis, 2008, p. 186). The term 'design' has a variety of meanings and inferences, depending on an area of work. Applied Art and Craft are areas which use the term 'design' in a different context to the design community. An applied artist may well use the term 'design' to mean the overall effect. A designer understands 'design' to be a structure of fabrication. However, an engineer understands and uses 'design' to define a complete system.

Figure 2-10 displays a 'Wordle$_{TM}$' of definitions of design, the more a word is utilised within the definitions, the larger the representation of the word in the illustration. The most prominent words are, *activity, make, product, structure* and *physical,* all of which may be applied to a pot throwing performance.

Figure 2-10:Wordle cloud formed from definitions of the term 'design'.

Definitions were then encoded into NVivo 10 giving the following list of word similarities all linking back to design. Considering the same data from the definitions of designs, this is a different list. Most words selected in the list do match. ‘New’ and ‘perform’ linked in a pair need serious thought, but when linked with a second close pair of ‘physical’ and ‘problem solving’ make more sense. Like elements are similarly colour coded.

When trawling to define the term ‘design’, the phrase ‘design intent’ became prominent. This expression is seldom used within the pot throwing community. The question was raised, ‘What is ‘design intent’?’ American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), suggests that ‘design intent’ ‘are really only the designer’s narratives of system descriptions’ Stum continues with the suggestion that there is confusion around the term. He proposes clarifying the term with ‘owner’s project requirements’ (Stum, 2002, p. 1181). This understanding does not sit well with applied arts practitioners, as their work relies less on commissions and thus, the customer usage would be less pre-determined.

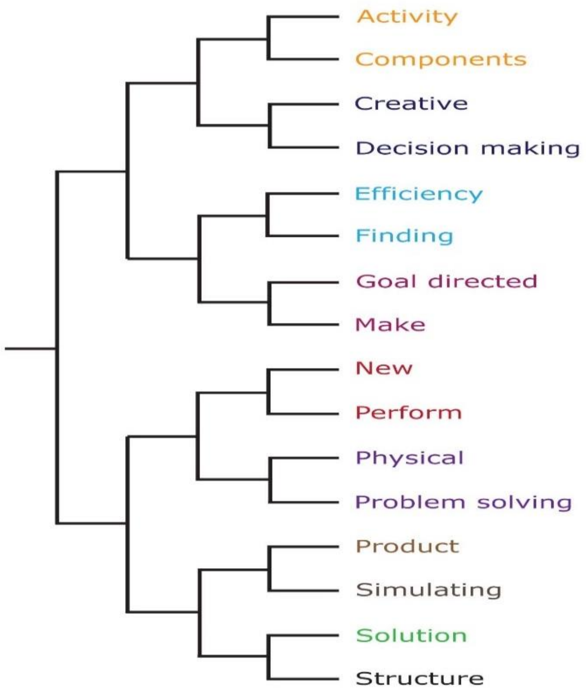

Figure 2-11:Word similarity from definitions of 'design' using NVivo10.

‘Design intent’ within design communities is held to mean, as defined by IVCC, (Illinois Valley Community College, 2011) that:-

- Design intent is the intellectual arrangements of features and dimensions of a design.

- It governs that relationship between features in a part or parts in assemblies.
- The intent of each component of a design is to work as a solution to the design problem.

This definition applies more to the design of vessels rather than to artistic responses when using clay material. When expanding this enquiry, the thought was formed in a question 'Do potters design or do they create? How does design intent impact the pot throwing process?'.

When potters respond to the material in order to convey some abstract concept, there is more 'creative' intent rather than 'design' intent. When a production potter makes vessels, there is design intent, when consideration is given to the process in order to replicate the vessel and make the process iterative.

Design intent proved to be an interesting discussion point as when throwing a pot, a potter would have 'intent' but might be led by the material into an alternative outcome.

2.2.2 Applied Arts

The label 'Applied Art' is an expansive term concerned with a wide area of skills and 'arts' that can be learned. Crafts are part of this area, along with some more unusual 'arts', for example neurosurgery has been discussed as an 'applied art' (Salcman, 1995, p. 125). Dr Roger Kneebone, a conference session Keynote speaker at 'Make:Shift' 2014 heavily referenced crafts and applied arts in 2014 as needed to train surgeons (Kneebone, 2014).

> *'The Arts are a subset of a human's creative activities that aim to excite the receiver's neurons in a certain manner, through that person's senses with or without significant consequences…applied arts, by definition, are explicitly useful.' (Lam, 2011).*

In the field of Applied Arts and Crafts, there is no commonly accepted definition of 'craft'. Although a common-sense definition of the word 'craft' seems clearly expressed: an activity which involves skill in making things by hand, derived from the old English word 'craeft' meaning strength or skill. Glenn Adamson, in a radio interview, discussed craft,

> *'I think the interesting thing about 'craft' is that it is in fact all those things at once. So, it covers a very wide range of human endeavour, so anytime you have skill and you have the process and you have the knowledge of materials, you have craft.'* *(*Strainchamps*, 2012)*

Crawford (2010) and Frayling (2011) believe there is a need for individuals to work with their hands, making, repairing, and remodelling. Frayling recognises 'craft' as needing a meeting of the head, the heart, and the hand. This belief introduces a theme of sustainability, suggesting there may be a deliberate move to choose an exploration between crafts and sustainability. The hands, the more inclusive the better, a culture of innovation. The heart recognising the movement within the crafts arena (ibid, 2011, p. 142).

Maker or artisan is a term used currently within the crafts community to describe an individual who uses their hands to create artefacts, very often substituting for the more classic term of craftsman. A maker is an individual who makes, uses material to design and create an artefact.

The term 'craft' has increasing popularity in industrial product promotion, being borrowed by the manufacturing, processing industry wishing to promote their goods with the language of craft e.g. potato crisps being hand-crafted, suggesting hand made.

Craft is an attractive term suggesting a hand-made approach that is extremely attractive to industry who wish to convey that their goods are hand-made. In the crafts making community, because crafts are hand-made, they are not always going to make an economic return, they sometimes don't achieve a break-even point, yet industry is willing to raise their prices because they are 'crafted' and people will pay.

2.2.3 Creativity

This important area is briefly defined, because the purpose of this study was not to encroach on the creativity of an individual, but will to enable an individual to become more creative by enhancing automaticity in a pot throwing performance in order to free creative actions. It was felt useful, however, to briefly review literature concerning creativity.

Creativity is often mentioned alongside the term 'craft'. In a similar pattern with craft, creativity has numerous definitions. Dakers states 'Creativity is an ambiguous and problematic term' (2004) and similarly struggling to define, 'Creativity is paradoxical and complex' Rothenberg and Fausman (1976, p. 3). It can be applied to many widely differing areas from accounting departments in the workplace to journalism and computer programming. Artists and makers are not the sole beneficiaries of 'creativity'. In the area of design, Dakers suggests 'Creativity is acknowledged to be an essential feature of design and technology' (D&T) (Dakers, 2004). 'It (creativity) can be stifled in an educational or testing environment'. (Runco, 2010, p. 3). Getzels and Jackson 1962 believed that creativity was different from intelligence cited in (Sternberg, Robert and O'Hara, Linda, 1999, p. 264).

There has been discussion as to whether individuals are naturally creative or whether creativity can be acquired and learnt. Otto Rank explains that creativity is directed towards finding motives that function in distinctive ways in the creative person.(Rothenberg and Hausman, 1976, p. 15). This study acknowledges the myriad of definitions of 'creativity' but is not presently including the term within the scope.

2.2.4 Equipment

A throwing performance involves interaction between the elements of human, material, and equipment. It is important to include literature about equipment.

In order to throw a pot on a potter's wheel there necessarily needs to be a wheel. Wheels are powered in a variety of ways, by hand or foot, by crouching to throw, or by foot with a kick wheel, where the potter is standing a lever is kicked which powers the wheel. A momentum wheel relies on power from a seated potter to power the wheel through the moving backwards and forwards of the lower limbs. The an electrically variably powered wheel used a motor and an electrical power source, (Hamer, 1975, p. 316; Leach, 1976, p. 66; Rogers, 1995, p. 11).

Academic literature appears to be sparse concerning equipment. Potter's manuals tend to mention equipment in passing, concentrating on the skills and processes for a pot throwing performance. Modern wheels are an adaptation from the design of ancient pottery wheels. There have been very few significant changes.

Original pottery wheels were merely hard disks rotating on a curved surface. A development was to raise the wheel away from the ground and then to add a spindle for a powering mechanism. It is recognised that the Uruk period around 4000B.C. in Mesopotamia was a time of growth and technological advances, where wheel throwing and mould 'manufacturing was state-of-the-art' (Pollock, 1999). Potters were making their storage vessels by coiling lengths of rolled clay. Innovation came when it was discovered that a horizontal stone resting on top of a rock could aid the making of these coiled vessels. As these horizontal stones rotated the making of these coiled vessels could be considered the first coiled but 'thrown' storage vessels (Courty and Roux, 1995). This early method of throwing was disseminated by itinerant potters (Roux, 2003).

These travelling potters visited from settlement to settlement demonstrating and working in communities situated throughout Mesopotamia. The skills for throwing by wheel were hard to acquire due to the inconsistent nature of learning opportunities. Itinerant potters 'worked on a seasonal basis', offering small pockets of tuition to expand skills to novice potters. The acquisition of skills was a lengthy process (Berg, 2006). Berg supports the idea that there might have been wheels existing but this 'does not imply the utilisation of rotative kinetic energy during the making of a vessel' (ibid, 2006). Skills and throwing knowledge, migrated from the Mesopotamian region to Egypt, Powell discovered while working with the Amarna Project (Powell, 1995). The first potter's wheels were recorded in Greece around 2000B.C. Research has been made, on ancient thrown pots and stress, in the making of traditional pot shapes, through the use of x-ray (Berg, 1988). The adoption of the potter's wheel and its' mastery has been progressive (Gandon *et al.*, 2011). The Roman Empire used pottery wheels to produce pots known as Samian ware; increased pottery wheel skills enabled the ware to be produced in numbers. Thus, the status of pots changed from being a valuable item to commonplace. (University of Leeds, 2012). It took until 63A.D. for the Roman Army to arrive in England with the invasion of the Roman Empire. Potters wheels and skills were then passed on to the natives as there was an abundance of natural clay material, and so transportation of pottery ware from France to England was time consuming and costly. After the Roman occupation most wheel thrown pottery was made in urban areas, with country areas keeping to hand made methods. (Cherry, 1991, p. 201).

After the Romans left, they abandoned wheel-throwing technology behind, production was limited to eastern areas of Northumberland and East Anglia (Cherry, 1991). The passing on of the skills of making were family oriented, from father to son. There is little evidence of apprenticeship learning at this time, possibly due to the high clay taxes imposed on makers. Potters' were for the majority, part-time workers with the remainder of their time spent working on agricultural land (ibid, 1991, p. 204). Tracking the development of pot making during the Middle Ages is challenging because the medieval potter's guilds were secretive, they concentrated on, the form as important, and not the material.

A huge development for pot throwing was in 1759 with innovations from Josiah Wedgwood and the advent of the industrial revolution. As a move away from industrial practices, Bernard Leach arrived back in England from Japan, having studied Mingei folk art philosophy (Kikuchi, 1997; Victoria and Albert Museum, 2005). He trained apprentices who developed their skills to establish their own thrown pottery studios.

Isaac Button was a rural potter who threw household ware and agricultural ware, he mined and processed the clay material used in his studio, then threw clay vessels with the clay material he dug, fired and glazed the ware before selling to the local community. (Soubriquet, 2008).

When a regular electricity supply was installed, potter's wheels were designed and adapted to use the power. Currently potters still use potter's wheels based on the design of the wheels used in the industrial revolution.

2.2.5 Ergonomics and the impact on pot throwing.

Ergonomics can be defined as:

> *'Ergonomics is a science-based discipline that brings together knowledge from other subjects such as anatomy and physiology, psychology, engineering, and statistics to ensure that designs complement the strengths and abilities of people and minimise the effects of their limitations'.* Chartered Institute of Ergonomics and Human Factors (2012)

A thought to consider would be, the organisation of tools around the potter's wheel so as not to put undue strain on a potter's back.

The area of biological and physical science literature touches on how skeletal and muscular problems may develop after a significant time of throwing performances to create pots. Ergonomic literature covers the study of human work. Both these areas are pertinent to the pottery throwing process as ergonomically there seems not to be a study within a pottery workshop. Throwing a pot is a repetitive action. Articles found are focussed on athletic performance rather than pot throwing. Injury due to repetitive actions is an area of debate, due to legal arguments over the existence of repetitive strain injury or cumulative trauma disorder. Pascarelli (2001) took research a stage further when including computer users and musicians into consideration when relating to upper limb repetitive injuries and how to alleviate them. Potters were not included in the study. There appears to be a gap in existing knowledge due the lack of papers or articles found relating to the systematic analysis of the throwing process or performance.

2.2.6 Language for pottery

The etymological foundation of clay terminology has roots in Old English Language. This language developed after the Angles, the Saxons and the

Jutes arrived in England. These invading tribes spoke similar languages, which blended with the Celt influence of the native language combined to make the language termed 'Old English'. Old English is believed to have been spoken and written between 450A.D. and 1050A.D. before being mixed with French influences with the invasion of the French.

England became a two-language country, the lower working population continued to speak Old English whilst the upper classes were encouraged to speak French, eventually influencing the main spoken language.

There are various suggestions for the derivation of the term 'throwing'; one is using the moment the clay is thrown onto the wheel; therefore, the term is throwing. Another suggestion is that the clay on a revolving wheel, due to the centrifugal force, is always trying to 'throw' the clay material off-centre, hence throwing. These are hearsay derivations whereas etymologist potter, Krueger (1982) investigated the origins of terms and phrases used in the area of pottery making. Table 2-3 outlines current term usage and derivations.

Table 2-3:The derivation of current clay terms.

Current term	Old term	Definition	Derivation
Clay Throwing	Claeg Thrawan	Clay To turn, twist	Old English Old English
Pot	Potare	A drinking cup	Latin / Middle English
Potter, pottery	Poterie	-er One who does -ery where	Middle English / French
Slip	Slype	Liquid mud	Old English
Glaze	Glaer	Amber colour	Old English
Kiln	Culina	Kitchen / cookstove	Latin
Ceramic			Greek / French

The only term used today which remains with an undiscovered root is the term ‘grog’ which consists of fired clay ground into fine particles. ‘Grog’ is used to reduce shrinkage in clay bodies. The most prevalent definition for ‘grog’ is drink and rum related. Pots thrown during this time were practical in nature, storage jars and tableware.

There are particular terms for parts of a ceramic pot, based on human anatomy. Figure 2-12 displays the terminology for pots. Starting at the base of a pot there is the ‘foot’. The pot rises to the belly, continuing upwards to the shoulder of the pot. From there, there is the neck of the pot, sometimes narrow and sometimes wider. At the top, opening of a pot there is the lip of the vessel. The sides of a pot are called the walls. Walls are pulled up when constructing a thrown pot. A lip completes the walls of a pot. The lip is at the opening to the cavity of a pot. Rim is an alternative term, a throwing potter consolidates the rim during a throwing performance to firstly compact the clay particles, making the lip, the rim, stronger and more durable. Secondly the lip, the rim can be smoothed to prevent any roughness and to preserve the appearance of the vessel.

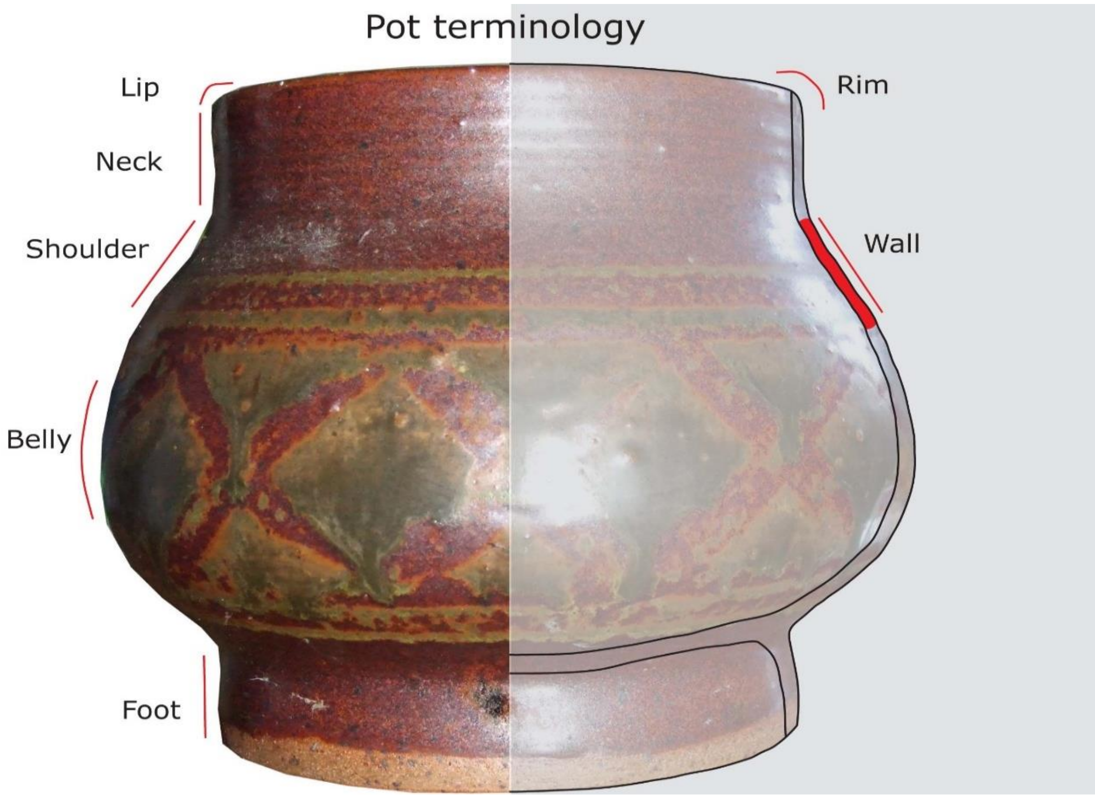

Figure 2-12:Terminology of a pot form.

2.2.7 Material

An important element of the throwing process and performance is the material used in creating a hollow vessel from a lump of material. This material is clay. Clay material is found worldwide. It varies in consistency and attributes as the clay material is naturally formed differently at each location.

Scientifically, clay is a common natural material 'used by humans since antiquity' and has been 'implicated in the prebiotic synthesis of biomolecules and in the very origins of life on earth' (Theng, Bergaya and Lagaly, 2006). It also a very modern material found to be 'abundant, inexpensive and environmentally friendly' (ibid, 2006). Hamer defines clay as:

> *'hydrated silicate of aluminium. A heavy, damp, plastic material that 'sets' upon drying and can be changed by heat into a hard, waterproof material'.* (Hamer, 1975)

The chemical formula for a china clay, kaolin, is $Al_2O_32SiO_22H_2O$, meaning that a pure clay is a silicate of Aluminium, with silicon dioxide and water. Norton acknowledges that when defining clay material, clay has three distinct properties:

> *'first, it may be deformed without cracking; second, when the deforming force ceases, the shape will remain fixed and further, when the clay mass is dried, it has considerable strength'.*
> (Norton, 1976)

Clay as a material demands an interaction, whether out in nature or refined and in the studio. Schaffner and Porter describe clay in its raw state '*is exceedingly tactile even sensual. It warms to the hand and is infinitely malleable. It is heavy. It is humid. It can be the closest approximation to the physicality of a warm body. Clay is familiar as an everyday object'* (Schaffner and Porter, 2009). This notion is recognised within the ceramic crafts community:

> *'Dirt's physicality can bring on this fleeting sensation of well-being, happiness and pleasure. There is the delight that results from simply sticking one's hands into warm mud'.* (ibid, 2009)

Powerful microscopes have enabled the examination of clay particles. Figure 2-13 confirms the reported image of each clay particle is a hexagonal–like shaped crystalline plate. The average diameter of each crystalline plate is one micron. Other particles in the clay can be as large as 50 microns and as small as one tenth of a micron.

The particles are floated on an exceptionally fine water film which separates them from each other, there is a force which attracts the platelets to each other, but not strong enough to squeeze out the film of water lubrication. This is an important point to know, considering events of the throwing performance such as the wedging and centring of the clay.

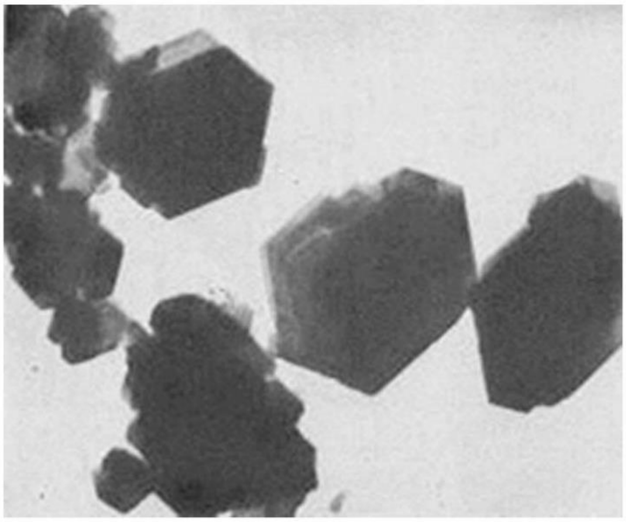

Figure 2-13:Crystals from a washed Kaolin showing hexagonal plates (electron microphotograph, X 32,000).

The plasticity, the degree of malleability, of the clay, can be affected by the mix of clays and minerals and by water content. There are generally three categories of clay, earthenware, stoneware, and porcelain.

Each formula is dependent on the number of differing variations of the mix of the source materials and the hydration needed for plasticity. Each mix of clays has differing uses and properties of the material and requires differing firing temperatures in a kiln. As the clay dries and the water content decreases, plasticity is reduced. Even if the clay has become firm and brittle, it can still be reconstituted to its former state of plasticity by immersing in water. Once hydrated, the clay material regains plasticity and can be reused and reformed. However, once the clay vessel has been dried and fired in a kiln, it has changed state permanently, becoming a brittle porous material. When glaze solution has been applied by pouring over the pot or dipping the pot in a glaze solution, it is then placed in a kiln and fired once more. A second change occurs, a pot changes from being a porous material into a strong and generally waterproof object that can be used for a variety of purposes. Evans (2008) categorised seventy different methods of using clay. Broad categories of use are shown in Figure 2-14. Throwing and hand building are seen in Group 2, Deformation processes.

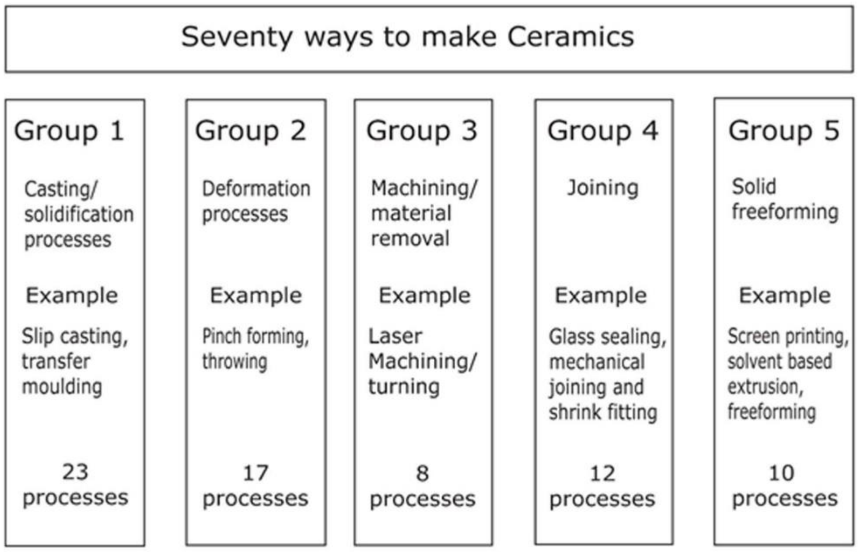

Figure 2-14:Diagram of clay uses, adapted from Evans (2008).

Creatively, clay touches tacit, very personal areas of participants, and becomes implicitly understood in the ceramic craft community.

> *'Moist clay is a material of many moods. The better we understand the underlying structure the more closely it can be adapted to our needs. The right clay used in the right way can be*

> *a faithful servant, but the wrong clay and the wrong use turns it into an exacting tyrant'* (Norton, 1976).

The type of clays commonly used in this study, will be plastic, throwing clays. They will differ slightly with each participant, having, potentially, their preferred material.

To consider changing the state of the clay material, heat needs to be applied. Originally clays were placed in fires and baked in the heat, changing the state to the clay from soft and malleable to hard and brittle and longer lasting. Now vessels are fired in various ways. Firstly, a lower temperature bisque or biscuit firing to change the state of the material, followed by a higher temperature glaze firing. Kilns can be heated by gas, electricity, or wood. Each method of firing gives distinctive attributes to the finished ware.

2.2.8 Ways of making.

There are many different methods of making a clay vessel. The simplest method of making a pot, without using tools, is a thumb or pinch pot. Then there is the coiled pot where rolls of clay are coiled and joined to make a 'coiled pot'. A slab pot is as the name suggests made by forming clay into slabs and joining them to make a pot. Slabs of clay can also be used to make a moulded pot, as can coils. A slip-cast pot uses liquid clay to pour into moulds to make a pot. A thrown pot uses a ball of clay and a potter's wheel to form a pot. Figure 2-15 illustrates some simple ways of making. Pots can also be made by combining methods of making.

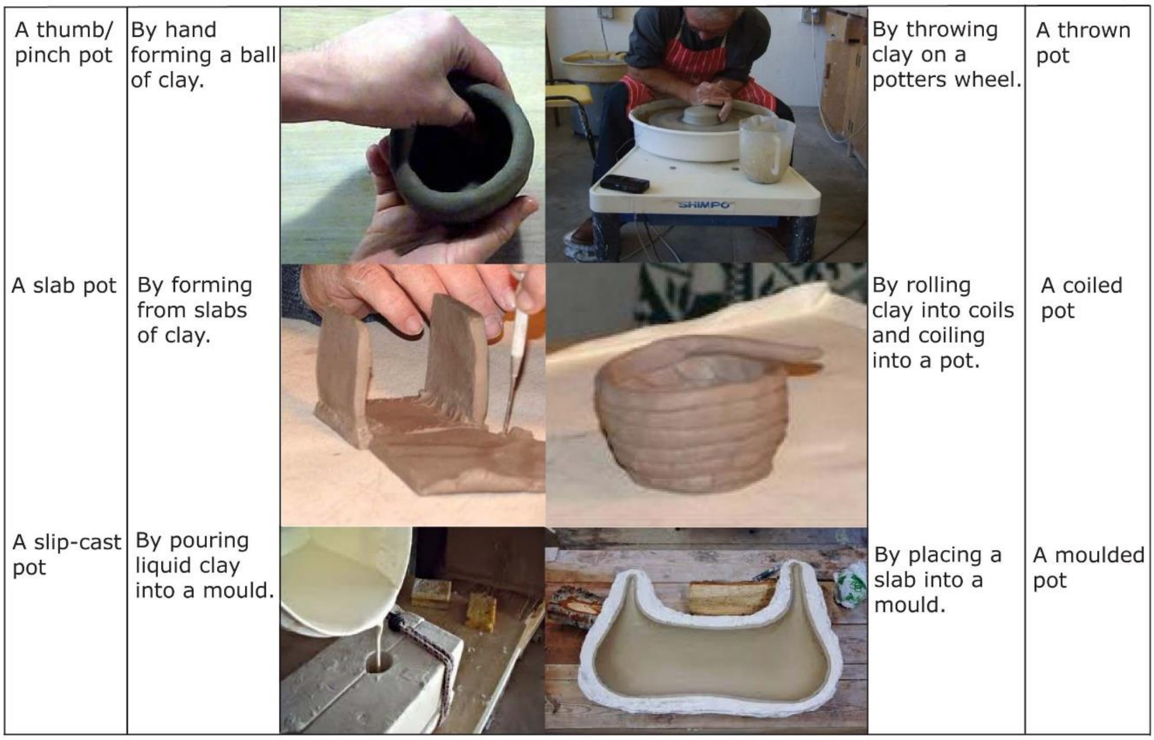

Figure 2-15:Methods of making a clay pot.

All literary contributors have an opinion about the pot throwing process that they wished to communicate about to other interested parties. All reviewed pieces were subjective in style, whether they were printed or digital literature.

From early paper literature, pot throwing has been seen as being quite different to other craft methods. In his reprinted 'The Potters Book', Leach defines the essence of the craft, '*There is nothing quite like throwing in any other craft. Wood, metal, fibre and glass, none of them are so responsive to the touch, as clay'* (Leach, 1976). Clark is equally descriptive when he writes, '*Throwing has something of magic in it. The unbelievable happens before your eyes'.* (Clark, 1970, p. 8). Bates follows with a similar thread; '*The potter's wheel has a strange fascination for most people and those who master it are easily hypnotised by its magic'* (Bates, 1981, p. 54). Even in later literature, potters are still describing the fantastical nature of the craft. Cohen states, '*I have never ceased to be fascinated by the craft of the potter's wheel'* and it is '*a pure joy to experience'* (Cohen, 2008, p. 8).

The essence of the process is difficult to describe with accuracy in objective terms. As early as 1940, Leach recognised the dilemma, by stating, '*any verbal description of the manipulation of clay on a potter's wheel is bound to be inadequate, if not misleading'* (Leach, 1976, p. 70). Bartneck puts forward the suggestion that many design books, for example, provide hands-on and relevant knowledge for the design practitioner. '*This knowledge does not attempt to be scientific'* (2009).

Practitioner potters' have published books demonstrating their style of throwing process to aid novice potters in grasping the throwing technique. This has resulted in a range of literature describing and instructing about the throwing of pots, culminating in somewhat conflicting instructions.

When defining and describing the conventional pot throwing technique, the book-based literature outlining the throwing process involved when creating a pot was found to be individual. There is a consensus, however, from literature about the basic key points. These include:

- Points such as the preparation of the clay prior to throwing. Wedging the clay. Placing the clay on the wheel head, the need for clay to be centred.
- The stage of opening out and drawing up of the pot, and,
- The end refinements of the process (removing the pot from the wheel).

The descriptions of how to achieve these key points are wholly subjective. To a novice, they may seem confusing when comparing a variety of sources. This points towards an identifiable gap in knowledge. Some documentation is necessary, in which ever medium, that outlines the process of throwing a pot, in terms which are both objective and accurate. Successful potters have recognised the gap in literature and have striven to close that gap in knowledge, through writing books about their practice. Table 2-4 highlights common and differing points of the throwing process. This confirms the individuality of process literature.

Yamamoto discusses points about the wedging routine (2008). There are varying instructions on how to place the ball of clay onto the wheel head, Mattison slams the clay down on the wheel (2003), others throw, place and slap the clay (Colbeck, 1969; Casson, 1985; Rogers, 1995; McErlain, 2002; Phethean, 2012). All agree that there must be a centring activity, then a divide occurs in opening up, whether to use the fingers, (Colbeck, 1969; Casson, 1985; Mattison, 2003), or to use thumbs, (Leach, 1976; McErlain, 2002; Phethean, 2012). Phethean is the sole advocate for consolidating the base of a pot and for using the strategy of throwing a cone from which to form other pot shapes (2012). Most agreed on methods of pulling up of walls. From the spread of ages of literature, there seem to be few trends, but as in history potter's skills were passed from master to apprentice, perhaps there could be styles originating from early potters, passed along through time.

> *Cohen (2008) encapsulates the dimensions of this study by defining 'Physical involvement, mental attitude and a sense of rhythm need to be defined in relation to the mechanical instrument (the potter's wheel rotating a piece of clay at variable speeds'.*

Technology in the late 20th century, improved methods of communication from one of purely print and drawing, to the present where there is a multitude of learning platforms which enhance the education process.

Table 2-4: Literature discussing the throwing process.

Part of the process	Comment	Literature examples
Preparation of the clay prior to throwing	Studying the technique of wedging, body posture, difference of expert and novice	Yamamoto (2008)
Placing the clay on the wheel	Throw the clay	Leach (1976) McErlain (2002)
	Place the clay	Bates (1981) Clark (1970)
	Slam the clay	Mattison (2003)
	Slap the clay	Rogers (1995) Phethean(2012)
	Bringing the clay down firmly	Casson (1985)
Centring	All literature thought this essential.	Leach(1976) Bates(1981) Mattison(2003) Clark(1970) Rogers(1995)
Opening out	By using fingers	Mattison(2003) Colbeck(1969) Casson(1985)
	By using thumbs	Leach(1976) McErlain(2002) Phethean(2012)
Consolidate the base		Phethean(2012)
Making a cone		Phethean(2012)
Pulling up of the walls	All demonstrated in a similar way	Bates (1981) Casson(1985) Mattison(2003)

The British Broadcasting Corporation (BBC), in 1953, broadcast 'interludes' when there were gaps in broadcasts. Interludes were short films, one of which featured a pot being thrown on the potter's wheel (1953)

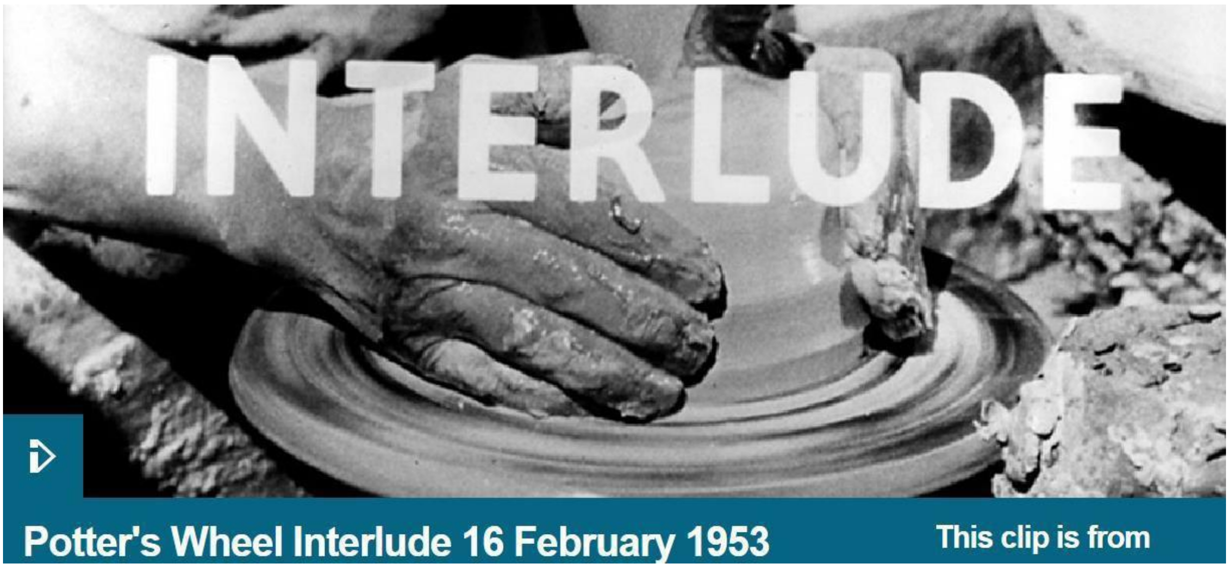

Figure 2-16:Screenshot of Pot throwing video (BBC).

The internet is saturated with instructional pages, some with the use of photographs, podcasts of instruction and short instructional videoclips of the process, where potters can demonstrate with commentary on all aspects of the throwing process. DVD instructional discs are also available along with interactive instructional programmes. Simon Leach (2013) has written and published a book designed to cross the boundaries of throwing a pot, supplemented by podcasts recorded into a DVD format. This medium may reach different audiences.

If skills can be learned by watching rather by an interaction between tutor and student, podcasts will adequately transfer some skills. Learning is not only visual, podcasts and instructional clips, appeal to visual learners. The sensory aspect would be fulfilled by a tutor teaching in real time about the clay and its qualities.

2.3 Human based literature

2.3.1 Heuristics and decision making

A decision is performed either consciously, explicitly, or unconsciously at a tacit level at every point in the pot throwing performance. Some decisions are 'by rule of thumb'; heuristic, when practicing potters' are familiar with the material they are using and know instinctively / intuitively what they need to do in a particular situation. There are many categories of decision-making. Dreyfus (1986), Cross (2004) and Collins (2007) discussed decision-making in terms of skills and expertise, resulting in a list of decisions:

- Decision making
- Generative reasoning
- Intuitive action
- Repertoire of strategies
- Tactical decisions
- Systematic design
- Rule breaker

An example of when a 'repertoire of strategies' may be used, during the throwing performance to solve unanticipated problems. As unexpected events occur, a practitioner may have a 'repertoire' of solutions to ameliorate the problem. The more experienced an individual is, either the greater the repertoire or the quicker the decision is made as to which course of action. 'Intuitive action' is aspirational for a novice and a strategy for the experienced and expert practitioner. It is with experience that decisions may become intuitive. 'Rule breaker' may have a place within a throwing performance where anomalies may occur and in response the practitioner appears to 'break the rules'.

2.3.2 Physical

Hands are vital in a craft performance as they act not only as receptors for sensory information but also as tools for carrying out a desired intention. This area of literature explains the importance of these organs.

'The hand is both an organ designed to obtain information and an organ of execution' (Tubiana, Thomine and Mackin, 1998, p. 1). It is sited at the extremity of the upper arm, sharing nerve endings, blood supply and muscles. It is actively involved in human learning (Wilson, 2010, p. 277).

> *'The human hand is an organ of considerable virtuosity, with it we feel, point and reach and determine the texture and shape of objects we palpate'* (Mountcastle, 2005, p. 1).

It is from the hand that continuous sensory messages are passed to the brain which require instantaneous reaction to information. This uninterrupted flow of messages between hand and brain are vital when engaging in a throwing performance. The hands, including the finger or digits need to sense the smallest of variations of change to the surface of the clay to deploy messages to decrease or increase velocity of the wheel, or whether to increase lubrication of the clay, or indeed whether closer inspection is needed.

The hand has a skeletal structure at the core which is constructed of 27 individual bones. Figure 2-17 displays the skeletal structure of the hand in terms of noting the phalanges found in the fingers, the metacarpal bones seen across the palm and the carpel bones in the wrist. The carpels, metacarpals and phalanges are linked together by fibrous tissue, ligaments, fibrous sheaths, and plates. The fibrous tissue provides stability for the hand (Tubiana, Thomine and Mackin, 1998, p. 24).

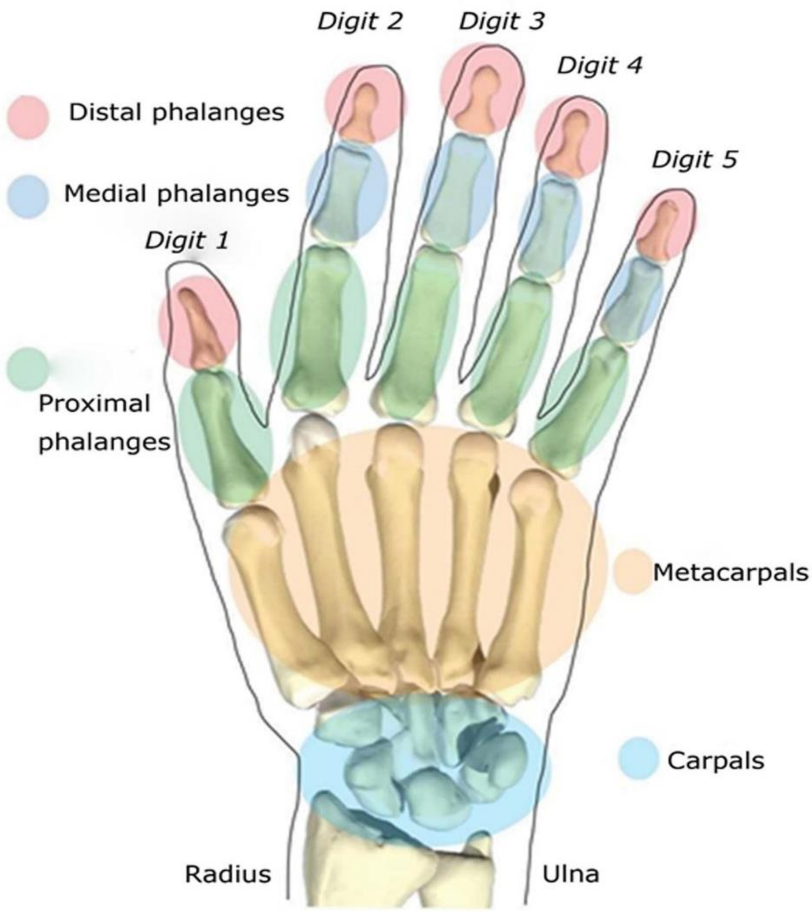

Figure 2-17:Skeletal structure of the hand adapted McGrowther et al (2009).

The external areas of the hand which cover palm muscles at the epidermal level are the 'Thenar Eminence' and the 'Hypothenar Eminence'. The thenar and hypothenar eminences are used at the beginning of a performance when centring the clay and will detect the physical condition of the clay material. Both eminences must gather and send and receive sensory information to achieve centring the clay material. Figure 2-18 illustrates the positioning of the Thenar Eminence and the Hypothenar Eminence on the hand. The muscles in these areas are dextrous. MacKenzie states that '*hand postures afford different ways to apply forces*' (1994). This is explained by the fact of '*biomaterials such as bones, muscles, tendons, ligaments and skin create limitations on static and dynamic force generation*' (ibid, 1994, p. 308).

Figure 2-18:Displaying Hypothenar and Thenar eminences.

Soft tissue contains mechanoreceptors which give instantaneous feedback to the brain which in turn responds to the signals with adjustments to the tendons, guiders, and muscles. These mechanoreceptors are sited in the dermal layers, the epidermis, the dermis, and the subcutaneous layers. They detect tactile sensations and muscle indentations (Johnson and Yoshioka, 2001, p. 74). There are many more tactile receptors found in the finger pulp, the fingertip pads, than in any other part of the body (Mackenzie and Iberall, 1994, p. 314). Therefore, this would indicate that fingers, digits are ideally placed to make fine adjustments during the throwing performance due to the numerous tactile receptors gathering reactive sensory data.

Mountcastle discusses peripheral sensory nerve formations (2005, p. 113). These are referred as the somatosensory system which describes sensory perceptions other than vision, hearing, balance taste and smell. This system detects temperature, touch and proprioception being utilised in sensory motions of the hands. The information is then channelled in four parallel streams and response is made (Johnson and Yoshioka, 2001, p. 73).

Fingertips have a high density of receptors, Meissner corpuscles, Merkel discs, Pacini corpuscles and Ruffini endings. These are embedded in ridges and folds of the sulti cutis and cristae cutis of the dermal layers. These receptors allow acute sensory messages relaying information to be transmitted to and from the brain, so whether thermal, tactile/haptic, or positional reactions and adjustments can be made.

There are four types of cutaneous mechanoreceptors used in touch. Table 2-5 summarises the receptors and their sensitivities. Mechanoreceptors sense data from a greater area than their physical size, therefore, the whole hand can sense rather than distinct regions of the hand.

Table 2-5:Summary of mechanoreceptors and sensitivities.

Mechanoreceptor	Sensitivity (Jones and Lederman, 2006, p. 27)
Pacinian Corpuscle	Large receptive field, sensitive to vibration and detecting remote events.
Meissener Corpuscle	Motion perception, grip control detecting actual slip and micro slip
Ruffini Ending	Sensitive to skin stretch, perceiving hand configuration and finger control, motion direction
Merkel Disc	Form, texture responds to lateral stretch.

Sited alongside and among the mechanoreceptors are thermoreceptors which detect heat. Heat more than 45°C damages hand tissue as do repeated temperatures below 14°C (Jones and Lederman, 2006, p. 34). Whilst the increased temperature of 45°C might not be an issue in general studio working conditions, the lower temperature might as practitioners extensively use cold water in a throwing performance.

Muscle receptors relay proprioceptive information. These are sited in interior muscle fibres, intrafusal fibres, and exterior muscle fibres, extrafusal fibres. Intrafusal fibres are specifically responsive to the velocity of changes in muscle length and muscle stretch (Snell, 2010, p. 93). Extrafusal fibres are responsive to both the intrafusal fibres and to positional sensitivity. A third receptor, the Golgi Tendon Organ relays information about forces and tension generated by muscles or effects from an external force. These receptors, muscle spindles, are sensitive to motor intention and volition (Berthoz, 2000, p. 28).

Each mechanoreceptor is linked to one of three nerves sited in the arm and the hand. The radial nerve, the ulnar nerve, and the medial nerve. Figure 2-19 illustrates the placing and path of the three nerves.

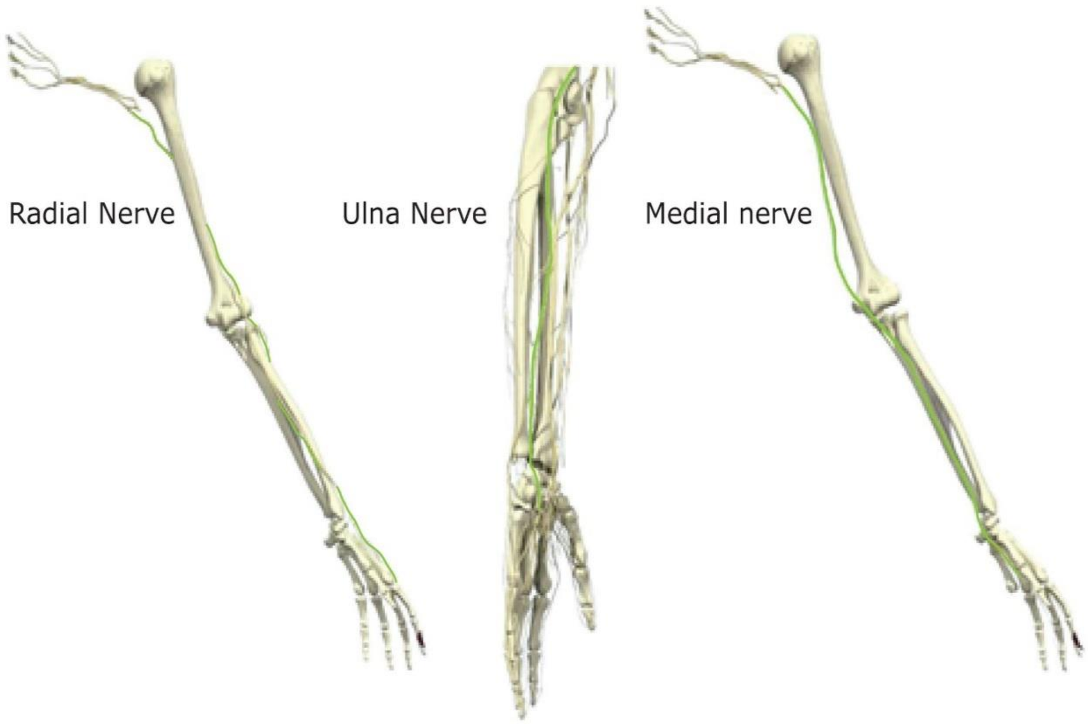

Figure 2-19:Main nerves of the upper limbs.

dermatome nerve areas (C6, C7 and C8) of a left hand. Dermatome areas are areas of skin on the upper limb that are innervated by a single spinal nerve. They act as sensory areas and determine movement. Dermatome C6 emanates from the radial nerve, dermatome C7 from the medial nerve and dermatome C8 proceeds from the ulnar nerve.

Dermatome C7 covers digits 2 and 3 which are instrumental in a throwing performance. The medial nerve gathers and provides tactile and dynamic information during an active throwing performance. Dermatone C6 encompasses digit 1 needed for the duration of a throwing performance. Therefore, any interruption in the flow of sensory messages would impact on the throwing performance.

Figure 2-20:Nerves of the Upper limb.

Figure 2-21 is a schema of the flow of decision-making impulses based on sensory perceptions. The aim of this thought signal diagram is the Desired outcome (e.g. a cylinder pot), which is matched in a series of high-speed impulses with memory data of past actual outcomes, (failed pots, successful pots, pots with errors). There are initial conditions which in this diagram have two equal schemas, recall, remembering previous data (where to start, what movements to make), and recognition schema, requiring mechanoreceptor data to match with recall schema (state of clay, wheel responses). In all to achieve the desired outcome. This diagram of sensory decision making will be repeated many times throughout the pot throwing performance, with each change of action and movement of the material and potter’s wheel.

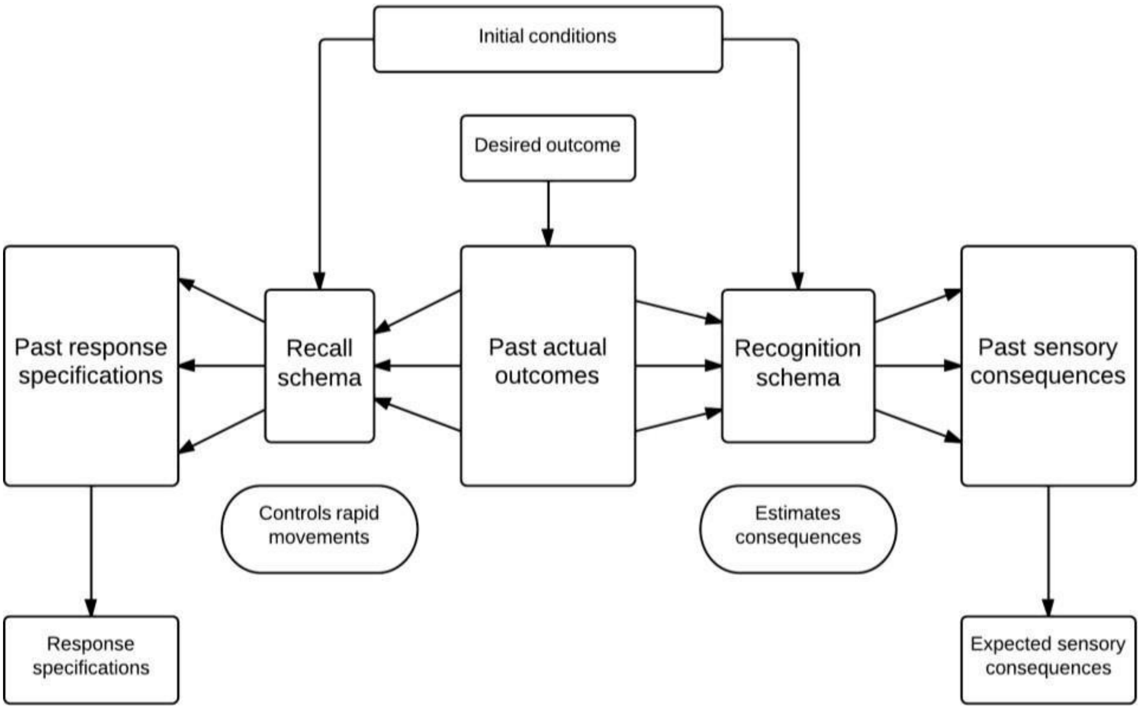

Figure 2-21:Sensory schema.

Little appears to have been recorded using hands as tools from a crafts viewpoint. Each publication might have some element which might be applied to a throwing performance, but nothing directly. Topics discussed included dexterity, power measurements also skin cooling on contact with cold materials (Jay and Havenith, 2004), grip strength (Roberts *et al.*, 2011), haptic feedback (Evans *et al.*, 2005), and the range of motion in human finger joints (Ben-Naser, 2011).

2.3.3 Hand preference

A dominant hand is the preferred hand of an individual for completing activities requiring co-ordination and skill (Martin, 2010, p. 329). Hand dominance or hand preference has significance when throwing. The wheel head usually turns anti-clockwise, of benefit to those with a right- hand preference and more difficult to use for individuals with a left-hand preference. 10% of the population is believed to have left-hand preference, a small percentage uses either hand, ambidextrous or the remaining percentage of population is right-hand dominant. Frievalds and Coren agree that 10% of the population has left hand dominance (Coren, 1992, p. 1; Frievalds, 2003, p. 439). Pheasant, states that the population figures are reported and therefore, the percentage may well be greater in actuality (Pheasant and Haslegrave, 2006, p. 145).

A rotating head of a potter's wheel usually turns in an anti-clockwise or counterclockwise direction in Europe and the United Kingdom. Clay would pass through the potter's hands from left to right. An individual with a right-hand preference generally works on the right-hand side of the wheel. Clay passes through the palm areas of the hand before the sensitive fingertip pads. This would enable a smooth squeezing action to be exerted on the rotating clay material, as the clay would pass and touch the length of the highly sensitive pad, sending much sensory information through the mechanoreceptors to be able to execute minor adjustments in pressure between the fingertips. An individual with a left-hand preference would ideally work on the left-hand side of the wheel where the left hand was free to be dominant. With the clay rotating towards the hands the sensory information would be limited both with number of receptors in the fingertips and the time to process and adjust movements. There would be a possible increased risk of spoiling the outcome with a less refined pot.

2.3.4 Knowledge

Literature concerning knowledge was a plentiful area. Defining knowledge, the type of knowledge, how it is used and how it might be revealed are all pertinent to pot throwing. Knowing how to throw requires knowledge. This knowledge is stored in differing areas; theoretical knowledge of how something should be, know-how knowledge of how to do and practical muscle-memory knowledge.

Early philosophers thought and debated the topic of knowledge. Plato considered 'epistemology' as true belief with account. In 'Theaetetus' Plato examined 'episteme' knowledge and 'techne', craft or art knowledge (Chappell, 2013). Socrates defined epistemic knowledge as 'justified true belief'. Aristotle argues the difference between 'episteme', the knowledge of science, a deductive ordered body of knowledge (Audi, 1999, p. 46), and 'techne', the 'craft knowledge of the universals and clauses' and this knowledge can be taught (ibid, 1999, p. 904).

Nonaka believes that 'knowledge is a multi-faceted concept with multi-layered meanings' (1994). This is borne out with differing and numerous perspectives of what knowledge is and how it might be created or discovered. Botha considers that 'knowledge is a definable and describable entity' (2008). He describes knowledge and continues to list attributes, 'knowledge is volatile, replicable, has contextual value, is catalytic and dynamic and that the transfer of knowledge is costless', but safeguarding two knowledges, explicit, external knowledge and implicit, internal knowledge (ibid, 2008, p. 8).

Dienes and Perner, define implicit knowledge as knowledge consisting of representations that merely reflect properties of objects or events without predicating them of any particular entity (Dienes and Perner, 1999). Davies defines implicit knowledge simply as 'knowledge that is not explicit' (Davies, Smelzer and Baltes, 2001, p. 8126). He aligns it to Polanyi's 'tacit knowing' that 'we know more than we can tell' (2009, p. 4). Polanyi states that tacit knowledge has two positions, attending 'from' and attending 'to'. He exampled a craft skill involving 'the awareness of a combination of muscular acts for attending to the performance of a skill, he continues with ' we are attending from these elementary acts to the achievement of their joint purpose' (ibid, 2009, p. 10). This may be viewed as working from the proximal, the inner most tacit knowledge to the distal, the outer tacit knowledge. The knowledge here; may still not be able to be articulated.

Habermas was critical of the view that all knowledge, particularly knowledge of the social sciences must perform to the cannons of natural science. He developed the view that there are three different kinds of knowledge, theoretical, practical, and critical knowledge take shape, and serve different human interests (Finlayson, 2005, p. 18). Niedderer supposes that there are a number of types of knowledge included in ‘phenomena of knowledge’ listed under non-propositional knowledge. Some areas featuring in the list compiled by Neidderer include skills knowledge, complex knowledge, situational knowledge and process knowledge, all very practitioner based (Niedderer, 2007, p. 7).

Collins, a sociologist, suggests there are three types of knowledge, explicit, implicit, and tacit knowledge. The understanding is, that should knowledge be a metaphorical straight line, therefore, explicit knowledge is oppositional to tacit knowledge, and that implicit knowledge meets each extreme centrally. Equally knowledge could be cone or cylindrical in shape as knowledge is not linear but contained. Figure 2-22 demonstrates that explicit knowledge is towards the external world. Implicit knowledge is knowledge held by self and a community and tacit knowledge is inner knowledge.

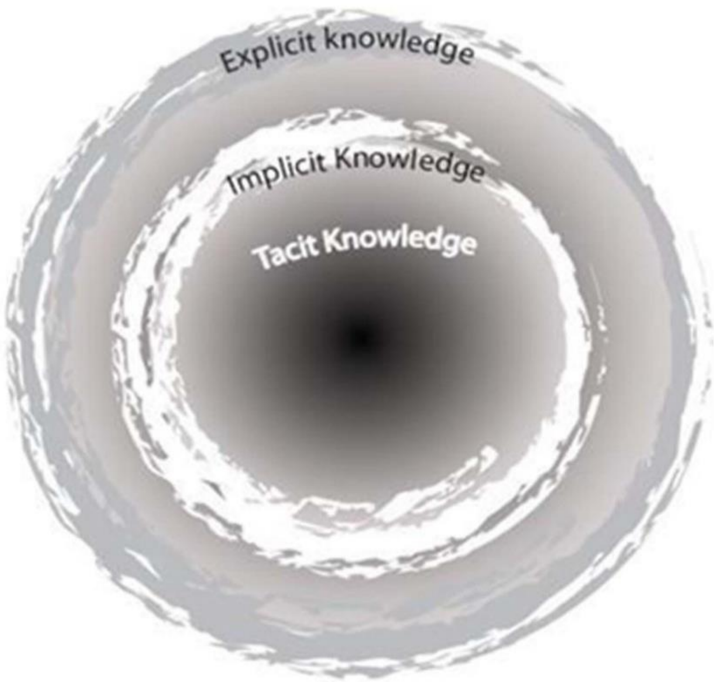

Figure 2-22:Explicit, Implicit and Tacit knowledges.

2.3.5 Explicit knowledge

Explicit knowledge is articulated and available within the public domain, societal knowledge contributed to by any number of individuals (Collins, 2010). It can be spoken, printed, symbols, codes strings of information that are communicated to be widely understood by all. Explicit knowledge can be accessed through communication, and at human level can be interpreted. Explicit knowledge concerning the throwing process would include materials, equipment, the structure of the process and knowledge of individuals who engage in the activity. It would include the use of books and electronic reference material, highlighting the craft process. All this information is freely available in society.

2.3.6 Implicit knowledge

The area of implicit knowledge is situated in between societal explicit knowledge and tacit personal knowledge. It is defined as an area of 'knowing-how' knowledge, procedural knowledge being used almost unthinkingly. Sometimes, with careful questioning, what previously seemed to be deemed tacit knowledge may be explained; it is then termed implicit knowledge (Dienes and Berry, 1993, p. 154).

Implicit knowledge concerns those supportive routines that potters use when throwing a pot e.g. when water is used for lubrication to aid the throwing process. Polanyi describes the knowledge in craft terms, in the *techne* areas, 'using tools as an extension of ourselves' (2009, p. 16). Wilson refers to this area as 'implicit memory' which is 'the means by which we learn skills, automatizing what was formally effortful…with practice though, new skills become automatized, reducing cognitive load and circumventing the representational bottleneck' (Wilson, 2010, p. 633).

2.3.7 Tacit knowledge

Explicit knowledge is seen to be at the outer extremity of communicable knowledge and tacit knowledge is at the inner extremity of non-communicable knowledge. Tacit knowledge is an internal personal knowledge that has not been explicated (Collins, 2010). Schon agrees that this knowledge concerns knowing intuitively, and that this knowledge is not easily explained. Those portions of knowledge, for example, that an individual has experienced and generally has not the means to articulate to others (Schon, 1991).

Collins proposes in 'Tacit and Explicit Knowledge' that there are three types of tacit knowledge: Collective, Relational and Somatic tacit knowledge (2010).

Collective Tacit knowledge embodied from an individual embedded in society, the knowledge that most potters use clay and those who throw pots will use a potter's wheel. This could be more ontological rather than biological. It involves the knowledge of social society and is only human due to the need to have special and continuous access to the location of knowledge (Collins and Evans, 2007). The brain and body have unique capacities to allow it to acquire tacit knowledge from the world in a way no other machine can yet match.

Relational tacit knowledge is where knowledge is related to the social life of social activity and relationships, most individuals have a unique tactile experience of clay or some similar malleable material (Collins, 2010). Schaffner discusses that 'clay is also primal - a medium for the most elemental associations and expressions' (2009).

The third knowledge is Somatic tacit knowledge dealing with a tacit knowledge embodied by the human body and brain. This knowledge might be how an individual might handle clay under differing conditions, too moist, too dry and how to ameliorate the condition where a person might instinctively know how to manipulate the clay (Collins, 2010).

Work from Rust and Wood discuss tacit knowledge in relation to the capturing and passing on of craft skills from master craftsmen. The focus of their work was about which medium craft skills might be most efficiently passed on. They recognise that 'a great part of a craft practitioners work is internalised as demonstrated by the difficulty of the master blade grinder experienced in articulating his knowledge in the pilot study' (Wood, Rust and Horne, 2009, p. 71). Polanyi features in their discussion, in their article, as explanation for tacit knowledge using the terms proximal knowledge and distal knowledge and the relationship between the two types of knowledge (ibid, 2009, p. 18). Their conclusion is that the knowledge, Polanyi acquires is experiential knowledge and to pass this knowledge on needs 'reflection in action' as explained by Schon (1991, p. 120).

2.3.8 Experiential knowledge

'It is a way of knowing about and understanding things and events through direct engagement' (Berg, 2008, p. 322). Figure 2-23 shows how experiential knowledge interacts with tacit, implicit, and explicit knowledge areas.

Figure 2-23:Experiential, Explicit, Implicit and Tacit knowledges.

Berg explains that *indigenous* and *local environment* knowledges are gathered as information or meanings from active participation in a group. This would occur when novice learners would glean information from master craftsmen practitioners. This knowledge aligns with *implicit* knowledge where there is a societal influence on tacit knowledge areas.

> *'Knowledge can be likened to a suitcase. You know it all, but you have to unpack it item by item in order to understand how it is packed together'* (Pountney *et al.*, 2000).

This anonymous quotation was cited by Pountney et al when discussing explicit knowledge. The other knowledge areas may necessarily become evident as the 'repacking' is attempted. Knowledge, experiential knowledge, has been the subject of debate and research. Barratt has considered the work of Dewey who claims that '*all knowledge is essentially experiential'*, knowledge gained through or by experience (2007). Neidderer and Reilly have explored aspects of experiential knowledge. They refer to Johnson and his understanding of knowledge and knowing and his refuting the term 'body of knowledge' which he understands as a fixed identity rather than having the reflecting and enquiring elements of real learning, one conclusion they made was that projects needed to 'move from reflections on tacit knowledge in research and practice, to studies of tacit knowledge in application' (Niedderer, 2007, p. 86).

2.3.9 Learning

This section considers the learning element of how skills involved in the throwing process may be acquired by an individual. Systems of learning from the Multi-intelligence theory from Gardner, VARK, and learning preferences, the experiential learning cycle of Kolb and developed by Honey and Mumford and a framework for the design of experiential learning from Beard. Education research has shown that there are different ways of learning a skill that an individual can utilise, e.g. observation, instruction, and practice. The area of cognition and learning is being constantly explored, and knowledge of learning is being increased through research, but rarely, if at all to the authors' knowledge through the medium of craft.

Gardner (1993) and VARK (Fleming, 2013) are used to investigate and confirm learning style preferences. Each exponent has devised a tool to aid an individual in the recognition of how an understanding of a preferred style of learning may be beneficial, especially in education settings. They generally involve an individual completing a questionnaire; the answers are then graded resulting in a type of general learning style. It could be a visual, observational style, an aural, listening style or a kinaesthetic practical and hands on style.

Gardner (1993), an educational theorist offered the theory that there are seven intelligences or modes, that have importance when learning takes place. Intelligences are the terms for the ways in which individuals best learn. His first devised list of seven intelligences was published in 1983 and has now been refined and extended to eight, the original seven are better known. He proposed that everyone has learning preferences or a distinct learning preference; some preferences are more dominant than others in individuals. Table 2-6 demonstrates Gardner's learning preferences.

Table 2-6:Gardners learning preferences.

Learning preference	
Linguistic	Learning through language, linguistic learning
Mathematical	Logical learning
Musical	Learning through rhythmic activities and with music,
Interpersonal	Learning with a group, able to problem solve.
Intrapersonal	Learning through self-awareness, analytical
Kinaesthetic	Learning through using the body, remembering by doing
Spatial-visual	Learning through visualising images and space
Naturalist	Learning through nature and experiencing the natural world

Gardner proposed the view that each person has their own way of learning and so would progress far more with that element in lessons, in order to make lessons more easily learnt.

VARK is a questionnaire that provides users with a profile of their learning preferences. VARK refers to four main preferences for learning,

- Visual
- Aural
- Read / write
- Kinaesthetic

There is a fifth preference of 'Multimodal' learning, where an individual might have similar scoring in several of the four areas, and showing no seeming bias; therefore, the individual would enjoy a 'multimodal' learning preference. These preferences are about 'the ways that they want to take-in and give-out information' (Fleming, 2013). Vitiello suggests that VARK 'was based on a sensory model built on neuro-linguistic programming work and measures learners on their perceptual preferences and strength' (2013, p. 44). VARK is structured specifically to improve learning and teaching (Fleming, 2013). Fleming acknowledges that 'Gardner's Multiple Intelligences Theory' is another cognitive model and that it includes some of the VARK modalities as 'intelligences' and extends that list to at least five other dimensions. He continues 'sometimes the link between VARK and these theories appears to be quite strong, but VARK has its own focus, rationale, and strategies' (ibid, 2013).

The implications for learning a craft skill by the method of potter and apprentice could involve a variety of these methods of learning. The most prevalent areas of learning preferences would be crossing between kinaesthetic and visual-spatial where the learner would be able to react to physically using the clay and the wheel. However, it could be seen that almost all ways of learning as advocated by Gardner could benefit the pot throwing process. Craft has seldom, if ever been mentioned in studies concerning learning styles. Wood in her thesis considered how ancient and dying craft skills, skills for clog making and bowl turning, might be transferred to students by the use of technology (2006). Her focus remained on the type of knowledge, which was required to learn skills rather than the mode by which a learner might acquire the skills, apart from a very brief mention of Kolb (Wood, 2006, p. 129).

2.3.9.1 Kolb: The experiential learning cycle.

Fleming suggests' David Kolb's Experimental cycle is a model of cognitive processing – how we process learning in the brain' (2013). Meittenan proposes that Kolb's four-stage model of experiential learning is a 'fundamental representation of the approach' and that 'it has been the starting point for several attempts to develop Adult Education theory' (2000, p. 55). Kolb began his learning cycle with a practical and sensory activity. An individual then had an experience on which to base learning, because when learners 'involve themselves, fully, openly and without bias in new experiences' learning occurs, (Kolb, 1984, p. 30). The second part of the learning cycle considers that this is the stage to interpret and reflect on points from the practical activity before generalising learning points ready for the final stage, where what has been learned is applied and tested for efficacy. Figure 2-24 shows the learning cycle from Kolb.

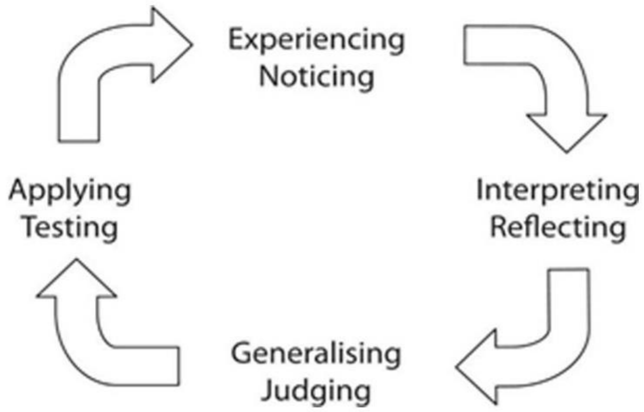

Figure 2-24:Kolb learning cycle adapted Beard & Wilson 2006.

The Kolb learning theory model has been discussed by Beard and Wilson as being a 'widely established and is almost taken for granted theory of learning' (2006,p 40), but it has 'lack of direction', 'subjectivity' and limitations in the form of coming to false conclusions, not understanding change and may cause laziness and dogmatic thinking' (ibid, 2006, p. 41). Meittenan states that Kolb 'unites terms and concepts, extracting them from their idea-historical contexts and purposes and puts them to serve the purposes of his own presentation' (2000, p. 56)

2.3.9.2 Honey and Mumford

Honey and Mumford developed and built on Kolb's learning cycle. Their explanation suggests four types of people whose learning styles aligned to the four stages of the learning cycle. Table 2-7 outlines characteristics of the learning styles which are placed into the four stages of the learning cycle.

Table 2-7:Attributes of learners, Honey & Mumford.

Student	Characteristics	Application
Activist	Learns by doing	Involves in activity
Reflector	Reflects on the whole picture	Gathers data, considers
Theorist	Needs to understand relationships and theories involved	Model maker
Pragmatist	Experimenters – seeing if new things work	Puts knowledge to practice

In consideration of the work of Kolb and Honey and Mumford, Figure 2-24 combines both thoughts on learning styles. The planning element works with pragmatist, followed by experiencing and activist. The third element, reviewing sits neatly with reflector, and the final part of the cycle, concluding, works well with a theorist element.

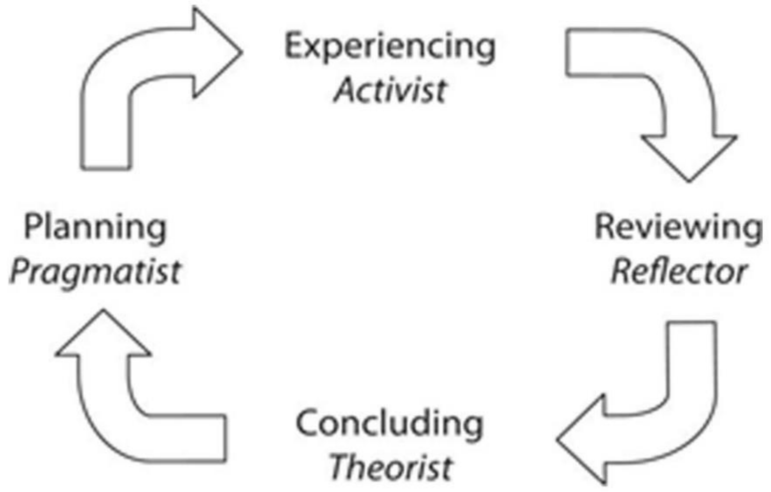

Figure 2-25:Matching Kolb to the developments of Honey & Mumford.

Beard has formulated a framework for the design of experimental learning. The framework, seen in Figure 2-25, ‘is an abstract visual metaphor representing a combination lock with several categories or cogs, that can all be independently rotated producing several million possible permutations’ (Beard, 2008). The Learning lock would be complex to use and remember but would offer learners a structure to learn at maximum efficiency once the formula was discovered for a learner.

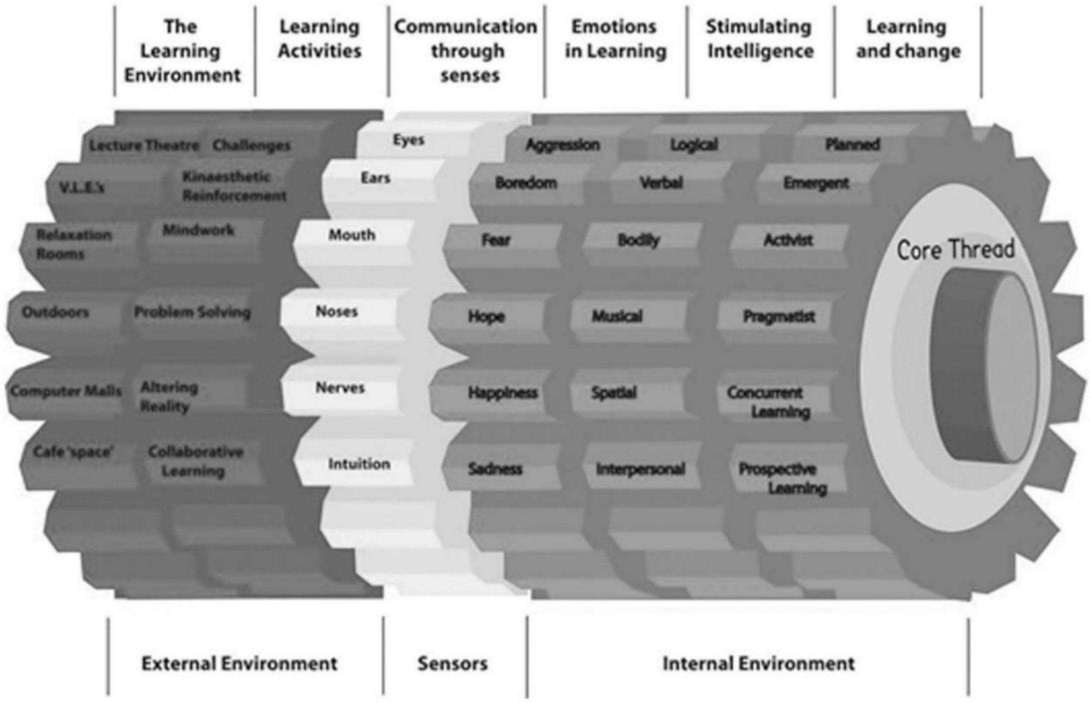

Figure 2-26:The Learning Lock, adapted from Beard.

Alongside the learning combination lock, Beard has assembled a definition of experimental learning, which covers both tacit and explicit aspects of experiential learning and knowledge:

> *'EL is a sense making process of learning that actively and reflectively engages the inner world of the learner as a whole person (physically-bodily, intellectually, emotionally and spiritually) with the intricate 'outer world' of the learning environment (nature, place, social, political)'* (Beard and Wilson, 2004, p. 2).

Experiential learning is learning through experience, through direct engagement with the learning situation. It is believed that the learner is at the centre point of the learning focus, with a teacher acting as facilitator, the experience, upon reflection, would contribute to the learning. (Andresen, Boud and Cohen, 1999). It would involve the whole person including feelings and senses, the outcome would be influenced by factors such as, the quality of the experience, the expertise of the facilitator and the degree of skill in which they operate. There is expectation that a learner would reflect on their experiences in order that true learning would take place (Moon, 2000, p. 103).

Through the essence of making, pot throwing is an experiential activity. It is action led, therefore, an experience. There are facets of the term experiential which can be explored through the example of pot throwing, although the term can be used for any active learning in whichever discipline. Figure 2-26 depicts experiential learning with the student at the centre point of learning.

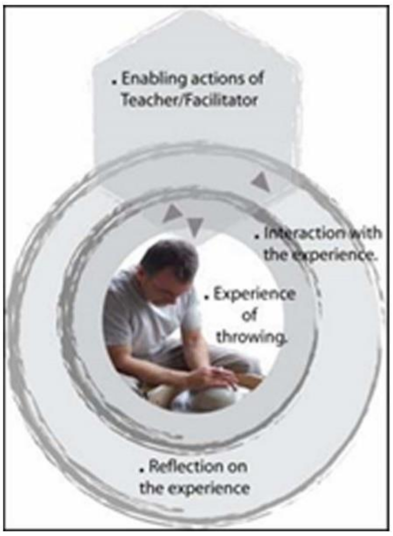

Figure 2-27:Experiential learning.

Therefore, when learning to throw a pot, the student is necessarily at the centre of the activity, engaged perhaps, in active observation of a potter throwing, visually resulting in unconscious tacit learning through the action of 'mirror neurons' helping us learn unconsciously highly specific movements' (Onions, 2009). The student would then be encouraged to put their observed knowledge into supported practice with the clay and the potter's wheel, in order to get a 'feel' for the process. Pountney et al, suppose, through practical experience, that it can take 'millions of repetitive movements to produce a perfect print of the skill on (ibid, 2009)motor memory' (Pountney *et al.*, 2000; Sennett, 2009). Therefore, the skill of throwing a pot on the potter's wheel needs to be practiced a multitude of times for the process to become automatic. A cycle of learning similar to Kolb (1984) where a skill must be highlighted, reflected upon, and practiced and then applied. This cycle would continue to be adapted with each cycle of learning.

Through observation, there might be anticipation of the learning / practical experience that there might be reactions in the brain. Zeki proposes that there may well be chemical changes in the brain altering neuron patterns, after having experienced a visual artwork. The work evokes an emotional response thereby triggering a change in the state of the neurons. It could happen that neurons and the chemical composition of the brain could equally be changed as a result of an intense tactile personal experience with clay (Zeki, 1998). As noted, Schaffener believes that 'clay connects to some pretty basic and base impulses. It practically demands to be touched and shaped', she continues 'the physicality can bring on this fleeting sensation of well-being, happiness and pleasure' (Schaffner and Porter, 2009). Therefore, with the feelings of happiness and pleasure might come the greater potential to learn, from this happy experience, supporting theories discussed by Zeki.

2.3.10 Skills

Skills, especially craft skills, can be time-consuming to acquire. Skill is defined as 'the ability to do something well; expertise'. Table 2-8 shows a taxonomy of skill, which has been compiled from the attributes from each research area of Collins, Dreyfus and Cross, highlighting the attributes, the skills. There are two levels of attributes included within the table, firstly the main strands of knowledge, explicitly stated, highlighted in yellow, and secondly the implied strands of expertise are highlighted in grey. The attributes of expertise are not listed firstly, in any rank order, but purely in alphabetical order of attribute, this creates a seemingly random pattern of expertise and skill. When like attributes are grouped in areas categorised as ability, knowledge, skills, decisions, and approach, as shown in Table 2-8, a pattern emerges where it is evident that Collins is linguistically based, and Dreyfus and Cross are more practically based. The striking difference, evident within Table 2-9, is that neither Collins nor Dreyfus appears to consider ‘approaches to problems’ within their sphere of expertise study. This difference appears in this comparison to belong to the area of design.

Table 2-8:Attributes of skill and expertise from Collins, Dreyfus and Cross.

Skills	Collins	Dreyfus	Cross
Ability			
Ability to apply new information quickly	■	■	■
Automaticity		■	
Communication skills	■		
Contributory expertise practical skills	■	■	■
Contributory expertise language skills	■		
Decision making	■	■	■
Deductive solution of problems			■
Deep understanding of subject	■	■	■
Excel in domains		■	
Experience	■	■	■
First principles			■
Flexibility in approach to new problems			■
Framing the problem			■
Generative reasoning		■	■
Intuitive action		■	■
Repertoire of strategies	■	■	■
Rule breaker		■	■
Solution focussed			■
Superior performance			■
Systematic design		■	
Tactical decisions	■		

A pattern of agreement emerges when the attributes of expertise are grouped according to mentions from Collins, Dreyfus and Cross. A hierarchy of attributes of expertise is then evident. The following table starts with attributes that are common within the three considerations of expertise, which might be thought of as important, then attributes within two strands of expertise and then one strand of expertise. See Table 2-9.

Table 2-9:Grouped attributes of skill from Collins, Dreyfus and Cross.

	Attributes of expertise	Collins	Dreyfus	Cross
Ability	Ability			
	Excel in domains		■	
Knowledge	Ability to apply new knowledge quickly	■	■	■
	Deep understanding of subject	■	■	■
Experience	Experience	■	■	■
	Automaticity		■	
Skills	Communication	■		
	Linguistic contributory expertise	■		
	Practical contributory expertise	■	■	■
Decision making	Decision making	■	■	■
	Generative reasoning		■	■
	Intuitive action		■	■
	Repertoire of strategies	■	■	■
	Tactical decisions	■		
	Systematic design		■	
	Rule breaker		■	
Approach to problems	First principles			■
	Flexibility in approach to new problems			■
	Framing the problem			■
	Deep understanding of subject			■
	Solution focussed			■
	Deductive solution of problems			■
	Superior performance			■

The attributes of expertise and skill were then grouped together creating a clear visual pattern in focus from each perspective.

Table 2-10:Attributes of expertise and skill ranked in frequency.

	Attributes of expertise	Collins	Dreyfus	Cross
Section 1	Ability			
	Ability to apply new information quickly	■	■	■
	Decision making	■	■	■
	Deep understanding of subject	■	■	■
	Experience	■	■	■
	Practical contributory expertise	■	■	■
	Repertoire of strategies	■	■	■
Section 2	Communication skills	■		
	Linguistic contributory expertise	■		
	Excel in domains		■	
	Generative reasoning		■	■
	Intuitive action		■	■
	Rule breaker		■	■
Section 3	Automaticity		■	
	Deductive solution of problems			■
	First principles			■
	Framing the problem			■
	Flexibility in approach to new problems			■
	Solution focussed			■
	Superior performance			■
	Systematic design		■	
	Tactical decisions	■		

The first range of attributes has elements of each grouped category, ability, knowledge, experience, skills, and decision making except approach. There is a strong designer bias within ‘approach’ from Cross which is not common in use with Collins and Dreyfus.

Section 2, grouping of elements is less defined and could easily have been considered as essential within the attributes of expertise. This grouping highlights that Collins is linguistically and societal based. In his discussions of expertise an ability to excel in a domain is not necessary, because his focus is looking at how an expert- functions within a group. The adoption of expert vocabulary of that group does not necessarily make for an expert in a practical domain. The lack of practical subject knowledge would prevent generative reasoning and to a certain extent intuitive action. Dreyfus lacks consideration of communication and language skills as these were not part of their studies into how proficiency and expertise is gained. Cross benefits here from the tacit understanding that skills in communication can be viewed as part of designer expertise.

The third grouping attributes have been considered only in one strand of research into expertise which seemingly makes them less strongly needed, yet all are considered important to have been included in the original area of expertise. The following seven attributes of expertise listed below appear across the areas covered by Collins, Dreyfus and Cross making them the top seven attributes of expertise: -

- Ability
- Ability to apply new information quickly
- Practical contributory expertise
- Decision making
- Deep understanding of subject
- Experience
- Repertoire of strategies

The seven attributes may now be applied to differing domains of expertise: specifically, the skill of pot throwing.

2.3.11 Application

When applying this combination to the participants the seven most common attributes of expertise can be matched to the prospective participant potters. Table 2-11 outlines the application of the seven common attributes of expertise to potters.

Table 2-11:Application of skills and expertise to pot throwing.

Ability	A potter needs an ability to interact with the material, clay with success.
Ability to apply new information quickly	When throwing a pot, the potter needs to react with immediacy to sensory information acquired through fingertips.
Practical contributory expertise	Throwing potters pass on skills to others through practical learning, writing or visually.
Decision making	Decisions are made throughout the throwing performance resulting from sensory input.
Deep understanding of subject	Will have a deep tacit understanding of the materials and the interactional forces involved in the throwing performance.
Experience	Tacit implicit and explicit knowledge is involved in the levels of experience.
Repertoire of strategies	Are needed throughout the throwing performance to counteract the problems that may arise.

These brief outlines for each attribute are an initial response and need further and more precise application.

Pot throwing skills were learned from master craftsman to apprentice in a time served apprenticeship. Ericsson suggested that to become expert at a skill takes 10,000 hours (Anders Ericsson, 2004). This time is taken to teach the required muscles to retain muscle memory and become expert at a particular skill. This takes perseverance. There are skills of balance and the ability to be able to control the speed of a potter's wheel combined with manipulating clay material and lubrication.

One critical skill involved in successfully throwing a vessel is the ability to 'read' the physical material and respond, in a timely manner, to changes in physicality. 'Reading' in this instance is defined as the ability to haptically (through hands and fingers) sense and understand enough of the sensory information, for the practitioner to have the ability to respond to the information sensed. Therefore, an experienced practitioner would be able to respond to ameliorate an issue between potter, material, and technology.

Malafouris discusses this set of skills, this dialogue between potter, material, and technology as 'material agency' (Malafouris and Knappett, 2008).

Learning the skills of how to throw a pot can be achieved in several ways; Figure 2-27 outlines differing paths of learning how to throw a pot. There are advantages and disadvantages attached to each method of learning. The process of learning is a highly individualised process. It appears the teaching and learning would provide aspects of sensory teaching.

Figure 2-28:Methods of learning how to throw a pot.

From early times, pot throwing skills have been passed from master to apprentice. This gives the notion that the process, as part of a collection of craft skills, such as throwing, require one-to-one teaching. This method of learning skills has continued until recently with the onset of rapid knowledge transfer via podcasts and instructional video clips and the wide variety of internet pages of instructions combining both audio with visuals. This is placed in the self-taught category of learning, with kinaesthetic and visual spatial where the learner would be able to react to physically using the clay and the wheel. However, it could be seen that almost all ways of learning as advocated by Gardner could benefit the teaching of pot throwing. The implication for learning a craft skill by the method of potter and apprentice could involve a variety of these methods of learning. The most prevalent areas of learning preferences would be crossing between how to throw a pot may be adequate, but not necessarily with the best, most efficient technique.

Apprenticeships have been revived to provide training available post 16, however, the creative arena declines to offer or mention any current apprenticeships with traditional crafts. Historically books and creative arts digital pages recognise that Leonardo Da Vinci had been an apprentice, (Nicholl, 2005, p. 61). There have been journal articles about apprenticeships within pottery studios. James Cornwallis (2006), was inspired by a thrower to find a potters' apprenticeship; and travelled abroad to France to learn.

The study by Wood and Rust considers alternatives to person to person tuition by capturing and passing on digitally skills knowledge (Wood, Rust and Horne, 2009).

2.3.12 Expertise

The domain of Art and Crafts appears to be in the early stages of research in this area. The reviewed literature suggests little exploration in the area of expertise. What has been done is embedded within education focussed studies (Wood, Rust and Horne, 2009). Craft expertise as a factor of Aggrandizer strategies, is discussed in an archaeological paper considering the case of flint knapping production in late Neolithic times (Olausson, 2008). Therefore, it appears, the craft area has little to date, in specific research about expertise in crafts.

Defining expertise was necessary when considering the experience of participants for the study. Three 'experts' in the field of expertise, Dreyfus, Cross and Collins, were selected for this review. The three definitions of 'expert' and 'expertise' were applied to gain the optimum balance of metrics for the requirements of a pot throwing performance.

2.3.12.1 Definitions of expertise

Discussion around expertise has been explored since the 1960's. There has been much documented about expertise with music, chess, and athletes (Ericsson and Charness, 1994). The area of business management was the first field to consider expertise. Initial studies in management and expertise are dated around 50 years ago. Figure 2-28 demonstrates the development in the area of expertise as described by Germain and Ruiz expanding from management expertise. The developments diffuse into Computer Science and Cognitive psychology, further growth into Education and the nursing side of Medicine. Then initiating Engineering expertise, into Design and Craft areas and developing beyond. (2009).

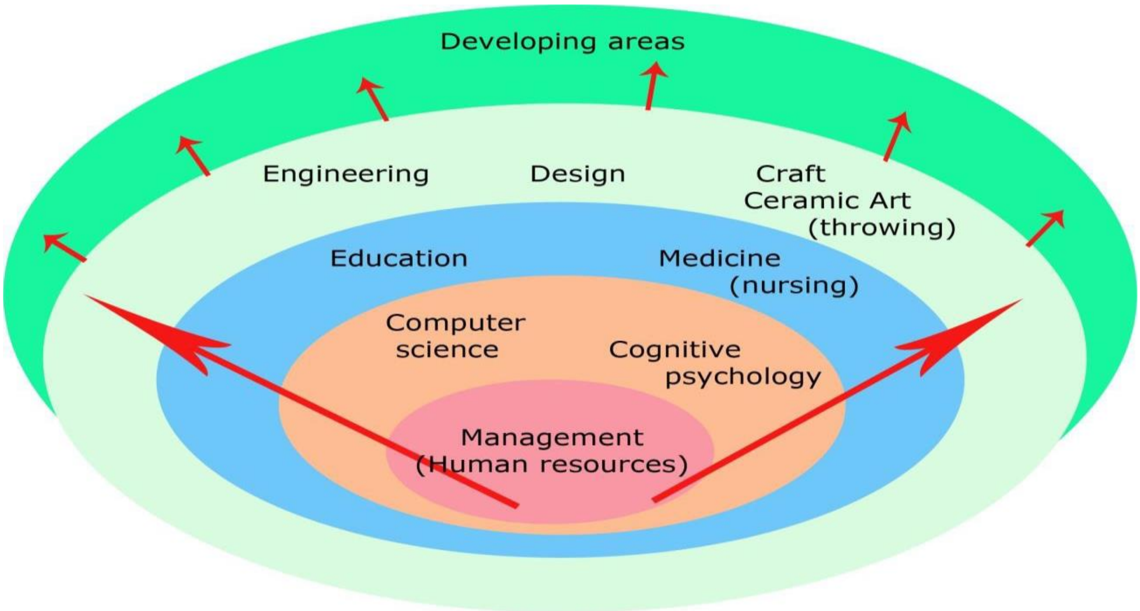

Figure 2-29:The development of expertise, illustrated, Germain & Ruis 2009.

Reflecting on previous studies, Brandsford (1999, p. 31) lays out knowledge and behaviours, experts can manifest. Felton (2007), from an Education perspective, concludes that definitions of expertise are domain specific, due to differing values of the criteria for expertise in each domain. Some domains value and favour track-record expertise; and others on skill set and knowledge (Dreyfus, 1988). From a design and engineering perspective, Cross (1998) discusses differences between novice and expert design behaviour. He concludes that truly expert designers have been omitted from studies, thereby giving an inaccurate picture of expertise within the design domain (Cross and Clayburn-Cross, 1998, p. 141). Dorst and Reymen (2004) expanded their review into levels of design expertise through Cross's eight basic abilities and Dreyfus's five degrees of expertise. They concluded by suggesting there was a need for more research. However, neither author seems to have explored this area further. Cross makes a statement that 'expertise develops over time as a person matures and that performance will peak at different ages. In the arts, the suggestion is, a person would be in their forties before a decline in performance (Cross, 2004). This view is substantiated in 'Crafts in an Age of Change' (Yair *et al.*, 2012), with data showing in Table 2-12 following those findings. However, the metrics used to support these statements are less well described or defined.

Table 2-12:Craft Council figures and study figures compared.

Age of crafters	Percentage of study population
25-34 years	12.40%
35-44 years	21.40%
45-54 years	25.80%
55-64 years	25.30%

2.3.12.2 Collins on expertise

The first selected consideration of expertise, without explicit links to craft is from the sociologist, Harry Collins. Collins has been working since the 1990's developing knowledge and expertise from a sociology viewpoint; reviewing how experts gain expertise from a community aspect. Collins and Evans have developed a definition of expertise and expert knowledge from a linguistic and societal perspective, relating verbal knowledge and expertise. Intertwined into these definitions are elements of practical expertise at the more complex levels of expertise. Collins and Evans have compiled a 'periodic table' of their understanding of expertise entitled 'Ubiquitous Expertise'. The 'periodic table' lays out in four stands, categories of expertise and expert knowledge, ranging from the personal: ‘dispositions’, then ‘specialist expertise’, ‘meta-expertise’ through to ‘meta-criteria. Figure 2-29 is an adapted ‘periodic table’ of ‘Ubiquitous Expertises’ from Collins and Evans. The highlighted area is of special interest. Other strands of interest are ‘Dispositions’ and the second strand laying out ‘Specialist Expertises’. The model is human-centred design (Collins and Evans, 2007, p. 17). ‘Dispositions’ refers to an individual with an ability to interact and reflect (ibid, 2007, p. 13). The interaction could include material, for the purposes of this project, clay. The ability to reflect; is an inherent part when acquiring skills, and therefore, with application, interaction and reflection can become an expertise. The second strand applying to the project is entitled ‘Specialist Expertises’. It has two areas, ‘Ubiquitous Tacit Knowledge’ and ‘Specialist Tacit Knowledge’. The first part would be community and novice knowledge.

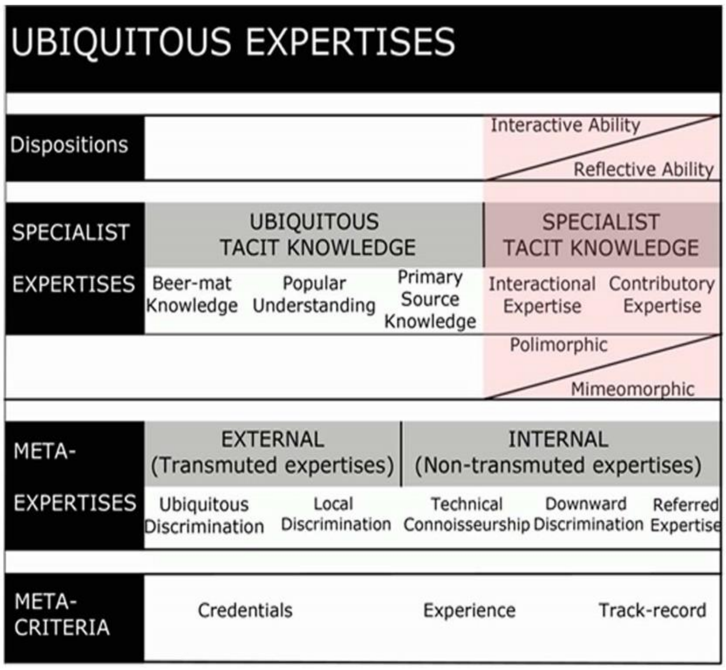

Figure 2-30:The 'Periodic Table' of Ubiquitous expertises adapted from Collins 2007.

The second part with ‘Interactional expertise’ and Contributory expertise’. These terms imply that there is an increasing knowledge involved combined with a relationship with a community, knowledge, and material.

The terms included in this strand of 'Polimorphic' and 'Mimeomorphic' apply within the 'Specialist Tacit Knowledge' area. The definition of both these terms of actions are outlined in Table 2-13.

Table 2-13:Definitions of 'Polimorphic' and 'Mimeomorphic' actions.

Polimorphic actions	Mimeomorphic actions
Actions needing social understanding	Actions are mechanical thus do not need to turn on social understanding of their movements
Behaviour responds to social changes	Can be reproduced by mimicking fixed behaviours
Cannot be mastered by machines	Humans cannot use some 'Mimeomorphic' actions

Despite seeming opposites, these terms can be combined when considering such skills as bicycle riding. The physical riding of the bicycle is a 'mimeomorphic' action, a repeated action. The social aspects and safety aspects of riding a bicycle are contained within the 'polimorphic' actions e.g. the application of a traffic code of conduct. Throwing a pot could be simply a mimeomorphic action, but the action demands far more response. The remainder of information displayed in the 'Table of Ubiquitous Expertises' outlines language expertise within societal groups.

2.3.12.3 Cross on expertise

The second example to consider expertise is from the designer commentator, Nigel Cross. Cross points that 'Too many studies have been based on novices or, at best, average ability designers' (Cross and Clayburn-Cross, 1998). A focus on a baseline of novice and average designers, may well have a limiting effect on the understanding of how expert designer activity operates. Cross suggests a change in focus to a comparison of expert designers, which may highlight expert behaviour. Figure 2-30 outlines designer behaviours evident in both novice and expert designers, referenced to journal papers.

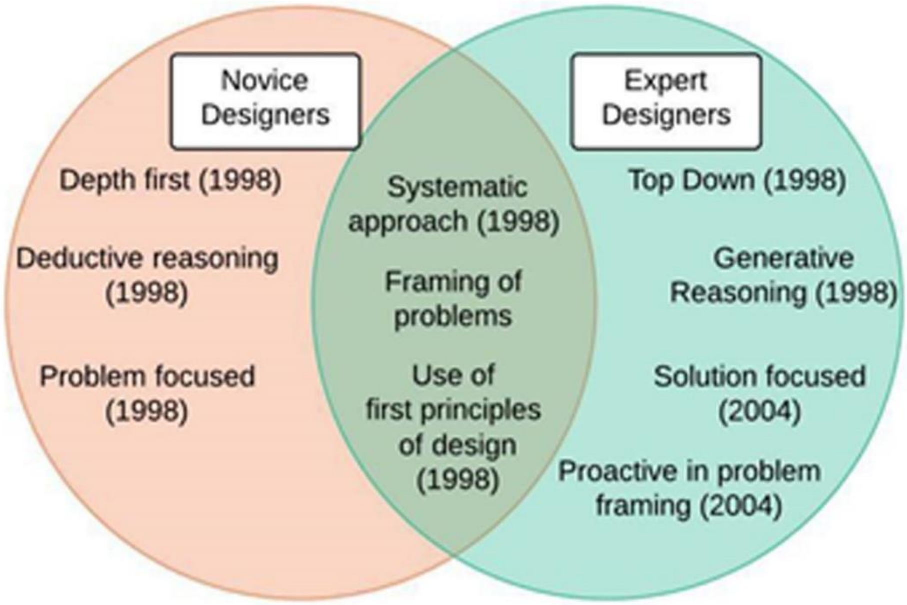

Figure 2-31:Attributes of expertise in novice and expert designers, Cross.

Cross discusses the acquisition of expertise in broadly similar terms to Dreyfus, in that, design thinking suggests there are different stages in the development of a designer (2007). Cross explains that introduction/neophyte, through to education/novice, and experience/expert towards eminence/master, although sequential, is not time driven. Cross states some individuals may reach their potential at other than the level of master. He concludes that there is more to be explored in the acquisition of skills from novice to expert to master, to enable the process to be better facilitated.

2.3.12.4 Dreyfus on expertise

The structure of developing expertise has been applied across many fields requiring a framework for marking stages in progress towards expert status. The structure devised and developed by Dreyfus in 1980, concerned mental activities and directed skill acquisition, affirming the need for concrete experiences (Dreyfus and Dreyfus, 1980). The featured examples are not confined to chess playing or learning to play a musical instrument; but suggest learning to fly an aeroplane or a foreign language acquisition.

The range of application has led to adoption, possible adaptation, and interpretation of the initial acquisition structure across many areas. Table 2-14 describes the levels of acquisition from Dreyfus and Dreyfus (1980).

Table 2-14:Description of levels of acquisition adapted from Dreyfus 1980.

Stage	Level	Description
1	Novice	The instructor decomposes the task environment into context free features that the beginner can recognise without the desired skill. The beginner is then given rules for determining actions on the basis of these features.
2	Advanced Beginner	The novice gains experience in coping with situations. After seeing a sufficient number of examples, the novice recognises these new aspects.
3	Competence	A student may seem overloaded and seem not to be progressing with skills, with targeted application understanding and decisions become easier.
4	Proficiency	The information consuming disposition of the novice is replaced by involvement resulting in situational discriminations and associated responses.
5	Expertise	The expert not only sees what needs to be achieved; but thanks to a vast repertoire of situational discriminations, they see immediately how to achieve the goal.

Expertise is an ingredient for successful throwing. It takes time to build up sensory, haptic expertise and the making of many pots. Muscle memory and haptic touch need firmly embedding in an individual before the term expert can be thought of and applied.

2.3.13 Health and safety

The starting point for all students of any workshop-based skill are rules about health and safety. Whilst there are clear guidelines on conduct and good housekeeping in a ceramics workshop, health and safety issues associated with the performance of pot throwing are rarely if ever mentioned. The general guides from Stoke on Trent Institute of Ceramics, comprehensively covers all areas of physical lifting, e.g. considerations for weights of material to be carried, and chemical hazards caused by substances e.g. powdered ingredients for glazes (Institute of Ceramics, 1991). It neglects to mention anything associated with potential personal, physical problems e.g. highlighting the potential physical dangers of muscle wear and fatigue when throwing time is lengthy. There are few, if any, guidelines recognised by governing bodies. Radcliffe College, Boston, MA. (CVPA, 2009), is one college that identified a comprehensive need for guidelines in a section headed '*Overuse and strain injuries*.' The need for care is recognised when engaging in ceramics activities, highlighting such common possibilities as tendonitis and carpel tunnel syndrome. In a comparable institution in the UK, Manchester Metropolitan University, (MMU, 2009), the health and safety advice simply outline requirements to be aware of the effects of silica dust, the importance of clean floors and no eating in the ceramics workshop. UK places of work, from the smallest individual pottery to colleges of art and industrial premises, have a legal requirement to adhere to Health and Safety guidelines. These guidelines rarely if ever mention the importance of body posture safety, instead opting to emphasise the importance of lifting heavy objects correctly to minimise strain risk; or giving guidance in the operation of machinery.

2.3.14 Physical performance analysis

Task analysis is a number of different approaches of analysing observable human behaviour with a shared broad goal of measuring human performance (Gramopadhye and Thaker, 2003, p. 1). Task analysis is the term used to describe what 'a user is required to do in terms of actions and/or cognitive processes to achieve a task'. It can be achieved in a variety of ways as discussed by Kroemer (1997) and Grandjean (1969). An early method of annotating an activity, devised by Gilbreth in the late 19th century, was the use of 'Therblig's' when analysing an event. Therbligs are a series of symbols representing actions or delays in a sequence. This system was effective in making processes physically more efficient. The convention of task analysis is discussed by Stammer and Sheppard (1995). Using task analysis to visually assess the pot throwing performance, through a series of allotted individual codes for each movement, provides an overview of the key moments.

Studies using task analysis have involved a variety of situations and process, the most common found were studies of vehicle systems and of computer systems. The activity of task analysis provides a temporal order to the activity. The analysis can reduce inefficient or wasteful activity impacting on the potter’s performance, through fatigue for example. It may also point to performance critical points during a throwing task. This method is augmented by using visual and audio recording systems; the visual recording also enabling visual annotation.

Task analysis was originally a business management tool which has transferred to a variety of areas to be utilised where there is a procedure or task to be monitored for efficiency. There are action approaches where a task is analysed Hierarchical Task Analysis (HTA) and Cognitive approaches where decision making is considered. It is a combination of these two styles which will analyse the task of pot throwing.

There is hierarchical task analysis where the task is observed for routines and sub routines. There is RULA (Rapid Upper Limb Assessment), this is a series of assessments that consider the upper limb and the placement of such during a working task. It considers the angle of the limbs and the load placed on those limbs and then there is a risk assessment for those limbs. The pace of the throwing performance will differ significantly from the RULA assessments. A pot throwing performance is a dynamic performance.

2.4 Summary

This chapter has discussed a structure for completing a thorough, systematic review of all types of literature. It has outlined the diverse areas of reviewed literature. Temporal aspects of printed book literature have been explored. The structure considered in this chapter has enabled the researcher/author to focus on certain elements rather than wandering unsystematically through literature.

There is a scarcity of academic literature focussing on craft skills and surrounding issues that might be reviewed; therefore Design fits well with crafts, when design is understood to be as described by although some terms may be used differently there are structures and shared elements with terms such as '*activity, make, product, structure* and *physical'*. Design is 'The single word design encompasses an awful lot' (Design Council, 2014) and craft encompasses an awful lot (2012) Creativity is acknowledged to be in D and T (Dakers, 2004)

Equipment has not moved far from the roots. The powering of potter's wheels has developed to include electrical powering. There are some wheels that are beginning to be made from sustainable material, but generally little has been changed in this direction.

There appears to be a scarcity of objective analytical literature concerning the throwing of pots, inclusivity, and the arts. This is reflected when searching with a focus on craft making and especially pottery making. Papers and journal articles seem concerned with individual potters and rarely on techniques.

Expertise, an essential element to the research study, has been clearly discussed reading from three different areas. Some views are reflected in each source area, but there are individual views which are not shared views. This enables discussion between those areas, e.g. design and sociology groups.

The literature surveyed has been dated post 1940. Due to the paucity of academic literature on craft skills of pot throwing, other areas have been investigated. These areas were not directly connected but have supported aspects of a throwing performance e.g. literature on athletic performance and training to investigate keeping body parts e.g. the shoulders stable.

3 : Research methods design.

'*I love it when a plan comes together*.'

Colonel John 'Hannibal' Smith

3.1 Introduction

This chapter will discuss the philosophical aspects of research, qualitative and quantitative characteristics, inductive and deductive approaches and mixed or integrated methods of research and research design.

Research Design 'is a way of organising a research project or programme from its' inception' (Gorard, 2013, p. 8).The term 'research design' encompasses; not only the methods and tools used, but also the wider research areas of qualitative, quantitative, mixed and integrated methods. These terms are used comprehensively across the research community.

In considering research design, Kumar (2010, p. 9) discusses that there are, in his opinion, three different types of research.

- Research categorised by the findings of the study, research application.
- Objective led research, and
- Studies of enquiry, using either qualitative or quantitative methods or both.

Figure 3-1 outlines types of research as defined by Kumar. This study is placed within the research strand of enquiry as highlighted in Figure 3-1.

: Research methods design.

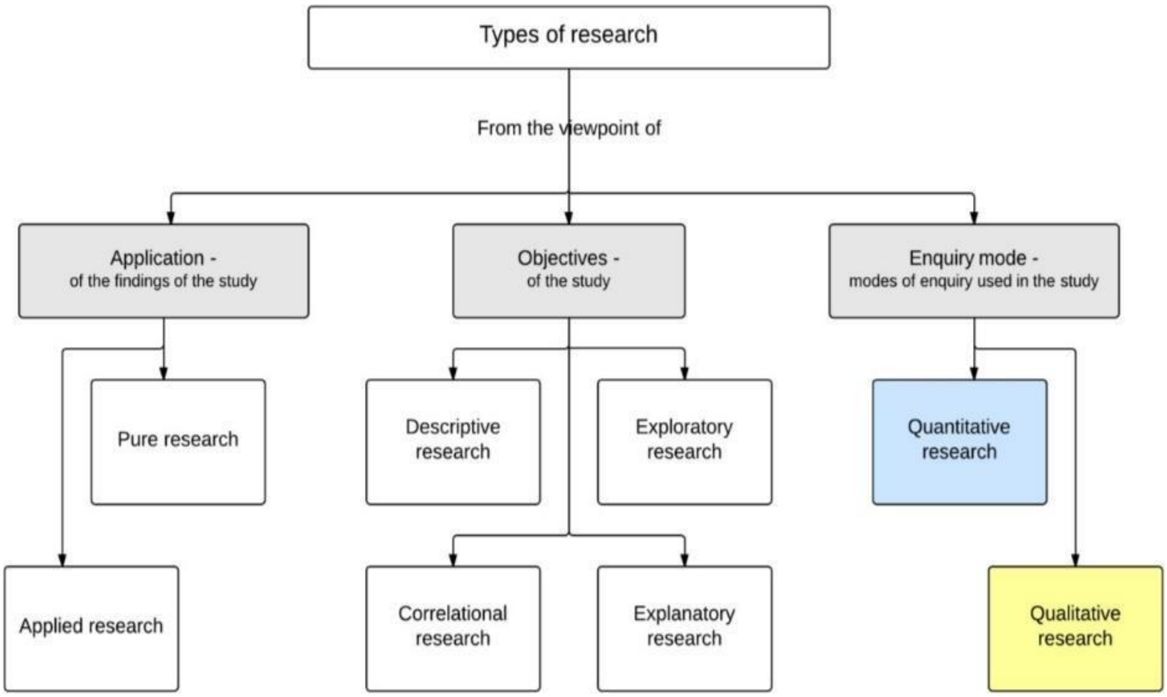

Figure 3-1:Adapted from Kumar showing research design from three differing perspectives.

Waring has a more complex research design approach by proposing four 'building' blocks of research. This is discussed by Cohen (2007, p. 7) with comparison to Burrell and Morgan (1979, pp. 23–25) who identified four similar sets of assumptions to Waring's four questions seen in Figure 3-2. The point of difference being the third question or assumption which, rather than using the term 'methodology', Burrell and Morgan consider the point to be 'human nature before continuing with the methodology assumption or question.

The four questions which form a frame are defined as: -

- Ontology defines the philosophical viewpoint of where a piece of research is placed, e.g. positivist, realist viewpoint.
- Epistemology considers knowledge and the type of knowledge that may be sought after, e.g. phenomenological study.
- Methodology places the research within a qualitative, quantitative, mixed methods or integrated framework.

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- Methods define the tools used for data collection and analysis, e.g. survey, interview.

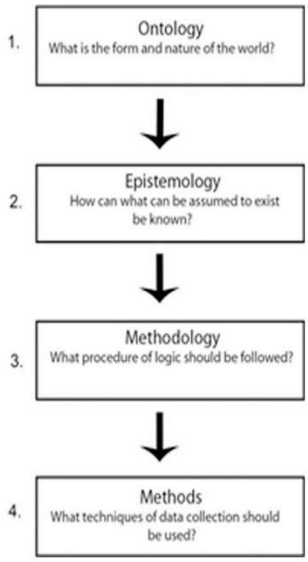

Figure 3-2:The research relationships, adapted from Waring 2012.

3.1.1 Philosophy of research design

From the conception of philosophical thought and discussion, scholars have been discussing knowledge, what constitutes as knowledge and methods of discovering new knowledge. Rockmore states a belief that 'ontology' is interlinked with the main strands of philosophical research, 'and yet being and knowing, ontology and epistemology are "indissociably" linked, hence inseparable' (Rockmore, 2011, p. 140). Table 3-1 outlines what might be researched should any of the paradigms be selected as research methodology. Five philosophical research areas demonstrate possible applications for this research study.

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Table 3-1:Five main strands of philosophical enquiry with study applications.

	Description	Application	Philosophers
Ontology	The study of beings or their being. -What is?	What is throwing a pot?	Anselm, Descartes
Epistemology	The study of knowledge. -How we know	How do we know what to do to throw a pot?	Ferrier
Logic	The study of valid reasoning. -How to reason	What reasons underpin decision-making processes?	Aristotle, Kant
Axiology	The study of values. -How we should act	What is the morally correct process for throwing a pot?	Socrates
Phenomenology	The study of our experience. -How we experience	How do we experience throwing a pot?	Husserl, Heidegger

Allison et al (2001); and Williams (2007) propose two research paradigms that support current research in the field of Art and Design. They list them as:

- Positivism
- Phenomenalism

Kumar agrees with the first point of positivism but prefers the naturalistic approach to be the second thread rather than phenomenalism. (Kumar, 2010, p. 14)

From the two main areas of research (Allison et al., 1996) states that there are seven main strands of research methodologies that have developed, covering all types of research. The study is placed between the descriptive and phenomenological areas of research methodology, as highlighted in Table 3-2, principally because observation of a throwing performance is a major source of data collection, before being analysed and described.

: Research methods design.

Table 3-2:Research methodology.

Research methodology	Description
Scentific method	Deductive Research able to be replicated to arrive at a conclusion.
Philosophical	A language focus, the meaning, structure and interpretation.
Historical	Research using historical data.
Descriptive	Needs reliability and validity for a descriptive explanation.
Experimental	Research has generally two groups, one for control and the second for testing.
Phenomenological	Observation is the main method of data collection. Researcher is a participant or not.
Practical	Research results in a product or products.

3.1.2 Research Paradigms

It is important to consider, here, research paradigms that could have an impact on this study. A paradigm is defined as ‘A conceptual or methodological model underlying the theories and practices of a science or discipline at a particular time; (hence) a generally accepted world view’ (Oxford English Dictionary, 2013b)

Ontology is a philosophical system about the nature of social reality – what can be known and how it is known. Researchers adopt a philosophical stance. These suggestions are not inexhaustive from among, e.g. positivist, interpretive, phenomenology or participatory (Kumar, 2010, p. 5). A researcher might pose their research question from these viewpoints.

Epistemology refers to the area of philosophical knowledge, who can know and how can they know. Waring proposes that epistemology has two interpretations, the realist, positivism, and the constructivist, interpretivism. (2012, p. 16). Waring discusses that the positivist, realist may feel it possible to gain direct knowledge of the world by directly observing a phenomenon. The constructivist, interpretivist feels it is not possible to gain direct knowledge by direct observation as any knowledge gained is from the interpreting of events.

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Phenomenalism upholds that each and every action is individual therefore the three postulates of positivism are not accurate. This form of research can take place in every area of life so therefore is 'the study of life taken at face value' (Cohen, Mannion and Morrison, 2007, p. 22) and is known within the area of qualitative research methodologies. Action research attempts to combine understanding or development of theory with action and change through a participatory process, whilst remaining grounded in experience (Kagan, Burton and Siddiquee, 2007). It is a straightforward cycle of research beginning with planning an action developing into realising the action, observing the action, there is then a time of reflecting on the action, instigating change which then leads to planning and the continuation of the cycle of action research.

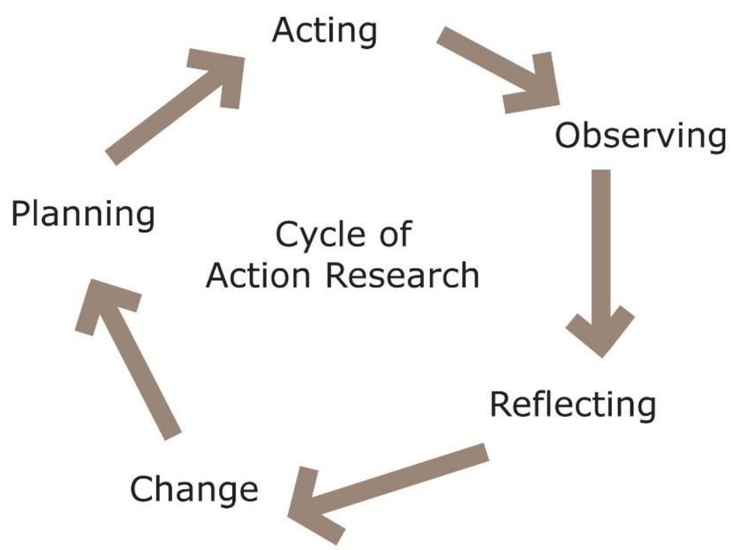

Figure 3-3:Cycle of action research (adapted from Hitchcock, Hughes 1995 p 29).

Postitivism involves a 'scientific method' which would incorporate 'description, prediction and explanation' (Allison and O'Sullivan, 2001).

It involves classifying substances, events and then observing them, systematically and scientifically. Positivism relies on three basic assumptions, as seen in Table 3-3. Cohen suggests from Duncan (1968) that there is ‘the acceptance of natural science as the paradigm for human knowledge’ (Cohen, Mannion and Morrison, 2007, p. 9).

Table 3-3:The three postulates of positivism.

Postulate	Description
Of natural kinds	Believing that all classes of substance or phenomena exhibit the same properties.
Of constancy	Believing that the phenomena changes very little over time.
Of determinism	Assuming there is an orderly regularity in nature.

This form of research can be measured and replicated therefore is part of quantitative research. The assumption was made that human behaviour is passive (Cohen, Mannion and Morrison, 2007, p. 18). It exhibits all the above assumptions with control, ignoring the fact that human behaviour is essentially active with inconsistencies. This paradigm places a researcher and a participant on different levels. Therefore, a movement began which rejected the structure of the positivists thinking, a post-positivistic movement.

Developments have been made with the post-positivistic movement. Groups rejected the three ‘postulates’ as being narrow and restrictive, despite adhering to the philosophical area. It was recognised that scientific processes of thought are situated closely to general thought processes. Post-positivism recognises ‘that the world is patterned and that causal relationships can be discovered and tested by reliable strategies.’ This paradigm has been named Post-positivism.

Kumar states he believes that there are two philosophical paradigms used within social science research. Firstly, scientific, and positivistic paradigm, covering those studies using both qualitative and quantitative methods. Secondly, naturalistic, and interpretive paradigms, embedded firmly in qualitative methodologies.(Kumar, 2010)

: Research methods design.

Research into pot throwing fits into the Post-positivism area as the paradigm sees that the world is patterned, and that causal relationships can be discovered and tested by reliable strategies. Such causal relationships as use of water in the throwing performance.

3.1.2.1 Characteristics of research

Kumar (Kumar, 2010, p. 8) and Coe (Coe, 2012, p. 8) discuss similar lists of transferable characteristics of research to be used whether the research is qualitative, quantitative or mixed with integration. These characteristics are listed that research should be,

- Critical
- Systematic
- Transparent
- Evidential
- Theoretical, and,
- Original

A successful study would have a combination of those elements. There would be critical aspects of a pot throwing performance from observations. The observations would be systematic and repetitive. From listing protocols, observations would be transparent. Results from observations there would be evidential aspects to findings.

3.1.3 Frameworks for an Integrated Methodology: Plowright

There was a framework that proved interesting. The framework follows a method offered Plowright in Frameworks for an Integrated Methodology (FraIM) (2011). This method can accommodate both qualitative (narrative) and qualitative (numerical) data sets. Plowright (ibid, 2011)builds upon an accepted conventional framework from Creswell (2010), Teddlie (2009) and Arthur (2012) by proposing an 'integrated methodology'. These, he feels, are frameworks to 'structure thinking about research', (Plowright, 2011, p. 3).

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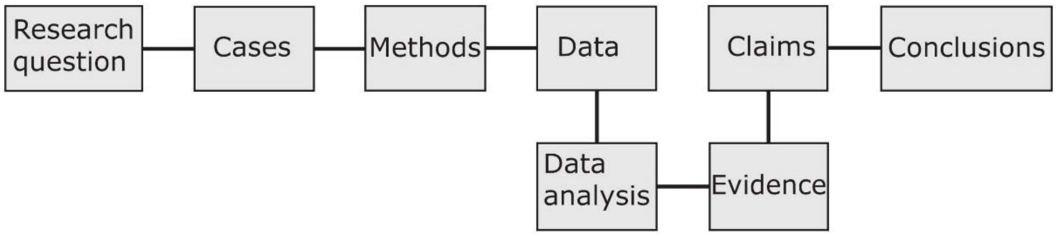

Figure 3-4:Section headings from an integrated structure. (Adapted Plowright 2011 p7).

Plowright suggests a wide number of contexts to be considered when explaining a research question. Such contexts as national, theoretical, policy, organisational and professional contexts. The inclusion of some or all of these categories of context supportive information would serve to develop the strength of the research question.

When Plowright uses the term 'Case', he explains that cases are sources of data, whether they are qualitative and narrative in origin or quantitative or numerical in source. This draws on the work of Hammersley (1992) who asserted that 'case' was an adequate term for a source of data. Plowright suggests the inclusion of sampling strategy and data source management under this heading. Such 'cases' of data might equally be placed within methodological aspects of research. The choice of data sources may be developed through a series of pilot studies (Blessing and Chakrabarti, 2009, p. 114) where data sources could be tested and evaluated for their utility. As expected, a sampling strategy in FraIM, for participants, would be either a probability or non-probability strategy.

Plowright discusses methodology in terms of degrees of structure and the proximity of the researcher. A higher degree of structure would include closed coding in both observation and analysis, and closed questioning in questionnaires. Less structure would enclose include open coding and more open-ended questions in a semi-structured interview setting. It is particularly the consideration of the degree of structure which enhances this research framework.

: Research methods design.

The framework takes on a three-dimensional form with the x axis bearing types of data. The y axis containing the names of tools and the z axis includes structured and non-structured, narrative, or numerical. Each cell would have the potential for a question to contribute to drive the research question forward. The proximity of the researcher to the data is raised in terms of ‘mediation’ ranging from the proximal observation to the analysis of the event with a short time scale to more distal analysis of events through artefact observation and interviews (Plowright, 2011, p. 50) Figure 3-5 illustrates a potential methodological structure.

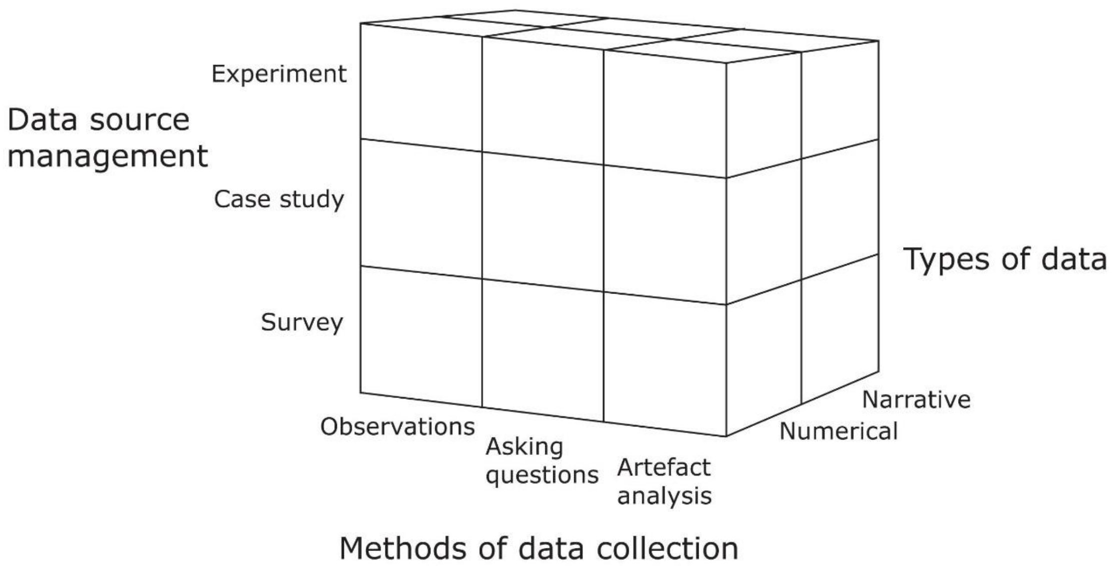

Figure 3-5:A visual structure of a research methodology adapted from Plowright.

Qualitative studies are placed in the area of humanities and social sciences, as the data is generally in the form of words (from interviews), via images (both still and motion) of the event. It is looking to understand people in terms of why they do what they do in their lives. This can include the use of artefacts (objects). The aim is a complete, detailed description of a phenomenon, an observable event. Themes are noted in interview and observational descriptions (Waring, 2012). Quantitative, numerical analysis involves measurements of time and length of throwing performance and the length of individual events within the performance. It can involve the measurement of motion (ibid, 2012)

Table 3-4 outlines three methods of data generation suggested by Plowright (2011, p. 16). It uses observation, asking questions and artefact analysis and how the structure applies within a pot throwing performance study.

Table 3-4:Three methods of data generation.

Method tools	Description
Observation	Observations will be made through digitally capturing a throwing performance.
Asking questions	Questions will be asked through a semi-structured interview both prior and post throwing performances.
Artefact analysis	The specific artefact to be analysed will be the digital footage of the throwing performances.

Data is referred by Plowright in terms of generation and the structure of data whether it is highly structured or less structured where a researcher might apply a more open form of coding (2011, p. 61). Data analysis refers to the structure of mathematical, numerical, or quantitative analysis or narrative qualitative analysis. In this study there is planned to be several differing analysis strategies. Qualitative analysis will employ the use of coding of narrative data; meanwhile quantitative data will use numerical tools for analysing. The method of task analysis will be utilised in this study.

Task analysis of visual data defines critical moments in a throwing performance. Task analysis is the study of physical work. This practitioner-based method is used for the systematic assessment of a task whether it is an activity of daily living or a work-related activity. According to Stammer and Shepherd (Wilson and Corlett, 1995, p. 149) there is no single definition of this tool. The method has many variations that are context driven. Design and ergonomics practitioners predominantly rely on post-analysis of video recordings of a participant performing a task (ibid, 1995, p. 174). In some cases, the operator of the trial may have to take visual annotations. Whichever method is used in recording the task, the codifying or breaking down the cask into moments of time can be used to quantify visual data.

After data has been collected, evidence is synthesized from the data sources, analysed and inferences can be drawn from the data (Plowright, 2011, p. 141). Analysis of raw data from both qualitative (narrative) data and quantitative (numerical) data would provide answers to research questions and contribute to an overall analysis of the project. From scrutinising and analysing the evidence, 'claims' can be made, and inferences drawn, based on the evidence analysis completed. Claims can then be substantiated by evidence. Discussion can then be completed, based on the findings from research methods and conclusions can be made from evidential data and material with reference to the research question. It was felt that the FraIM structure was not a good match for this research study.

3.1.4 Qualitative methods

Qualitative research investigates aspects of social life: focussing on the meanings and interpretation of social phenomena and the social processes in the particular contexts in which they occur (Jupp, 2006, p. 248). The data is generally narrative in the form of words (from interviews, focus groups), via images (both still and motion) of an event. Qualitative studies look to understand people, why and what they do, including the use of artefacts. These studies can be lengthy in terms of time, as data collection is intensive.

There are a number of qualitative methods gathered from Cohen (2007), Bell (2010), Kumar (2010) and Arthur (2012), seen in Figure 3-6. Highlighted areas indicate methods applicable to this study, Phenomenology, empirical and epistemology. Semi- highlighted areas of critical theory, case study and grounded theory have applications within this study.

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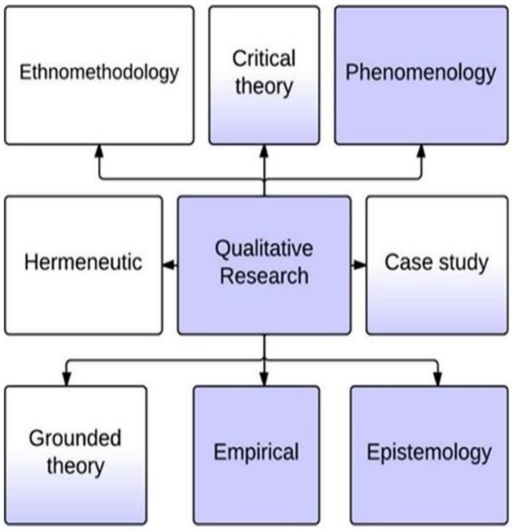

Figure 3-6:Highlighted strands of qualitative methodology applicable to the study. (Adapted from Cohen 2007, Kumar 2010, Arthur 2012).

The areas of qualitative research displayed in Figure 3-6 are detailed in Table 3-5 and highlighted with relevance to this study.

A researcher must be aware of bias and must be seen to be rigorous. Guidelines by May and Pope (1995) outline the keeping of rigour within a qualitative study by producing methodology guidelines through the use of questionnaires. The studies may be subjective, but a diligent researcher rigorously observes protocol in order to enhance the validity of the study. When methods such as questionnaires, interviews and observations are involved.

: Research methods design.

Table 3-5:Qualitative Research philosophy.

Research Philosophy	Definition	References	Application to study
Phenomenology	Qualitative, naturalistic approach, a theoretical view which advocates the study of direct experience. Taken at face value determined by the phenomena of the experience rather than external influences.	Jacob 1987 (Cohen, Mannion et al 2007 p22) Hitchcock & Hughes 1995 p309 English & English 1958 (Cohen, Mannion et al 2007)	Reseaching interaction between material, man and equipment.
Epistemology	The theory of knowledge. The place of experience in generating knowledge. (Blackburn 1996a p154)	Hitchcock & Hughes 1995 p21 Cresswell & Plano-Clark 2010	Researching the place of experience in gaining Knowledge.
Ethnomethodology	Focus on how people make sense of their everyday world. Social accomplishments. Linguistic, situational.	Burrell & Morgan 1979 (Cohen, Mannion et al 2007 p26-)	Not applicable in this study.
Hermaneutic	Focus on interaction and language. Focus on situations from participants view,	Habermas 1984: Giddens 1976 (Cohen Mannion et al 2007 p26-)	Not applicable in this study.
Empirical	Attempts to tie knowledge to experience.	Mouly 1978 (Cohen, Mannion et al 2007 p11)	Researching experiential knowledge.
Case Study	To portray, analyse and interpret individuals and situations through accessible accounts.	(Cohen, Mannion et al 2007 p85)	There could be a case study of each participant.
Critical theory	The purpose is not merely to understand situations and phenomena, but to change them.	(Cohen, Mannion et al 2007 p26)	Designed to understand the skills of pot throwing and enhance skills needed.
Ontology	A branch of metaphysics relating to the nature and relations of being.	Blackburn 1996b	Not applicable in this study.

Therefore, the study encompasses several qualitative areas.

Figure 3-7 illustrates tools that may be used in qualitative research studies compiled from Cohen. Tools utilised in this study are highlighted, including verbal protocol, self-reporting, and direct observation. The white areas are not suitable methods of data collection for this study. The blue areas will prove useful.

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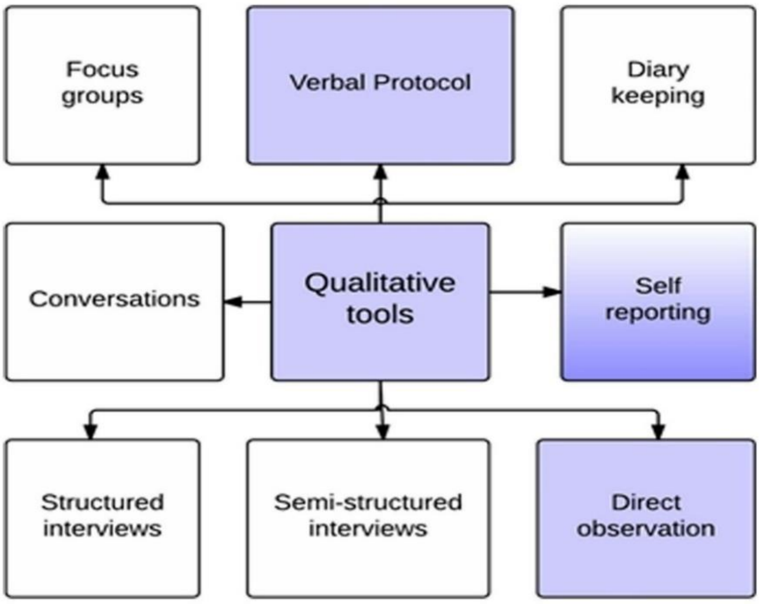

Figure 3-7:Qualitative tools applied to this study compiled from Cohen 2007.

The tools highlighted in figure 3-7 are detailed in Table 3-6, as qualitative tools.

Table 3-6:Qualitative tools.

Tool	Description	Application to study
Semi-structured interviews	Uses open-ended questions. Is less formal than a structured interview, but has more form than a conversation.	This tool keeps an interview to topic, yet allows opportunity to follow up oints raised. It is time intensive.
Verbal protocol	Participant describes actions in real-time.	Performance is important. Participants need to describe their actions prior to performing.
Role play	Groups role play specific senarios.	Not applicable in this study.
Direct observation	Digitally captured observation, non-participant researcher.	Performances digitally captured so as to review at real-time speed or in slow-motion.
Diary keeping	Keeping of regular personal participant notes.	Not applicable in this study.
Structured interviews	Using closed questions, needing little information.	Not applicable in this study. Closed questions limiting.
Conversation	Unstructured dialogue.	Conversation may miss pertinent data.
Focus group	Free flowing discussion about a defined topic.	No plans for participants meeting as a focus group.

: Research methods design.

3.1.5 Inductive methods

An inductive line of reasoning is more often seen in qualitative research as new theories can be generated by data rather than the testing of a theory by experiment.

It was originally thought to have been introduced by Francis Bacon as a method for philosophers to establish new thinking from fact to axiom to law. It was intended that philosophers freed their minds from the falsehoods of idola tribus (common to race), idola spectus (common to the individual), idola foli (the abuse of language) and idola theatri (abuse of authority). The end of an inductive approach would be the discovery of natural phenomena and the causes from which they proceed (Klein, 2003).

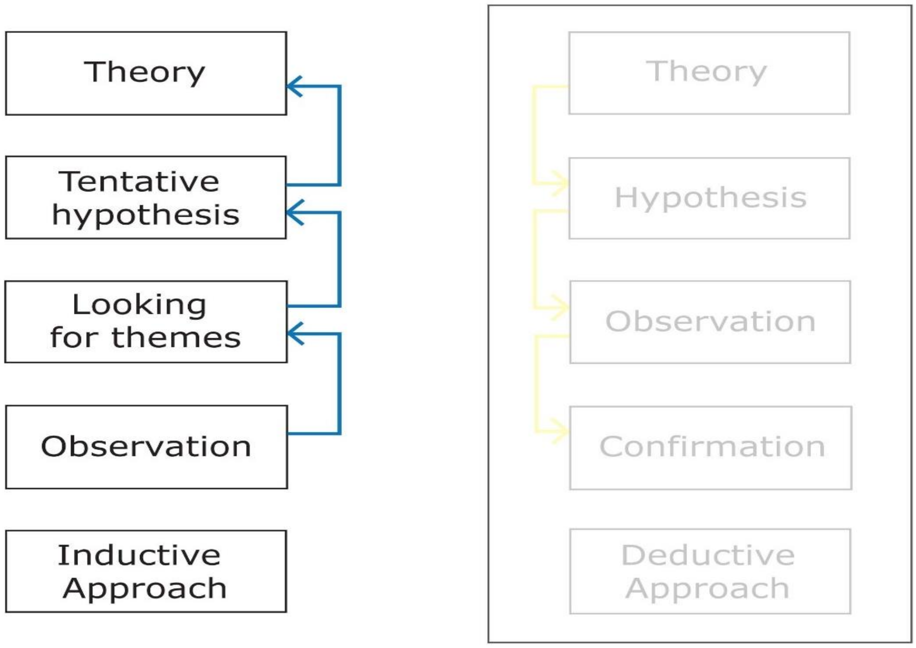

Figure 3-8:The structure of an inductive approach.

The inductive logic involves, for example, the observation of a phenomenon to answer a question. A period of interviewing and questioning participants follows. Then from there, an analysis, of data collected, is performed. A researcher would then seek for broad patterns, generalisations, themes, or categories. These, then could be traced back to past experiences or literature to give reference to the initial observations. Eventually a hypothesis could be reached that may explain the event or phenomenon. In essence thought flows from observations to causality. Therefore, in this study the action of throwing a pot would be studied, the phenomenon. The observations would be analysed and researched before arriving at a hypothesis.

3.1.6 Pluralist methodologies

Willig describes the pluralist approach as being

> *'based on the assumption that human experience is complex, multi-layered and multi-faceted, and that therefore a methodology which is equally complex, multi-layered and multi-faceted is perhaps the most suitable way to find out more about it' (2001)*

Therefore, a combination of qualitative tools may answer a specific research question more fully than with one single approach.

3.1.7 Quantitative methods

Quantitative research study designs are 'more' structured, rigid, fixed, and pre-determined in their use so as to ensure accuracy in measurement and classification (Kumar, 2010). They are also able to be replicated (Cohen, Mannion and Morrison, 2007, p. 15). Figure 3-9 displays a scientific method as understood by Hitchcock and Hughes (1995). This is a deductive method working from a hypothesis, although the lesser scientific terms of 'hunch' and guess' are included. The pot throwing study will involve a time element measurement, a movement measurement and decision points within the pot throwing performance. Therefore, there will be quantitative elements contained in this pot throwing study. A deductive approach is a common logical system to align with a quantitative study.

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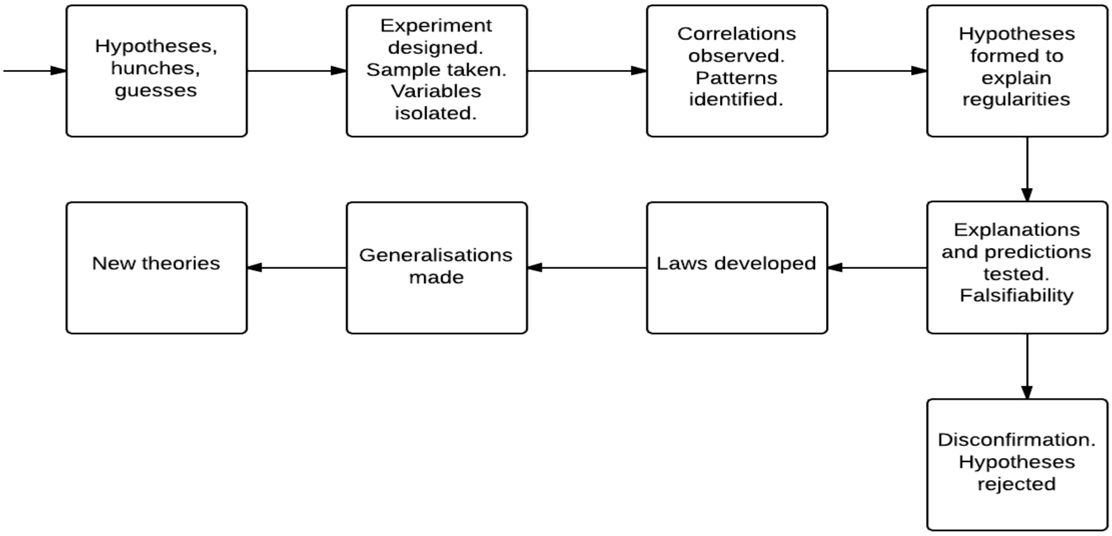


Figure 3-9:A scientific structure of study. (Adapted from Hitchcock, Hughes 1995 p23).

Figure 3-10 displays tools used in quantitative research. The highlighted tools of Biophysical measures, Sampling, observation, and questionnaire/survey are to be used in the design of this study.

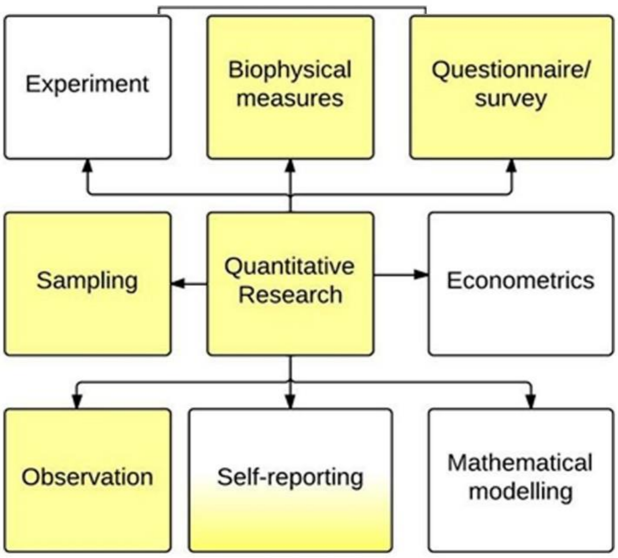


Figure 3-10:A range of quantitative research tools, compiled from Cohen (2007) and Arthur (2012).

The white areas are not useful to use with this study, biophysical measures may indicate similarities or highlight physical differences between the participants. Observation through artefact analysis, the analysis of video footage of the throwing performances, will be data rich.

Table 3-7:Details of Quantitative tools highlighted in Figure 3-10.

Quantitative tools	Definition	References	Application to study
Experiments	Quasi-experiments using non-randomised designs.	Kepple 1991 (Creswell, 2003 p14)	Study not experimental, but a repeated performance.
Surveys	Using questionnaires or structured data collection with the intent of generalising from a sample to a population.	Babbie (Creswell, 2003 p14)	Questionnaire /surveys to provide basic data. Interviews to be more semi-structured.
Econometrics	The area of statistics specialised to deal with economic models. There are identifiable distinctions between economics, statistics and econometrics.	Black, Hashimzade and Myles, 2012 p120	Economic models are not needed although the study may have an economic impact on potters.
Mathematical modelling	Beliefs about world functionality are translated into precise language of mathematics.	Clapham & Nicholson 2009	May have a place. Forces, speed of wheel, amount of water.
Sampling	Probability or non-probability sampling to populate a research study.	Cohen,Mannion et al 2007 p110	Will use purposive, non-probability sampling with snowball/ viral sampling.
Observation	Systematic observation of event.	Pink 2012 p9	Record each throwing performance as visual digital data.
Self reporting	Interview / questionnaire.	Cohen,Mannion et al 2007 p317	Will be necessary in this study.
Biophysical measures	Anthropometric measures of stature, upper limbs, hands and grip strength.	(Cohen, Mannion et al 2007 p26)	Will be necessary in this study.

3.1.7.1 Deductive approach

Deductive approach is placed generally with quantitative studies discussed by Creswell and Plano-Clark (2006). This approach has an element of a priori knowledge. A priori is knowledge from before; ‘knowledge originating from theoretical deduction rather from observation or experience’ (Oxford English Dictionary, 2013a). A statement can then be tested and proved or disproved. It involves reading around the area of focus in order to establish knowledge. An opportunity to test the gaps in knowledge demonstrates the need for research. From this a research question is formulated. A research structure is designed to enable the research hypothesis to be answered. The results of which, will then lead to a conclusion. Before researchers can predict what will or what has happened, they must have acquired the generalisation which they can link to the specific case. Figure 3-11 outlines development from theory to confirmation or negation.

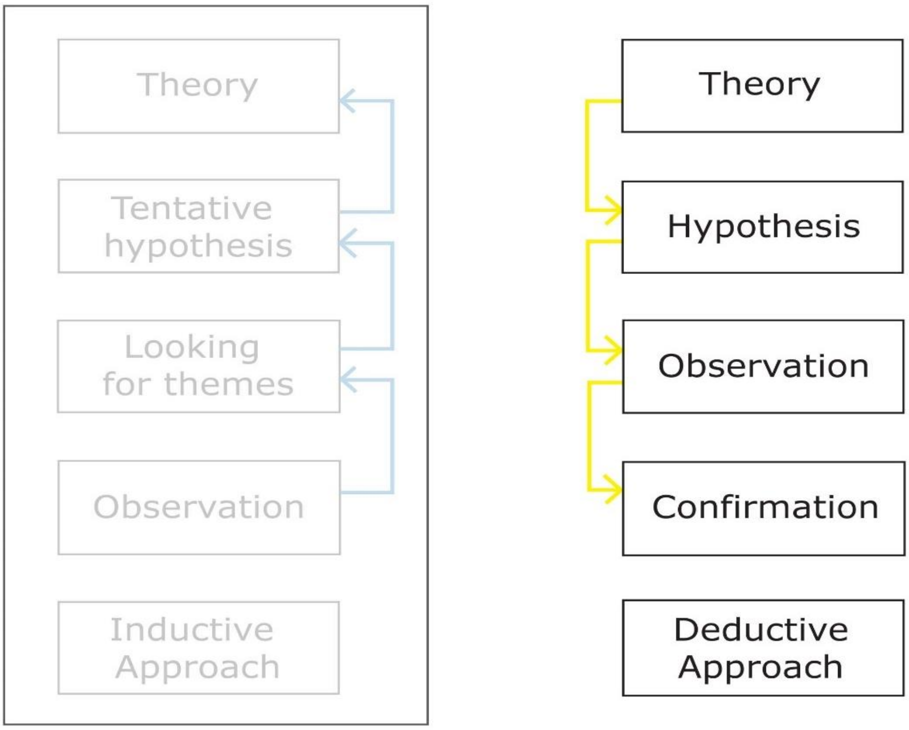


Figure 3-11:Deductive approach.

3.1.8 Mixed methods

The term 'Mixed Methods', has become an umbrella term for projects that triangulate both qualitative and quantitative methods of research (Howe, 2012, p. 89). Studies using this research method have elements of qualitative design combined with elements of quantitative design. Both types of enquiry complement each other e.g. a qualitative interview will provide information on a clinical trial and conversely a quantitative investigation might provide vital data for a qualitative enquiry.

The mixed method structure is understood to be a recently favoured method. It was originally used under the term 'multitrait-multimethod matrix strategy' from Campbell and Fiske (1959) cited by Troachim (2006).

: Research methods design.

This method was reconsidered and was piloted and trialled from the early 1990's. Leaders in this area include Creswell (2009) and Teddlie (2009). Figure 3-12 indicates qualitative and quantitative research areas and how tools from each area can combine to become 'Mixed methods' or 'Integrated methods' of research. Qualitative elements are coded blue. Quantitative elements coded yellow, the Mixed and Integrated methods of research are coded green.

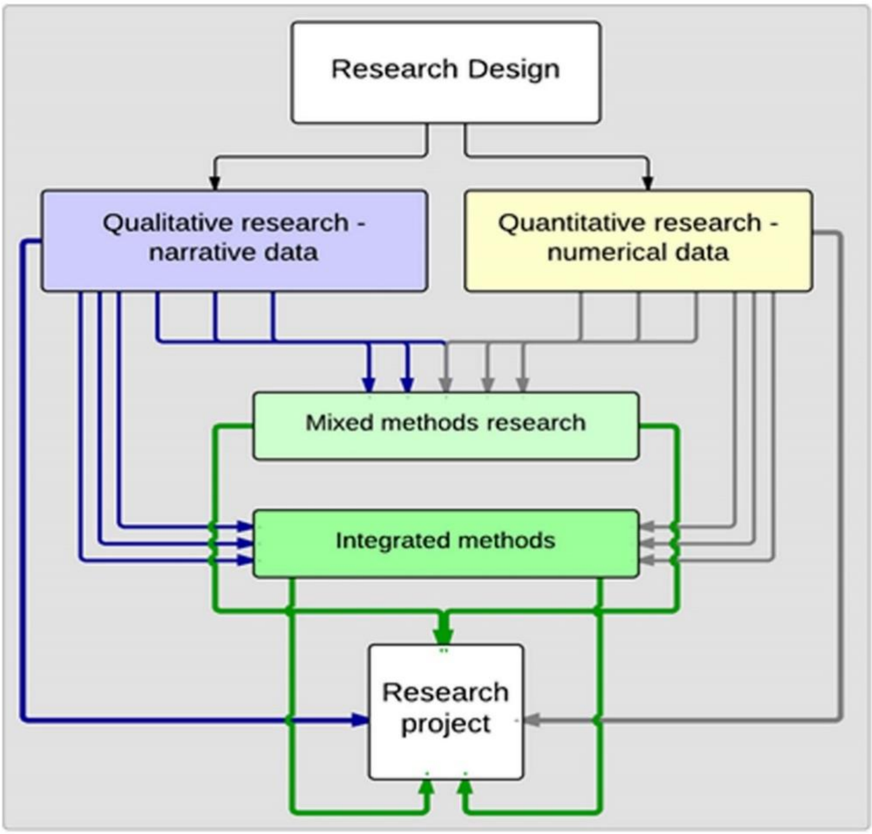


Figure 3-12:Qualitative, Quantitative, Mixed, and Integrated methods.

Table 3-8 lists the elemental tools that contribute towards the research design. Each element offers different data to be analysed surrounding a pot throwing performance.

: Research methods design.

Table 3-8:Qualitative tools.

Tool	Description	Application to study
Semi-structured interviews	Uses open-ended questions. Is less formal than a structured interview, but has more form than a conversation.	This tool keeps an interview to topic, yet allows opportunity to follow up oints raised. It is time intensive.
Verbal protocol	Participant describes actions in real-time.	Performance is important. Participants need to describe their actions prior to performing.
Role play	Groups role play specific senarios.	Not applicable in this study.
Direct observation	Digitally captured observation, non-participant researcher.	Performances digitally captured so as to review at real-time speed or in slow-motion.
Diary keeping	Keeping of regular personal participant notes.	Not applicable in this study.
Structured interviews	Using closed questions, needing little information.	Not applicable in this study. Closed questions limiting.
Conversation	Unstructured dialogue.	Conversation may miss pertinent data.
Focus group	Free flowing discussion about a defined topic.	No plans for participants meeting as a focus group.

Table 3-9 outlines qualitative and quantitative elements of this study. Each complement the other in order to make a complete investigation into a throwing performance of a 1kg. cylinder pot.

Table 3-9:Qualitative and quantitative elements of the study.

Qualitative elements	Quantitative elements
Observation	Measurement of wheel speed
Participant views	Patterns of limb movement
Semi-structured interviews	Body position
Commentary	Background questionnaire
	Grip pressure

: Research methods design.

3.1.9 Inductive/Deductive Approach: Kerlinger

Some research studies have used a mix, of both inductive and deductive methods, at different stages within a project. Kerlinger (1970) as discussed by Cohen, Manion et al. (2007, p. 6) supported the inductive-deductive system, believing that research should be empirical. A researcher should return to evidence in order to achieve validation of the evidence. It is thought, subjective belief has to be checked through empirical facts and through tests (ibid, 2007, p. 7). It is suggested that Mouly (1978) added the capacity of self-correction to the definition, believing that research should involve mechanisms for self-correction which should protect scientists from error.

Within the inductive/deductive system, Kerlinger supposed that researchers would oscillate between the two methods. They might inductively work towards a hypothesis from observations and then deductively test the findings against existing explicit knowledge and see any implications. Therefore, with this method, it would be 'systematic and controlled, rigorous and transparent for external scrutiny' (Cohen, Mannion and Morrison, 2007). Figure 3-13 outlines interactions between inductive and deductive approaches during research.

This study has elements of this structure as observing the phenomenon, the pot throwing performance, then analysing the digital evidence to arrive at the outcome hypothesis which then would be tested in a systematic, controlled, rigorous and transparent manner open for external scrutiny. (ibid 2007).

: Research methods design.

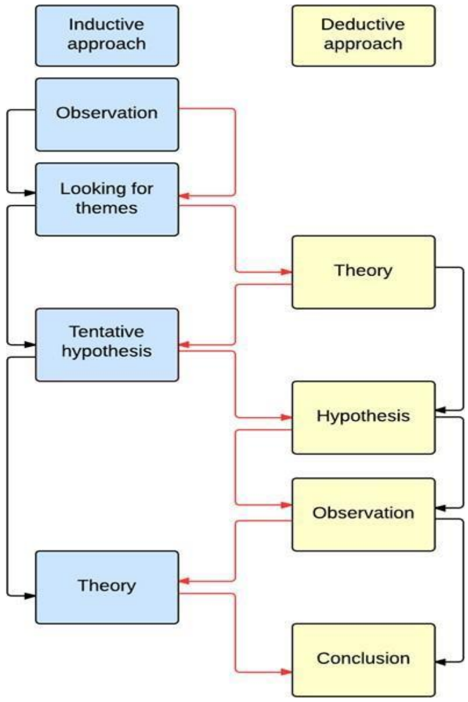


Figure 3-13:An Inductive-Deductive approach adapted from Kerlinger.

This study has a combination of qualitative and quantitative methods, therefore, a mixed methodology. It follows an inductive-deductive approach from Kerlinger, as to have been entirely deductive would have omitted vital data that would have come from an inductive approach. Therefore, as both methods are used; this has ensured the research model has been systematic and rigorous. Figure 3-14 outlines how both qualitative tools and quantitative tools were employed in the study. After the tools were selected, some of the more practical tools needed a protocol to ensure good continuity of data collection. These protocols were developed through pilot studies.

: Research methods design.

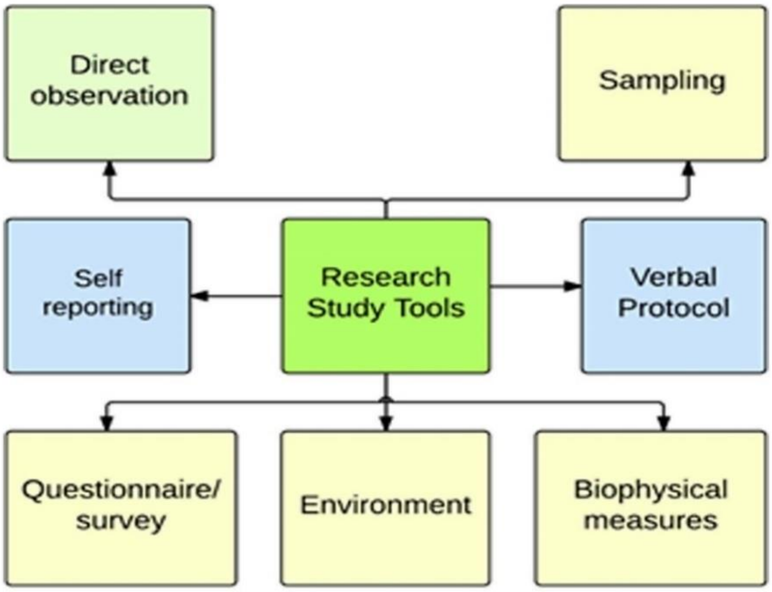


Figure 3-14:Research tools utilized in the study.

3.1.10 Pilot studies

Protocols are needed to trial any activity. Sharp explains 'A protocol is a set of rules which have to be followed in the course of some activity…If the protocol is not followed, the activity will not be successful' (1994).

The protocols of the event to be discussed here, are for the main data collection part of the study. These have been tested and developed through pilot studies.

The first pilot study involved two participants, throwing a pot, describing the process, whilst being recorded both visually and aurally.

The participants represented novice and experienced pot throwers. Table 3-10 outlines tools used, comments about the tools and then developments for the subsequent pilot study.

Table 3-10:Details from pilot study 1.

Event	Tools	Comment	Development
Throwing a pot			Define pot and weight of clay.
	Digital recording from frontal aspect.	Data collected	Two camera positions Front and 90° to left or right.
	Audio recording front	Not clear. Camera collection clearer	
	Still shots from a variety of angles.	Not needed can be captured from digital recording.	Capture still shots from digital recording
	Event log	Data collected	Continue
	Task analysis		Physical, event

The first pilot study confirmed the availability of usable data from visual digital observation and audio recordings.

The second pilot study involved five participants, who were asked to throw two 1kg pots, one performance was to have commentary and the second was to have optional commentary. Similarities and differences between performances were noted. Commentaries were transcribed, and themes detected in terminology and events within the performance. Methods and equipment for anthropometric measurement were piloted. It was evident from the visual data that commonly the participants used their first three digits, thumb, index, and long finger particularly while throwing. The remaining two fingers had more of a supportive role therefore the decision was made that when using anthropometric measures, the time taken to measure all five digits was lengthy especially while the first three digits were used more often during the throwing performance.

The second pilot study supported the visual data collection. It confirmed the need for anthropometric measurements. The pilot showed that the commentary was a hindrance as some individuals found describing, in real time, their performance a difficult task to complete cognitively. The commentary decreased the speed of performances. Some participants lacked explanation in their process. Table 3-11 summarises tools utilised in pilot study 2, comments on efficacy and then a development column advising developments to be made for the main study.

Table 3-11:Tools for pilot study 2.

Event	Tools	Comment	Development
Throwing 2 x 1kg cylinder pots	Digital recording (from frontal and lateral aspects).	Data collected	To continue
	Commentary	Themes detected	Replace with verbal protocol and post review.
	Event log	Data collected	To continue
	Anthropometric measures: Stature	Data collected	To continue
	Anthropometric measures: Hands	Data collected	Continue digit measurement of D1, D2 and D3 Evidence from digital data, these are the most frequently used digits
	Task analysis	HTA HOPI	To use tools for analysis
	Grip dynamometer		Strength of grip
	Thermistor		Noting of temperatures

3.2 Main study

If we knew what it was, we were doing, it would not be called research, would it?

Albert Einstein

The main study for data collection was developed from pilot studies. Protocols for the use of tools were devised for the study.

3.2.1 Protocol for biophysical measures: anthropometric tools.

These tools were planned to gather measurements which would contribute towards a participant profile. They were stored in a study bag to be available to be taken to each venue. Instruments would be checked for zero mark starting. Among the participants, it was anticipated that there would be a range of statures and physical dimensions in both genders. There were no pre-conceived expectations with stature concerning height or body size.

3.2.2 Digital callipers

Vernier callipers measure, accurately, the distance between two given points, recording length with a digital readout. The larger callipers measured the breadth of the shoulders between biacromial points, shown in Figure 3-15. A smaller set of callipers measured hand and digit measurements.

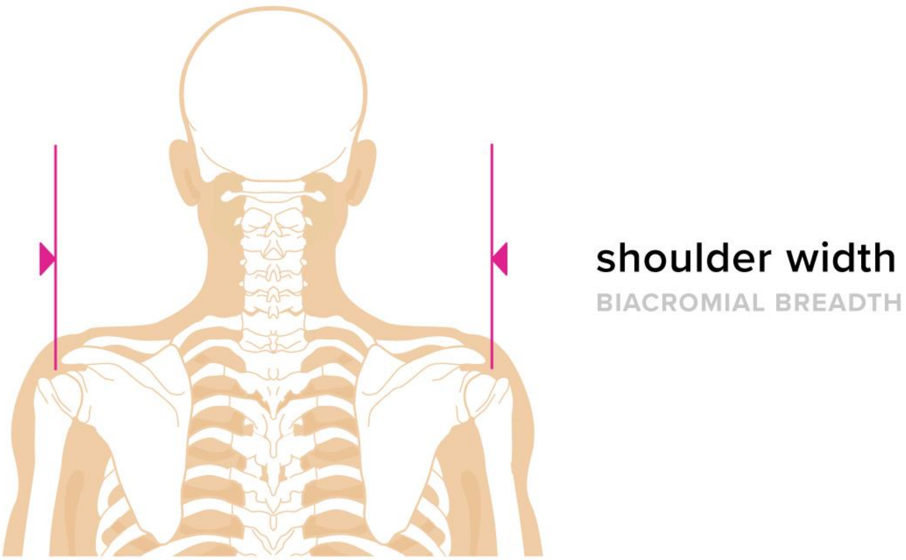
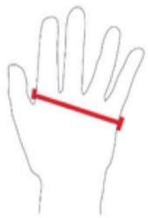
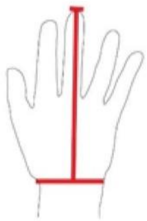


Figure 3-15:Distance between Biacromial points.

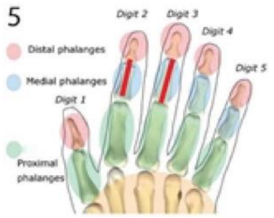
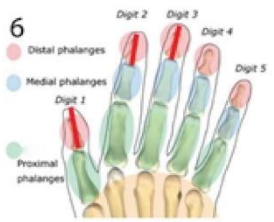
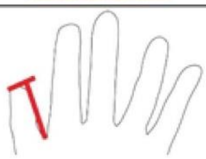
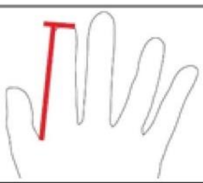
Table 3-11 and Table 3-12 display the range of hand measurements to be taken from participants. Measurements from Digits, 1, 2 and 3 as these involved in the pot throwing performance. One measurement will measure the length of the forefinger digit 2 from the saddle of the joint at the base of digit 1. This would check out how far digit 2 might stretch into a pot.

Table 3-12:Hand measurements.

Measurements	Description	Purpose
1 	Wrist breadth. Measurement across the carpel bones.	To ascertain whether wider wrists impact on throwing performance.
2 	Hand breadth. Measurement across the metacarpophalangeal joints.	Does more hand breadth offer more support?
3 	Hand length Measurement from wrist crease to tip of Digit 3.	Does the length of hands impact on a throwing performance?

The lengths of the upper limbs were to be measured from the biacromial point at the shoulder joint, along a straight arm to the tip of digit 3 with a fabric tape measure. This measurement would highlight those with extreme arm reaches either longer or shorter which would impact on an individual when reaching for water or tools when working at the wheel in terms of safe stretching and comfort.

Table 3-13:Digit measurements.

Measurements	Description	Purpose
4 	Digits 1,2 and 3 proximal phalanges. Measurement from metacarpophalangeal joints to proximal interphalangeal joint.	Does length make a difference?
5 	Digits 2 and 3 medial phalanges. Measurement from proximal interphalangeal joint to distal interphalangeal joint.	
6 	Digits 1,2 and 3 distal phalanges. Measurement from distal interphalangeal joint to tip of digits.	
7 	Digit 1 thumb saddle to tip. Measuring from the thumb saddle joint to tip of Digit 1.	When is this measurement used in a throwing performance?
8 	Digit 2 thumb saddle to tip. Measuring from the thumb saddle joint to tip of Digit 2.	Is this measurement used for stretching or pulling in a throwing performance?

4

Tape measure measurements

Stature was to be measured by a 3-metre steel tape measure. This measurement would indicate a precise measurement of height for each participant. The data was to be compared with UK national data to place the measurement data onto a percentile line.

3.2.3 Grip measurements

There were two grip measurements planned. The first was a hand grip measurement of both hands using a grip dynamometer to ascertain the grip strength of the participants. This would inform strength of the upper limbs. Participants would be gripping the clay material.

: Research methods design.

3.2.4 Pinch measurements

The pinch measurement was taken to ascertain the pressure of a pinch grip. This involved using a pinch dynamometer. The display would be reset if necessary and then would be grasped between digits 1 and 2 at a 90° angle so that both digits were horizontal to each other. The arm of the participant was bent at the elbow to an angle of 90°. The fingertip pad of digit 1 would be used as force against the pinch dynamometer as the medial phalanx of digit 2 would be supporting apparatus by resisting and adding to the pressure. The measurement would be repeated three times in total for each hand. This measurement, although not strictly a biomechanical recognised pinch grip would potentially replicate the grip used by digits 1 and 2 by the left hand when pulling up and refining the walls of a pot.

3.2.5 Protocol for digital observation equipment

Identical Canon Legria FS306 digital camcorders were used for capturing throwing performances. It was possible to store up to 8GB of visual data on SDHC (Secure Digital High Capacity) cards. This enabled visual data to be copied and stored immediately on a laptop for reviewing. Both camcorders had audio capture features. The camcorders were mounted on two identical tripods which allowed for both large and small area capture of data. The camcorders were recharged at the end of each day and the SDHC memory cards cleared of data in readiness for the next data capture. When not in use the cameras were stowed in a camera bag along with chargers and small tripods.

3.2.6 Protocol for wheel equipment

A Shimpo potter's wheel was transported to places of participation as this wheel had been modified with data collection equipment. The data collection equipment did not impede the wheel performance. The wheel would be placed in a space near to a 13-amp power socket. The wheel was cleaned after each set of throwing performances to avoid clay contamination, as each participant was to use their own choice of clay. On site the wheel needed to have connection with a small netbook data logger which had software installed enabling the collection of wheel speed data and the length of throwing performances. Once all was connected the performances could commence.

3.2.7 Participant sampling strategy

The participants for the main study were purposively gathered from two national and one regional event. This was combined with a 'snowball' strategy (Cohen, Mannion and Morrison, 2007, p. 116) or a 'viral' strategy as described by Plowright (2011, p. 43). The selection screening for participants started with makers in clay selling nationally or regionally, which then subdivided into pot throwers and clay hand builders. The first sub-section being of interest.

3.2.8 Throwing population

In justification of the small number of participants, the total population of throwing potters needs to be quantified. There is no exact figure on record for this to be accessed. 'Crafts in an Age of Change', a report from the Crafts Council (Yair *et al.*, 2012, p. 202) started with the Crafts Council database of makers, progressing to a web search for other makers. Data protection was a key issue here due to some regional craft associations holding records of makers and not being able to release data in line with data protection rules. A population of makers were discounted by not having an online-presence and were viewed as non-contactable. A set of assumptions was then made arriving at a total of 7,275 makers.

One assumption that was made was that 78.8% of these makers would be economically active, reducing the figure to 5,296 makers. Then assuming the figure of 5,296 makers is only 30.9% of the total population of makers, then the potential number of economically active craft businesses within England was then 17,133.

The project has, due to limitations of time, discounted the unknown off-line maker population, making them external to the boundaries of the project. Therefore, the total figure for makers is assumed as 5,296 makers of economically viable crafts, of which pottery, ceramic makers are a percentage of this population.

: Research methods design.

The Crafts Council categorised data into materials used by makers, informing that 26.6% of the craft making population used ceramic material. The figure of 26.6% of 5,296 results in 1,408.74 makers, 1,409 ceramic makers. Within this population of ceramic makers there are makers who make ware by throwing and another group of makers making by hand-building, with a third group combining both methods of making using clay materials. Throwing potters are a percentage of this group of 1,409 ceramic makers. To establish the approximate number of throwing ceramic makers, estimates needed to be made. Table 3-14 indicates the selection of craft society databases accessed, and the throwing makers were counted against the ceramic maker database population, duplicate entries were discounted. It was anticipated the total would be an approximated percentage of 1,409 makers.

Table 3-14:Craft databases accessed and analysed.

Register	Number	Throwing potters	Percentage
Art in Action	33	19	57.5%
Art in Clay	180	54	30.0%
Contemporary Appiled Arts	89	21	23.5%
Crafts Council	648	242	37.3%
Craft and Design	123	93	75.6%
Craft Potters Association	353	181	51.2%
Great British Designs	6	3	50.0%
Heritage Crafts Association	22	15	75.0%
Society of Designer Craftsman	132	25	18.9%
Studio Potters.co.uk	312	157	50.3%
		Average	47.0%

The throwing population figure calculations are shown in Table 3-15. The first row uses data from the compiled list in Appendix D and applies a calculation: that is, the list total of 491 is 47% therefore 1045 is the projected population. The second row uses population data from the Crafts Council report of assumed at 1409 and 633 is calculated as 47% of the assumed population of throwers.

Table 3-15:An approximation of the making population of throwers.

Potters	Start figure	Apply average	Results
Number of throwing potters	491	Av 47%	1045
	1410		633 throwers

3.2.9 Expertise of the makers.

Consideration is needed about how expert the sample needed to be to gain the maximum data from Face to Face meetings and practical participation.

Schon (1991) suggests that very expert potters might be sufficiently experienced as not to be able to clearly explain their process. The selection was made of very experienced potters, following the theories of Ericsson (1994) and Pountney (2000). Their theories suggested that 10 years or 10,000 hours is needed to be expert at a skill; therefore, the possibility of sampling a younger experienced potter would be remote unless there was exceptional talent.

Cross (2004) suggests that the maturing of expertise within an area occurs at differing ages. When considering sportsmen, their peak is early before a decline, whereas the arts has a later maturing time frame of, he suggests, around 40 to 50 years. This theory is supported by the Crafts Council in their report ‘Crafts in an Age of Change’ (Yair *et al.*, 2012) where their findings of ages of maker participants were greatest around the 34-65 age group. The average of the survey of makers was 49 years. Table 3- 16 is adapted from the report outlining the age of makers. The table follows the observations of Cross on the maturing of expertise; however, the participants of this study are at variance to the national study as 50% of participants are aged 25-34 years.

: Research methods design.

Table 3-16:Ages of makers involved in the study.

Age range (Years)	Percentage of makers	Male	Female	Study
16 - 24	1.4%	0.6%	1.8%	
25 - 34	12.4%	7.5%	14.6%	50%
35 - 44	21.4%	19.8%	22.1%	10%
45 - 54	25.8%	22.3%	27.4%	20%
55 - 64	25.3%	28.5%	23.9%	20%
65+	12.2%	20.0%	8.8%	
Declined	1.5%	1.3%	1.4%	

3.2.10 Recruitment and documentation.

Participants were gathered from the online questionnaire, and from national and regional pot fairs. The participants needed to be potters who threw pots on a potter's wheel which reduced potential recruits to a much smaller number.

Documentation for the project was completed and approved.

Ethical permissions

The Loughborough University Ethical Checklist (Appendix A) was completed to ensure that all participants would remain safe and that no other ethical decisions would need to be made by Loughborough University Ethics Committee.

University health check forms.

A form was handed to each participant to complete and sign at the point of commencement of practical participation Should there have been any unforeseen problems they could not have contributed (Appendix B).

Project participation details.

Each participant had their personal copy of the project participation details. These would need to be signed with the project information section retained by the participant (Appendix C).

3.2.11 Main study participants

There were ten participants available within the selected dates for data collection to contribute to the study. Table 3-17 exhibits participant details.

Table 3-17:Participant details for the main study.

Participant	Recruited	Listed	Notes
P1	Linked	Great British Designers	
P2	Art in Clay	CPA	
P3	Snowball gather	Leach Pottery	
P4	Art in Clay		
P5	Snowball gather	Leach Pottery	
P6	Snowball gather	Leach Pottery	
P7	Research community	Great British Designers	Left hand dominance
P8	Art in Action	CPA	Arthritis in both hands
P9	Snowball gather		Weak L.H. Digit 5
P10	Ceramics in Charnwood		

3.2.12 Design of the research data collection

The study comprises of both qualitative and quantitative elements. It is designed to be a data rich study. The task selected for the participants was a throwing performance throwing a cylinder pot from 1kg of clay. Throwing a cylinder pot is one of the most basic tasks undertaken whilst learning the skill of throwing, as it can form the basis for other designs of thrown pots. The cylinder pot has distinct visual and measurable qualities such as the foot circumference of the vessel being equal to that of the rim. This would be valid should the foot be wide and shallow or narrower and taller. The sequence of the study is shown in Figure 3-16 to outline procedural detail involved in the data collection process. The process starts with equipment marked in orange. Practical aspects of setting up equipment and stowing equipment is indicated in blue and hardware check prior to the practical data collection. The study procedure is shown in yellow with review and completion denoted in green.

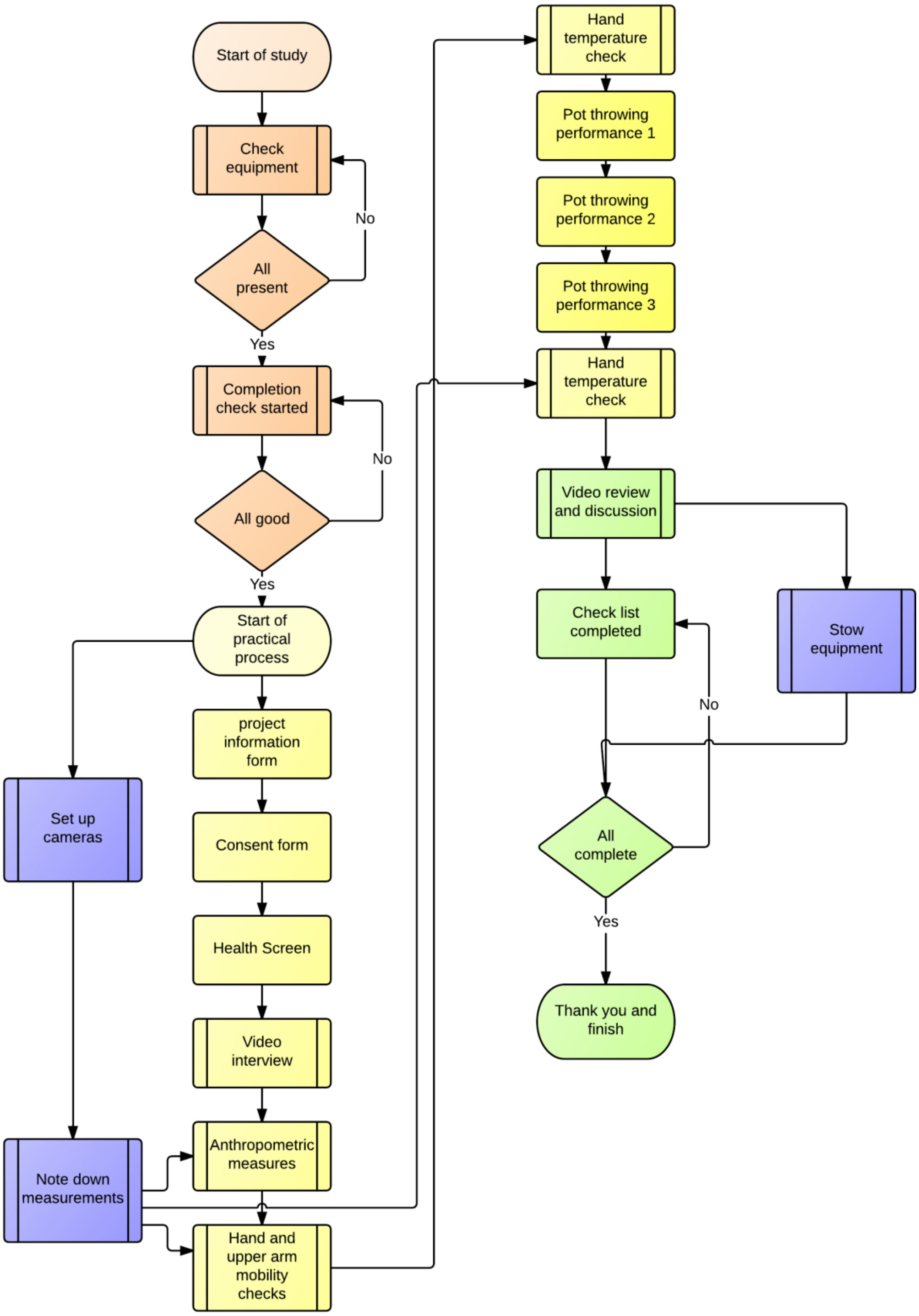


Figure 3-16:Data collection sequence.

Figure 3.17 indicates the research tools used in this study. Tools with a blue tone represent the narrative, qualitative elements of the research design.

: Research methods design.

Yellow toned tools denote numerical and quantitative tools to be used as part of the research design. The tools in the green tone have a combination of both qualitative and quantitative elements in the research design.

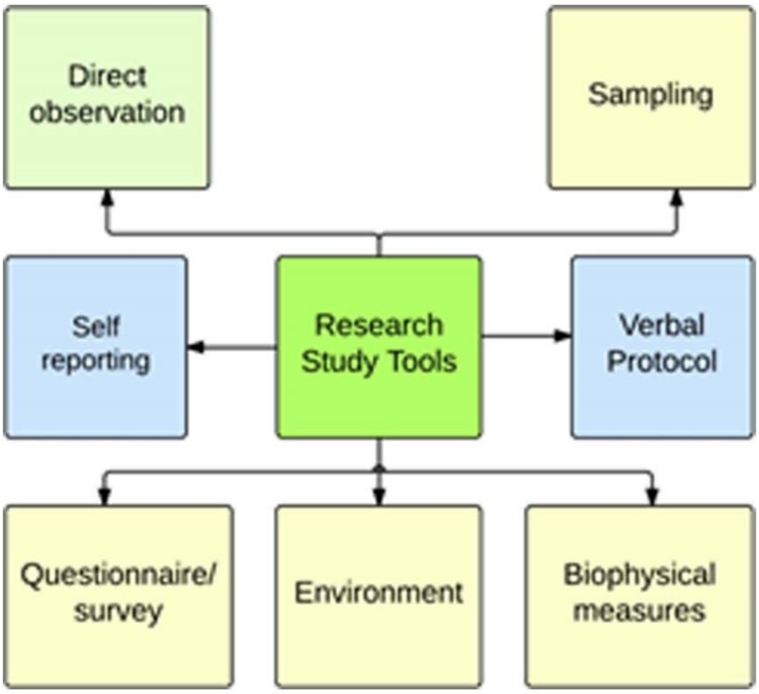


Figure 3-17:Research study tools.

The data collection opened with the gathering of selected anthropometric data from participants. Table 3-18 displays data collected for stature and measurements of the upper body and rationale/implication for collection of the data. Results of the collection of this data might allow assumptions to be made about the overall statures of the pot throwing population.

Once collected data would be compared to a UK adult population to investigate whether there is a distinct physical pattern of measurements to be determined for the pot throwing population. Data would also be used for identifying differentiating skills needed for a pot throwing performance.

Table 3-18:Anthropometric data collection.

Anthropometric measures	Reason
Stature	To ascertain the impact of stature on pot throwing.
Shoulder breadth	To investigate the bearing that shoulder breadth has within a throwing performance.
Upper limb length	To determine any influence the length of the upper limb might have on a throwing performance.

Table 3-19 indicates the focus on hand and digit measurements taken and reasons for investigating such measurements and the impact they may have on a throwing performance,

Table 3-19:Hand anthropometric data collection.

Anthropometric data	
Hand Length	To determine whether hand length has any influence on a throwing performance.
Hand Breadth	To establish how hand breadth may impact on a throwing performance.
Length of phalanges	To ascertain any effect length of phalanges has on a throwing performance.
Digit 1 (thumb)	To establish what impact the length of D1 may have on a performance.
Digit 2 (index finger)	To investigate the role of D2 in a throwing performance.
Digit 3 (long finger)	To clarify the role of D3 during a throwing performance.
Thumb saddle to D1	To determine the impact of a reach of D1 may have in a throwing performance.
Thumb saddle to D2	To ascertain the effect the stretch to D2 has in a throwing performance.

Figure 3-18 shows a series of dexterity checks were made to ascertain that participants had the full range of upper body movement. Therefore, they would be physically fit and fully mobile in the upper part of their body when completing their throwing performances.

: Research methods design.

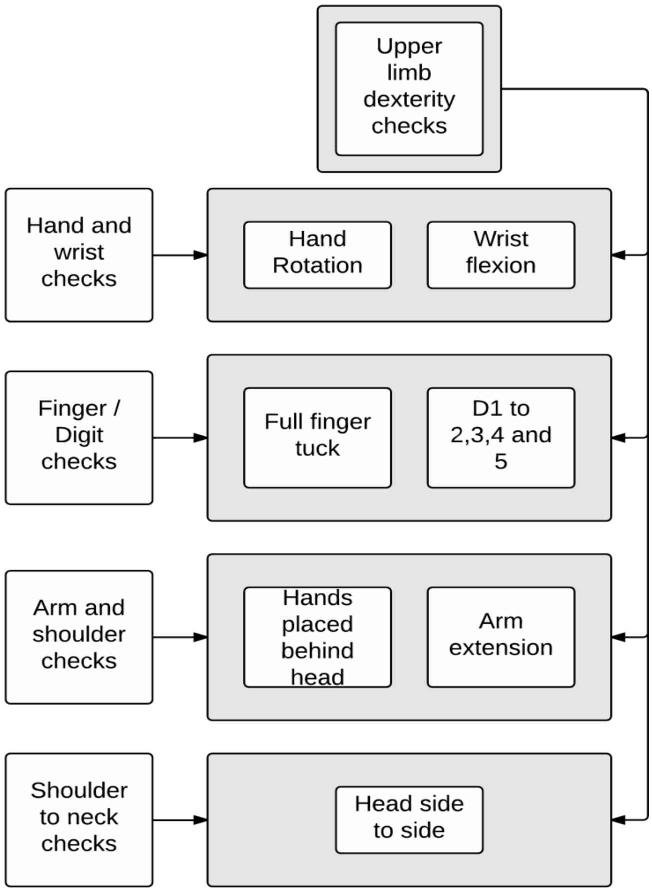


Figure 3-18:Upper limb dexterity checks.

The environmental temperature was recorded to investigate any influence that environmental temperatures that may have impacted on the throwing performances. Between dexterity checks and throwing performances there was a short semi-structured interview in the form of verbal protocol which established the intent of the participant during the throwing performances. The performances would then be matched to the recorded verbal protocol.

Hand temperatures were recorded pre-performance and post-performance to indicate any difference in temperatures around the performances.

Tools used for direct observation were selected to capture distinct data. Digital camcorders recorded the throwing performances from two angles. One was placed directly in front of the participant to gain a frontal view of the throwing performance. A second digital camcorder was positioned to the right-hand side of the participants to capture detail of hand position and body tilt.

: Research methods design.

The digital data was then used as

- A digital record of the throwing performances
- As visual data available for task analysis

Participation in the practical throwing performances was then finished. The final activity was reviewing one performance where participants were invited to watch and provide comments and feedback on their performance.

3.2.13 Analysis tools

The understanding of the forces being generated bridges the gap between the guidelines generated by task analysis and detailed biomechanics (the study of the forces exerted by muscles and skeleton) of the task. Biomechanical models are effective in providing practitioners with useful information about the effects of a task when they focus upon a specific limb, joint or biomaterial (Yamamoto and Fujinami, 2008). To effectively use biomechanical analysis, critical moments in the task performance must be identified.

Analysis tools were planned to include HOPI, where key moments can be further analysed using a model of Human and Object Physical Interaction (HOPI). Figure 3-19 shows the HOPI model breaking the physical interaction into three levels: macro, mezzo, and micro (Torrens, Gyi 1999). The research study design will certainly capture the macro level of the HOPI model.

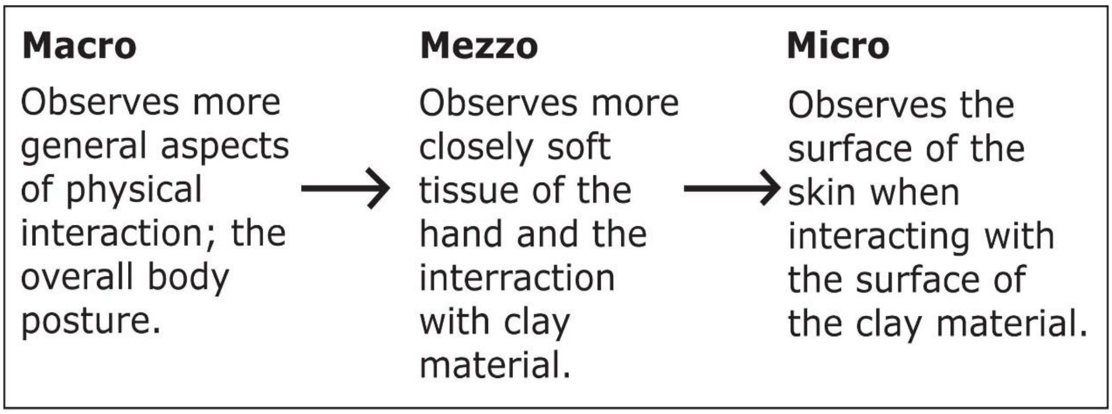


Figure 3-19:Explanation of the H.O.P.I. model.

: Research methods design.

3.2.14 Task analysis

Task analysis has a number of approaches; the efficacy dependent on the task involved. To use Task analysis as a tool; the user consistently approaches the activity with acute powers of observation. The film clips were viewed firstly in their entirety. They were then viewed action by action, to observe what was happening to the clay from clay ball to cylinder pot.

Excel cells provide a structure for recording each action. Each action was noted down in a separate cell. Once the performance events had been described, they would then be categorised by colour fill according to which part of the throwing performance they were part of. Generally, groups of cells would have like colour fills. The coding of which changed with the key part of the performance.

The digital evidence would then be viewed for different activities, to respond to the research question. *What events are involved in throwing performances to create a cylinder pot?*

Events are defined as moments of activity. Each performance would be viewed at normal playback speed and then again in slow motion speed so as to define critical moments.

The task analysis would begin with a first sweep of analysis by event. The events would be itemised, immediately prior, to the throwing performance. The task of wedging the clay in preparation for the performance was discarded as this area has been studied by Yamamoto (2008). Events would then be recorded through to the wheel stopping at the completion of the pot throwing performance.

The event itemising would focus firstly on the clay, what happens to the clay and what touches the clay and the consequences. Each participant would have a varied in the number of events in their performance. There would also be differences between each of the three throwing performances for the individual participant. The first performance was anticipated as generally a test performance with adjustments for each subsequent performance. The participants, generally, may have little if any experience

: Research methods design.

with a Shimpo potters' wheel, this would be an expected response.

- Each participant performed at least three throws with 1kg of the throwing clay of their choice.
- The throws would be varied in length.
- Each performance was coded by event Max – Min

There will be and interaction of all research tools to provide both qualitative and quantitative data, to provide mixed data to answer the research questions.

4 : Results

'*The gratification comes in the doing, not in the results*.'

James Dean

This chapter displays results from the study strategy elements. It opens with results of the questionnaire survey and follows with environmental results before participant information. It continues with anthropometric results, hand temperature measurements, before continuing with performance related detail of time, events, and speed. The chapter draws to a close with results of water use and biomechanical aspects.

4.1 Questionnaire survey

The survey questionnaire had developed from the pilot study stage of research. Responses were hand-written and time was included within the practical time in the studio. It was found to be more time economical to replace and develop the questionnaire survey into an online model. Therefore, as an online tool the questionnaire survey could be completed at a respondents' convenience. It was anticipated on distribution that the questionnaire survey may have generated further interested participants.

Bristol Online Surveys (BOS)[1] available from Bristol University was selected for ease of use, clarity of layout and the facility to be able to actively analyse responses to the survey. Questions posed in the survey were intended to give a general picture of how respondents acquired their throwing skills and to gain information about current equipment being used to throw now.

A small selection of 40 surveys, consisting of 12 questions requesting data on home pottery information, e.g. clay body used, most facet to remember about the process of throwing a pot. These questionnaire surveys were distributed online to randomly selected pot throwing practitioners, with an email address. Arthur suggests a 20% return rate

[1] BOS- Bristol Online Survey from Bristol University (http://.survey.bris.ac.uk)

is possible for validation in publication (2012, p. 239). There was an above average return rate of 40% for this questionnaire survey.

4.1.1 Response to Questionnaire Survey questions

Question 1: Location

The respondents were situated in five out of nine regions across the UK, principally the Midlands, the South-West, Eastern counties, London, and North East.

Question 2: Age

Age information returned, all respondents to the survey were aged older than 30 years. This could suppose that younger potters, or those under the age of 30 formed the non-respondents.

Question 3: Where was the skill of throwing a pot learned?

The responses returned seven categories of places and methods of throwing and methods of learning. These ranged from school, foundation degree, undergraduate degree, an apprenticeship to the less formal of evening classes and self-taught from books. The 'other' category gained interesting responses. The first learned with a Higher National Diploma (HND) course, another responder had private lessons with a potter, the third response in the 'other' category was self-taught, followed by refining tutoring from an industrial potter, then working with a potter in Japan. Another response highlighted a combination of evening classes and tutorage from books.

Question 4: At what age did you learn the skill of throwing a pot?

The question 'At what age did you learn to throw?' had results spanning from 'under 10 years' through to 49 years. The most frequently marked age range was 18–22 years, which would indicate that respondents would have acquired the skill in a foundation degree, HND and undergraduate study years.

Question 5: Frequency of throwing.

The question inquired as to how often the respondents practiced their skills. The age groups of 30-39 years and 40-45 years practiced their skills at least weekly whereas the group of 50-59 years had division between those who practiced their skills often and those who practiced their skills rarely. There was no follow up question to ascertain further information about the extremes of response. The group of 60+ years practiced from more than once daily to occasionally (monthly). Table 4-1 outlines the throwing habits of the respondents categorised by age.

Table 4-1:Throwing habits of respondents categorised by age.

	% of respondents	Age Groups				
		30-39	40-49	50-59	60+	Decline
Often, daily, or more than weekly	37.50%	1	1	3	1	0
Regularly - weekly	43.80%	1	2	0	4	0
Occasionally-monthly	12.50%	0	0	2	0	0
Seldom– less than monthly	6.20%	0	0	0	1	0
Rarely- less than monthly	0%	0	0	0	0	0

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Question 6: What is the most important thing to remember when throwing a pot?

This question required a narrative response, asking 'What was the most important point to remember when throwing? There were no declined comments, although there were respondents who contributed two points combined into a single statement.

The answers covered included:

- material aspects,
- cognitive responses,
- process and,
- advice about equipment.

Figure 4-1 shows the categories of response coding. The figure demonstrates, the larger the block more responses were made. The largest block, 'Material' advised various points regarding clays. Points such as wedging the material well to eradicate air pockets and to detect foreign material, both could affect a throwing performance and influence the outcome of the pot. Wedging also redistributes moisture resulting in a consistent throwing material.

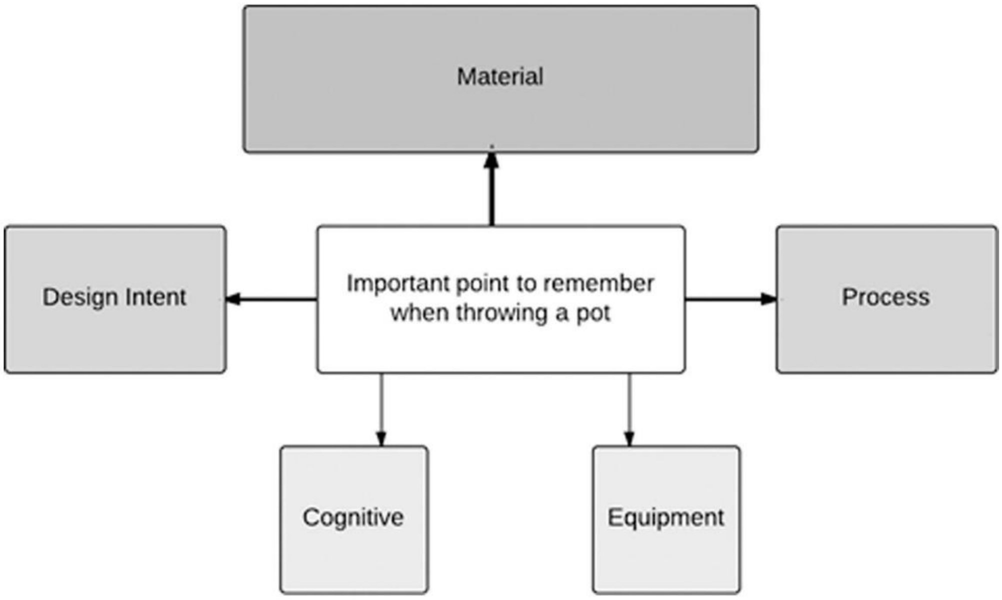


Figure 4-1:Categories of response coding.

The area entitled 'Process' advised about certain elements of the pot throwing process. Two prominent survey questionnaire comments involved, the importance of wedging the clay material properly and centring the clay on the wheel.

In consideration of the term 'Design intent', no participants used this term directly. The respondents did contribute some elements of design intent in the responses in the survey questionnaire. These responses indicated the importance of decision-making at the start of a performance on size, weight, and form of pot. Respondents contributed the importance of visualizing the product and thinking about the pot throwing performance in readiness to begin. Figure 4-2 indicates thoughts of survey questionnaire respondents.

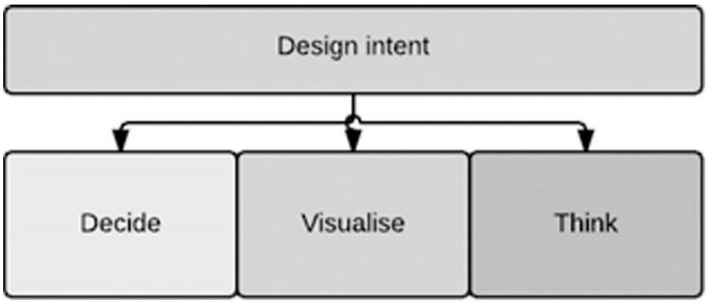


Figure 4-2:Response categories to the question of 'design intent'.

Question 7: Equipment

This question enquired about the about the equipment each respondent used for throwing. Each potter's wheel was electrically powered. The brands of potter's wheel are available in the UK. Some are tall models, which are designed to be easy for transferring from standing position to seated position almost at the level where the hips are. The shorter models may be used when space is minimal, or perhaps when potters are regularly throwing larger vessels, taller wheels are problematic when throwing the larger vessel. Figure 4-3 displays potter's wheels mentioned in the survey questionnaire.

	Alsager wheel	Cowley wheel	Gladstone wheel	Roderveld wheel	Shimpo wheel
Height	850mm	600mm	920mm	520-620mm	500mm
Length	1170mm	1100mm	1170mm	720mm	530mm
Width	760mm	800mm	780mm	580mm	500mm
Percentage of respondents	37.5%	6.25%	31.25%	12.5%	12.5%

Figure 4-3:Respondents potter's wheels.

The most popular throwing wheel used by respondents was the Alsager

Wheel, closely followed by the Gladstone wheel. Both wheels are similar sized, differing only in height. They both offer a shelf to store tools away from the wheel area. These wheels offer a similar height opportunity for transferring from standing to seated and vice versa. Next in ranking are the short and compact wheels, trailed by the Cowley wheel which falls in the middle of the selection in height and length, but is wider. The two shorter wheels, Roderveld wheel and the Shimpo wheel would be used in smaller studio spaces. The Shimpo wheel was used for throwing taller vessels where the taller wheels would be problematic for raising adequately tall walls. The stretch for the potter may cause muscular problems for holding positions when guiding the clay into shape.

Question 8 Clay material.

When probing about clay material used by the survey questionnaire participants, the response information indicated that 50% of the respondents blended their clay material, involving both porcelain and stoneware clays. Both of these clays have similar kiln firing temperatures, which would mean that the clay bodies would not be imbalanced. Of these blending respondents, 7.25% blended a branded clay with added grog (ground unglazed fired clay body), which would alter the consistency of the clay body. The remaining 50% of respondents used different types of clay, earthenware (12.5%), stoneware (18.75%) and porcelain (18.75%). This data may be misleading as some of the blended clays could be termed stoneware clays dependent on the firing needed. Figure 4-4 presents the data shown in a pie chart.

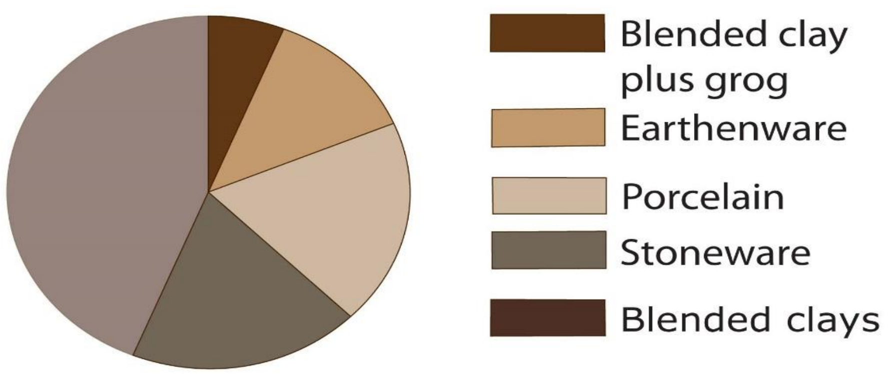


Figure 4-4:Types of clay body used by respondents.

Question 9: Level of expertise.

Question 9 enquired about the how survey questionnaire participants viewed their own level of expertise. None reported as being ‘novice’. 50% related in their opinion of being ‘expert’ 25% considered themselves as ‘proficient’, 18.75% reported as ‘competent’ and 6.25% deemed themselves ‘experienced’. Therefore, all respondents were knowledgeable about this craft. Figure 4-5 illustrates differences in levels of expertise.

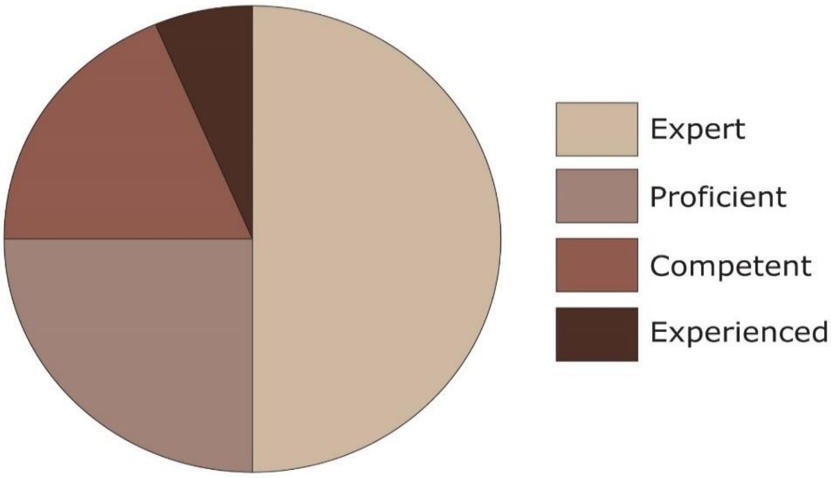


Figure 4-5:Respondents self-named level of expertise.

Question 10: Professional Terms.

The focus of this question was to determine how the respondents termed themselves, professionally. There was no consensus over terms. 62.5% identified themselves as ‘potter’, 12.5% ‘ceramicist’ and 6.25% ‘craftsman’. 18.75% of respondents used multiple terms dependent upon the occasion, suggesting ‘ceramic artist’ as a term. There was no evidence of gender preference in the use of professional terms. Figure 4-6 exhibits professional terms.

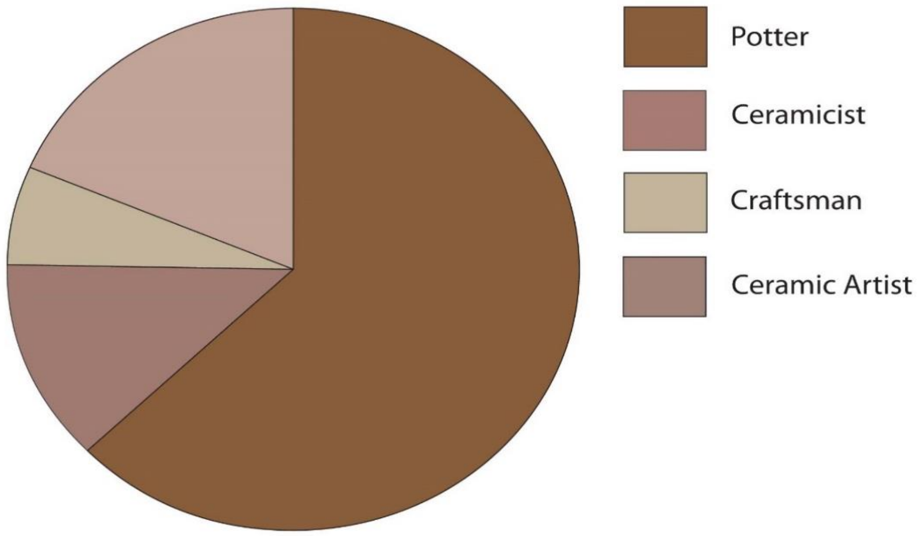


Figure 4-6:Professional terms.

In conclusion the survey questionnaire presented results of practitioner's details which are particular to the pot throwing community. There are some questions, should there have been more available time, could add to a craft debate as to how potter practitioners view themselves. Results, of which, could potentially clarify and ease the understanding of the craft field.

Question 11: Gender.

The question of gender showed that 43.8% of respondents were male and the remaining 56.2 % female. No respondent declined to answer.

Question 12: Further participation.

Of the participants in the survey questionnaire, 50% of respondents were not available to be involved in the practical sessions due to time and availability issues, and some remaining respondents contributed practically.

4.2 Environment results

All participants participated within safe criteria for this research study. The environmental measures were confined to temperature of the workspace and to the temperature of the water needed within the throwing performance. Each measurement fell within the Health and Safety recommendations although the degree of lighting was not measured; all production wheels were placed near to a window for natural light. Figure 4-

7 provides visuals of the study wheel in each workplace

Figure 4-7:Participant workplaces.

During the research study participation good natural lighting was observed. The environment for working is in line with the Craft Council report ‘Craft in an age of Change’ (Yair *et al.*, 2012, p. 61), question MQ18 posed this question to craft practitioners, ‘Where do you primarily carry out your practice?’ This study mirrors responses for ‘Formal workshop on home premises’ closely. Where there is a difference is for both the ‘HE Institution’ and ‘Other’ where the study figures exceed the UK figure. Two participants work within Higher Education Institutions which is a larger figure than the Crafts Council study found. Three participants work in an established workplace therefore the ‘Other’ category was the appropriate category to align them with. Table 4-2 displays comparison of study workplaces with UK data.

Table 4-2:Comparison of places of work with 'Crafts in an Age of Change'.

Place of work	UK figures	Study figures
Formal workshop on home premises	44.6%	40%
Individual workspace away from home rented	17.3%	10%
HE institution	0.5%	20%
Other	2.5%	30%

4.2.1 Workplace temperatures.

Figure 4-8 shows workplace temperatures of the study participants. There were five workplaces and ten participants, thus some workplaces had more than one participant performing. Therefore, there are multiple markings for some spaces. As performances from each participant were separate rather than concurrent, temperatures differed with the time of day or workplace ambiance. Workplace temperatures measured complied with the HSE guidelines. The Health and Safety Executive guidelines are suggestions ‘the working temperatures in all workplaces inside buildings shall be reasonable’ (Health and Safety Executive, 2009) rather than strict measurements to adhere to.

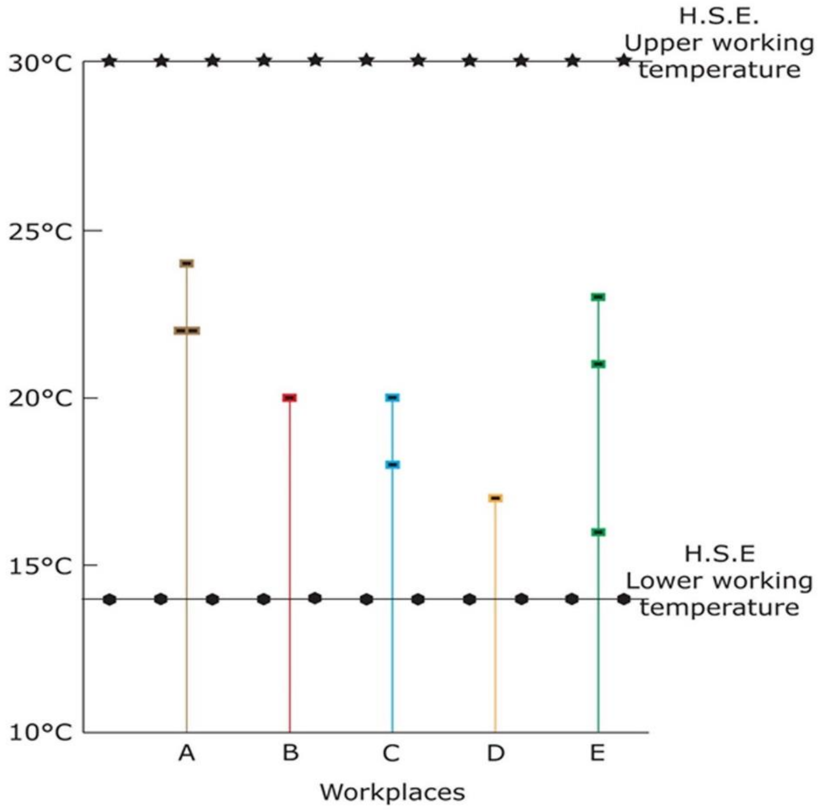


Figure 4-8: Workplace temperatures.

4.2.2 Water temperatures

Most of the water temperatures were recorded within a similar range whereas Participants 8 and 10 recorded higher temperatures. Participant 10 made no comment on the temperature of the water. He was participating in the Workspace A; and might have accepted that this was the usual temperature of the water. Participant 8 explained that she was beginning to be troubled by arthritis therefore she found throwing easier with warmer water and cooler and cold water tended to restrict hand movement after lengths of throwing. The cold stiffens her hand and finger joints and prevents fine motor movements (Elton and Nicolle, 2013).

4.3 Participants

Practical participants were purposively gathered from two national clay events and one regional event. This was combined with a 'snowball' strategy (Cohen, Mannion and Morrison, 2007, p. 116) or a 'viral strategy' (Plowright, 2011, p. 43). All completed, successfully, the university health checks (Appendix B) and the study upper limb dexterity checks (See Figure 3-18). There were only two health issues highlighted,

- Participant P8: beginnings of arthritis in both hands.
- Participant P9: Left hand digit 4 was broken historically and repaired, but weakness remains. However, left hand digit 4 is a supporting digit rather than an active throwing digit.

A third issue was

- Participant P7 had neither health issues nor dexterity issues, but one of left-hand dominance. P7 had left hand dominance but chose to throw in a right- handed, anti-clockwise direction.

4.4 Anthropometric results

Anthropometry

The anthropometrical part of the study involved taking physical measurements from the upper torso from each participant, to investigate any patterns held within the data and to determine effects upon pot throwing performance. Measurements taken included,

- Stature
- Shoulder breadth
- Upper limb length
- Hand length
- Hand breadth
- Phalanges length

The collected data was then reviewed against national data and is reported in raw data and percentiles. Percentile scores refer to the position of an individual on a given referenced distribution. The percentile scores are referenced by Pheasant (1996, p. 178) using Table 10.1 people aged 17 to 65. To understand percentile terms, for example, should a participant be placed at the 90th percentile, there would be 10% of the population with greater measurements than the participant. The participant would then have greater measurements than 90% of the population. The remaining measurements were taken to establish detailed hand data.

4.4.1 Stature

The first measurement taken was the height of each participant. This involved each person removing footwear and standing with a vertical surface behind them. Each participant would then be measured in centimetres.

All heights: recorded were between < 200 cm and > 150 cm. 60% of participants were placed above the 90th percentile equally shared between the genders. 20% of the remaining participants placed above 50th percentile and less than 90th percentile, these participants were female in gender. The remaining 20% scored above the 10th percentile and below 50th percentile and were male participants. From this purposive sample it appears that 80% of potter practitioners are taller than average height with the remaining 20% below average height. The male participants had a greater spread of measurements above 90th percentile and shorter than 50th percentile (60/40). All female participants measured above the 50th percentile with 60% placed above 90th percentile. The taller participants would potentially have differing issues with a pot throwing performance than shorter participants. Figure 4-9 has two sections, firstly, a graph showing the heights of the participants, in order of height and gender, and the second, percentiles, showing stature results after being compared with national data sets. These percentiles are shown in participant order. There were two particpants measuring in terms of percentiles, measuring below the average height of the population. There were conversely six participants measuring above the 90% percentile, indicating that these individuals are measuring in the taller members of the UK community.

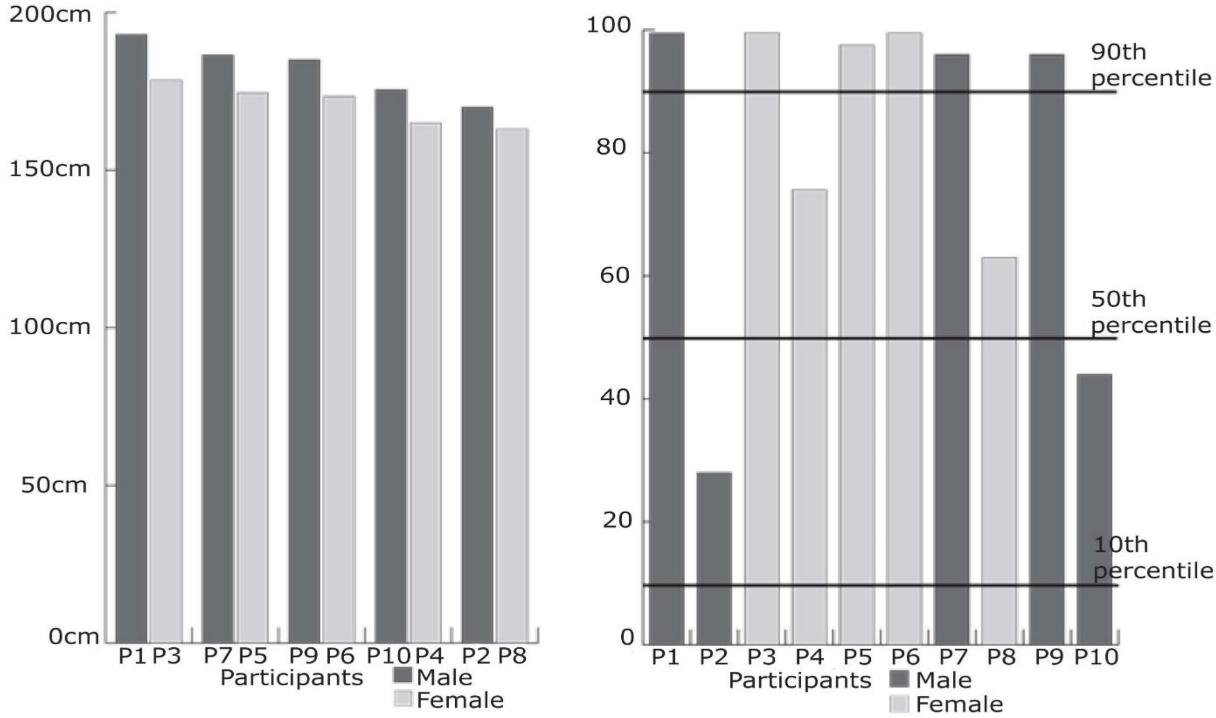


Figure 4-9:Stature of participants and percentile placements.

4.4.2 Shoulder breadth

When measuring the breadth of the shoulders, the measurement was taken between the *biacromial* points, providing a prominent measuring point. Male participants had broader shoulder measurements compared with female participants in pure measurement terms. The three tallest males had the three broadest shoulder measurements. The tallest female had broader shoulders than the rest of the female participants. There were interesting results, where the two shortest males had the narrowest shoulders, compared with the rest of the male population but broader shoulders than the shoulders of the female participants. All female participants had shoulder measurements placed above the 50th percentile which is average to just above average compared with the population. Male participants were either extremely broad shouldered 60%, above 90th percentile or narrower shouldered around 20th percentile. The stature and shoulder breadth of participant 9 did not follow the trend as he was tall yet narrower shouldered, and participant 2 was the shortest male in stature, with the broadest shoulders of the participants. Figure 4-10 has two parts, firstly showing the breadth of shoulders in participant order, and secondly using percentile lines to show the placement of shoulder breadth measurements of participants when compared with a national sample.

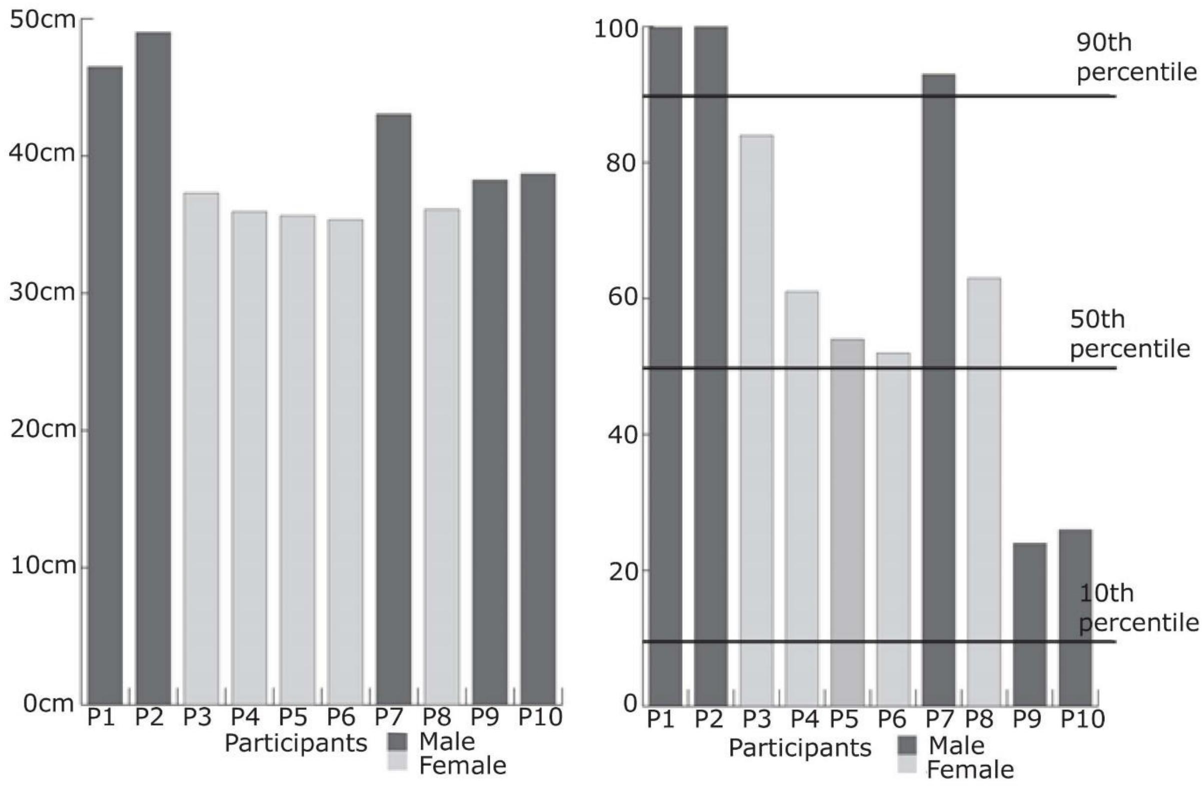


Figure 4-10:Shoulder breath measurements and percentiles for participants.

4.4.3 Upper limb lengths

The upper limbs were measured from the biacromial point along a straight arm to the tip of digit three. Each participant had both upper limbs measured. Figure 4-11 displays information concerning the upper limb measurements of the participants. with a comparison of the measurements with national data, using percentile guides.45% of the group had upper limb measurements reaching from 90th to 95th percentile area, whereas 30% of male participants had arm lengths in this range. There were 60% of female arm lengths measuring above the 90th percentile and the remaining 40% of female participant arm lengths measured above average. Male participant 2 was noticeable in measurements of his upper limbs, they measured shorter than the rest of the male participants, but when compared with the rest of the male population measured into 34th percentile much shorter than the rest of the participants. Participant P2 measures short for height, broad shoulders, and shorter arms,

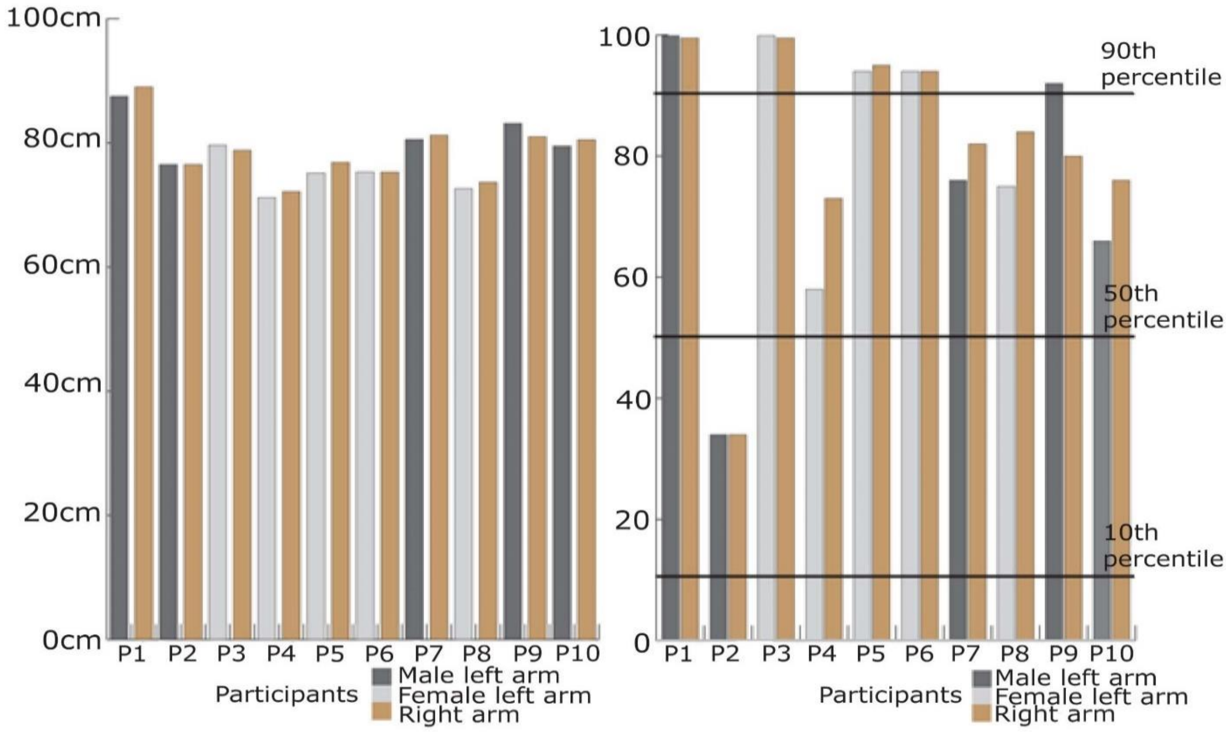


Figure 4-11:Upper limb measurements and percentiles.

4.4.4 Wrist Breadth

Each participant had asymmetric wrist breadth measurements. The wrist of the dominant hand was the larger in 60% of the measurements. 40% had larger measurements of the non-dominant wrists. There appears to be no national data for wrist measurements in the UK. Male wrists were larger than female wrist measurements. Figure 4-12 displays wrist breadth measurements of the study participants.

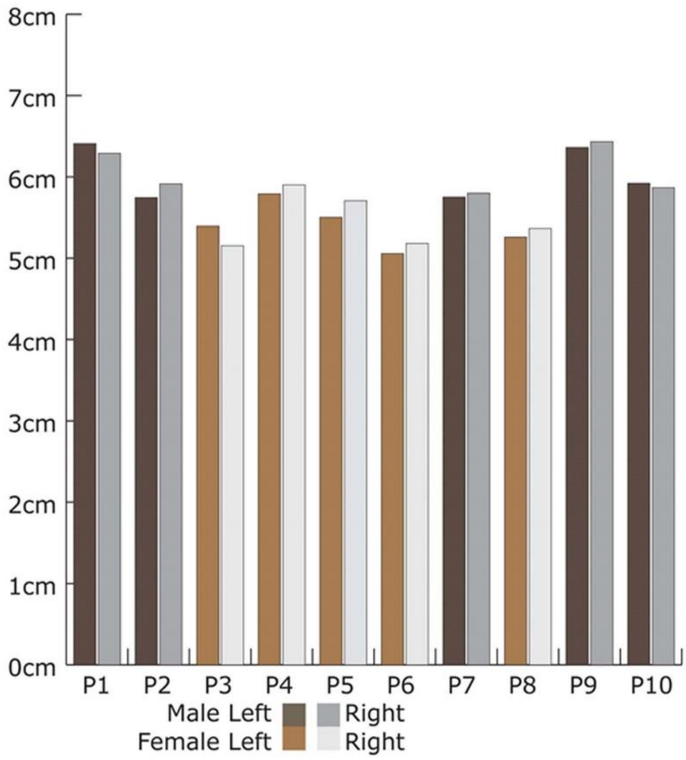


Figure 4-12:Wrist breadth measurements.

4.4.5 Hands

This section reports on findings from measuring the hands of the participants. The measurements measure the length of the hands and then measure the required digits.

When the hands were measured digital callipers were used for most measurements. Firstly, the length of the hand was measured from the wrist crease to the tip of digit 3. Figures 4-13 and 4-14 display hand lengths and comparison with national data of participants. The longest hand length was from participant P9 and the shortest hand length from participant P4. The percentile placing of measurements has 65% of measurements placed above the 90th percentile, 15% of measurements were placed between the 50th and 90th percentile and 10% of measurements were placed below and between the 50th and 10th percentile. There was participant P4 with measurements placed on the 2nd and 8th percentiles respectively for their left and right hands. This suggests that many of the adult population would have hand lengths measuring longer than theirs. The length of a hand may have an impact on a throwing performance.

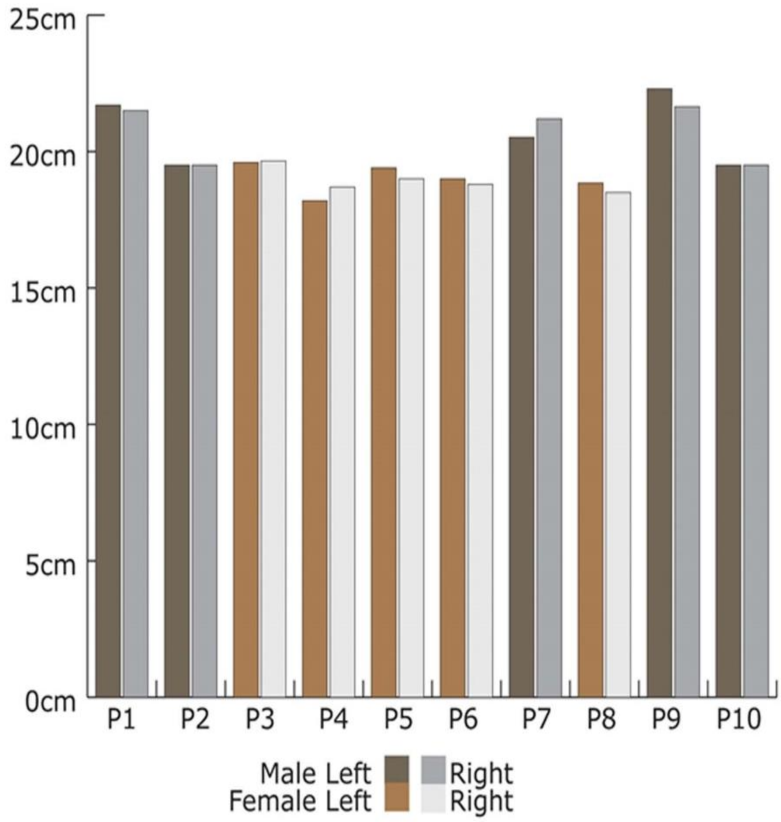


Figure 4-13:Hand lengths of participants.

Before comparing data with national statistics participant P4 has shorter hand lengths in actual measurements. When compared to the population those measurement differences with the rest of the participants give the impression of being so much greater. There are two participants measuring less than average hand length compared with UK, one female, participant P4, and one male participant, participant P10. A second male participant, participant P2 had measurements of hand length measuring above average compared with national UK data sets.

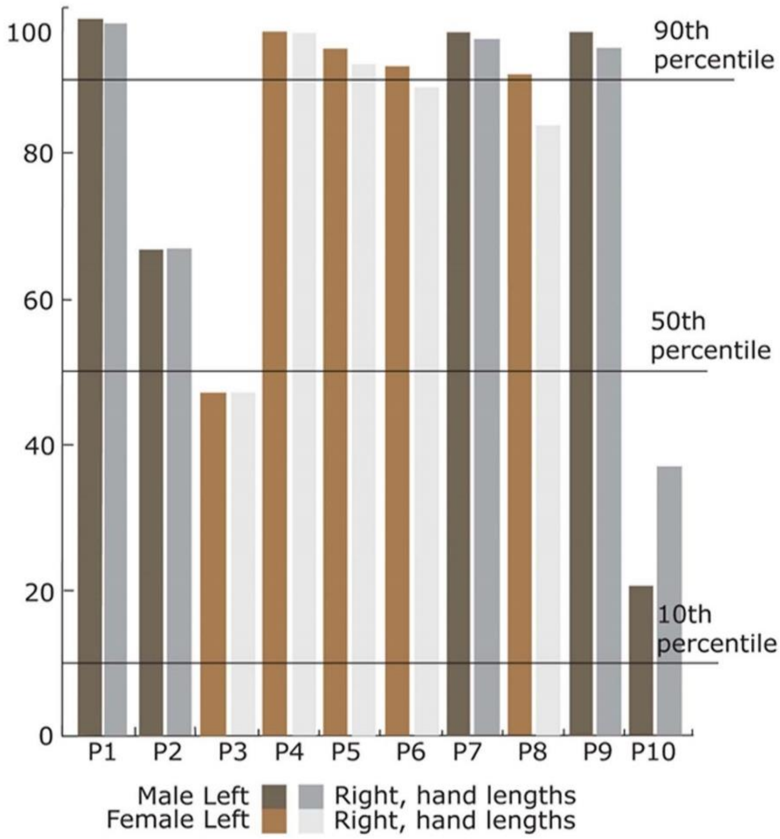


Figure 4-14:Hand length percentile comparison with UK data.

To add data information about the physique of the hands of the participants, measurements were taken of the hand breadth of each hand. The hand breadth was measured across the metacarpophalangeal joint, this being generally the widest part of the hand. This measurement can be referred to in Figure 3-11. Figure 4-15 shows few differences between the breadths of the hands. Male participant P1 had the broadest measurements of the participants followed by participants P7 and P10. Participant P6 had the broadest of female hand breadths, broader than male participants P9 and P2. The narrowest physically measured hands were from participant P8.

When compared with data from the UK, it appears that participant P2 has narrowest hand breadth measurements. The physically narrowest measurements from participant P8, are above average in measurements when compared to national UK data.

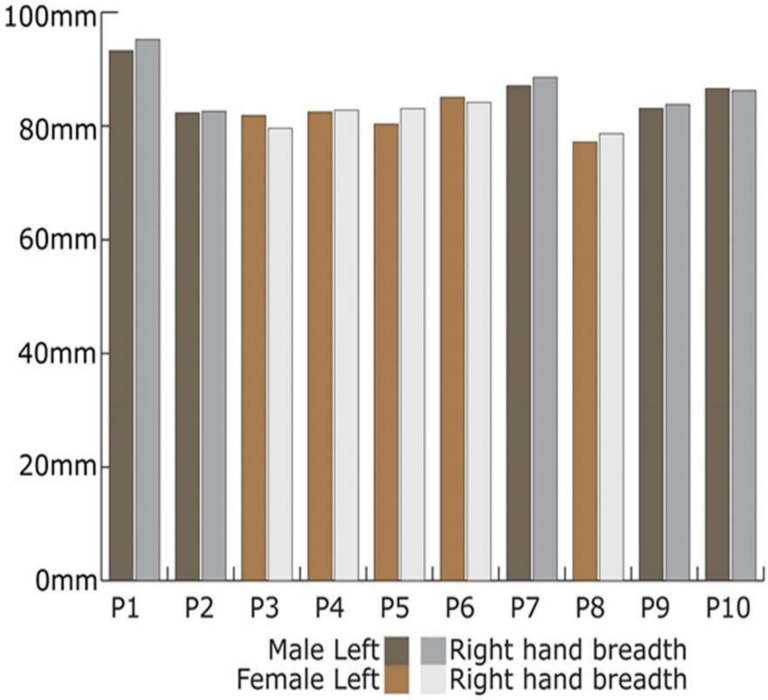


Figure 4-15:Hand breadth measurements.

However, when the measurement data (Figure 4-16), was compared with a referenced population, resulting in the measurements being allotted a percentile, the differences become greater. 35% of hand breadth measurements were placed above the 90th percentile, of these only two measurements were male hands (P1). Participant P6 had both left- and right-hand breadths placed in the 99.5th percentile. The other measurements, placed above the 90th percentile, were from female participants who had only one hand breadth measurement over the 90th percentile and their other measurement placed within the 50th to 90th percentile. Although these participants had right hand dominance it was not always the right hand being the greater in breadth. The hand breadth measurements sustained the notion of asymmetry.

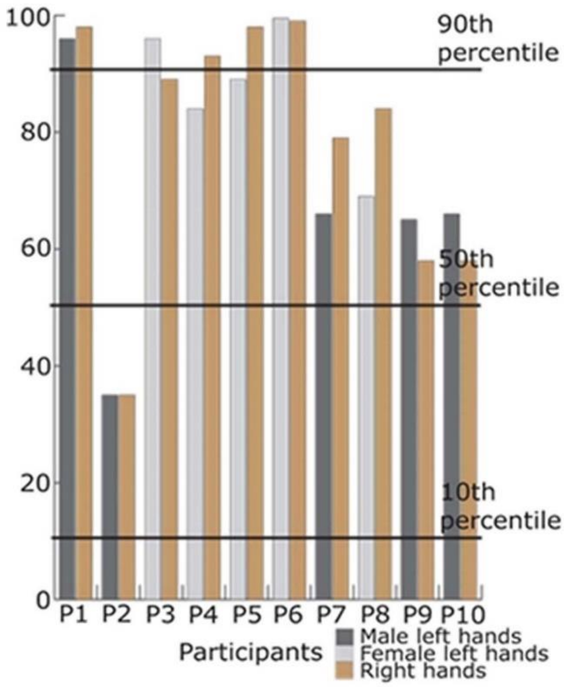


Figure 4-16:Percentile results of hand breadth measurements.

4.4.6 Digits

The following tables are gender split for comparison purposes. There are only three digits recorded from each hand of the participants because these are the main digits involved actively when throwing a cylinder pot. The remaining two digits from each hand generally play a supportive, balancing role. These digits are: -

- D1, digit 1 is the thumb
- D2, digit 2 is the index finger
- D3, digit 3 is the long finger

The digits have phalanges, sections

- Proximal phalanges: these are sited closest to the palm of the hand.
- Medial phalanges are sited between the proximal and distal phalanges.
- Distal phalanges are sited furthest away from the palm of the hand at the end of the digits.

Table 4-3 shows data from measuring phalanges digits D1, D2 and D3 of male participants.

Participant P10 had differing pattern of lengths of proximal phalanges, both Digit 1 proximal phalanges measured longer than Digit 2 and 3 for both hands. The hands of P10 had similarly sized measured digits.

Table 4-3:Measurement data of male phalanges of digits D1, D2 and D3.

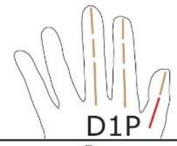
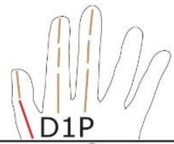
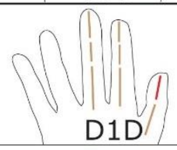
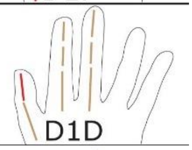
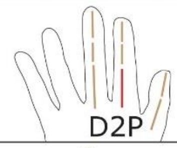
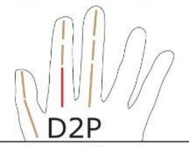
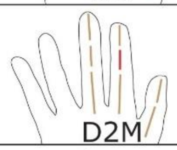
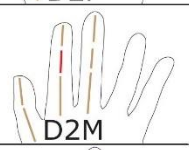
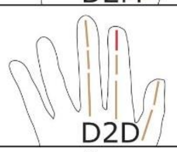
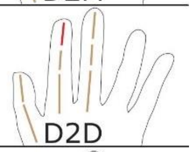
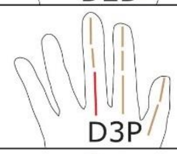
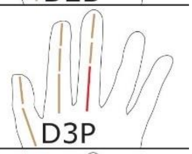
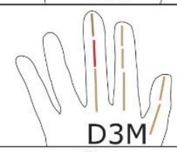
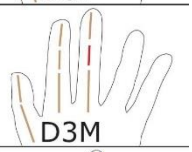
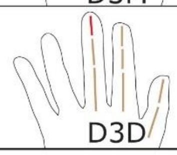
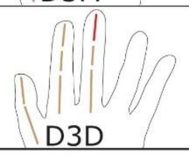
Left Hand	(millimetres)					(millimetres)					Right hand
	P1	P2	P7	P9	P10	P1	P2	P7	P9	P10	
D1P	41.68	33.19	36.93	39.91	39.17	42.84	33.19	38.04	41.60	35.19	D1P
D1D	33.62	33.41	31.93	30.74	35.69	34.28	33.41	31.32	32.54	33.99	D1D
D2P	46.74	45.01	46.41	52.28	29.12	49.65	39.54	44.32	56.29	30.08	D2P
D2M	27.52	26.63	27.11	33.31	26.71	29.99	27.36	26.43	33.59	25.38	D2M
D2D	24.57	25.01	25.98	27.01	25.58	26.99	26.08	23.54	24.20	23.31	D2D
D3P	50.97	49.04	50.41	52.58	30.08	49.80	44.16	51.48	52.36	30.01	D3P
D3M	34.46	30.68	35.88	35.48	26.37	35.13	35.50	34.42	36.80	24.58	D3M
D3D	27.26	25.41	25.85	27.51	31.07	27.27	27.15	24.66	25.12	27.95	D3D

Digit patterns of male participants have more occurrences of similar length Digit 2 and 3. Digits are not identical in length. One pattern identified is lengthening from D1 through to D3 for participants P1, P2 and P9.

Table 4-4 shows the patterns of data from the measurements of digits

D1, D2 and D3.

Table 4-4:Measurement data of female phalanges of digits D1, D2 and D3.

Left hand	(millimetres)					(millimetres)					Right hand
	P3	P4	P5	P6	P8	P3	P4	P5	P6	P8	
 D1P	36.37	35.90	39.06	33.37	32.79	36.97	34.43	37.21	33.71	34.62	 D1P
 D1D	31.54	29.37	30.36	30.55	29.55	32.44	31.03	31.15	31.17	32.05	 D1D
 D2P	48.89	44.80	45.27	47.34	40.27	49.40	47.23	44.80	47.12	43.25	 D2P
 D2M	29.58	23.75	25.69	26.31	22.54	26.38	27.34	30.96	25.76	21.53	 D2M
 D2D	24.89	22.58	24.22	23.35	29.93	23.92	24.15	24.27	24.45	23.63	 D2D
 D3P	47.43	49.19	51.54	45.34	44.80	51.59	52.58	49.25	46.39	44.09	 D3P
 D3M	29.83	32.68	33.66	27.45	28.54	32.05	30.29	35.20	27.65	26.73	 D3M
 D3D	26.16	22.59	25.70	24.36	25.43	25.10	23.84	24.76	25.45	24.58	 D3D

Digits 2 and 3 were similar in length for both left and right hands for P6. Female participants are reported. as having only one pair of digits similar in length. Participant P6 has D2 and D3 measuring a similar length despite a difference in the lengths of the proximal and medial phalanges. The differing pattern of lengths of those proximal phalanges, Digit 2 proximal phalanx measured longer than Digit 3 on both hands. Digits 2 and 3 were similar in length on both hands for participant P6. One pattern identified is seen as lengthening from D1 through to D3

Measuring the length from the Thumb saddle joint to tip of Digit 1 would indicate a possible point of reach during the throwing performances.

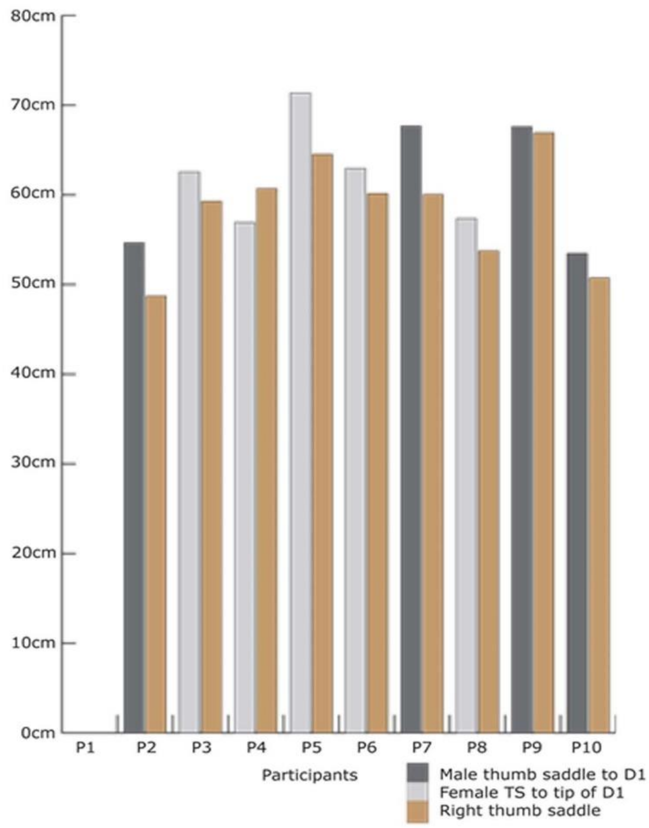


Figure 4-17:Measurements from Thumb saddle to tip of digit D1.

Figure 4-18 shows the measurements from the thumb saddle joint to the tip of digit 2. Participants, P5, P7 and P9 have the potential of the longest thumb (D1) stretches when throwing. Combined with the potential long stretch from the thumb saddle joint to digit 2, the hands would be dextrous to be able to pull walls.

These measurements were taken to investigate the depth of stretch of digits inside a pot when throwing a cylinder. Figure 4-18 shows the measurements of from the hand crotch to the tip of digit 2. P9 had the greatest potential for reach inside a pot whilst throwing. P8 had the least potential depth of stretch inside a pot.

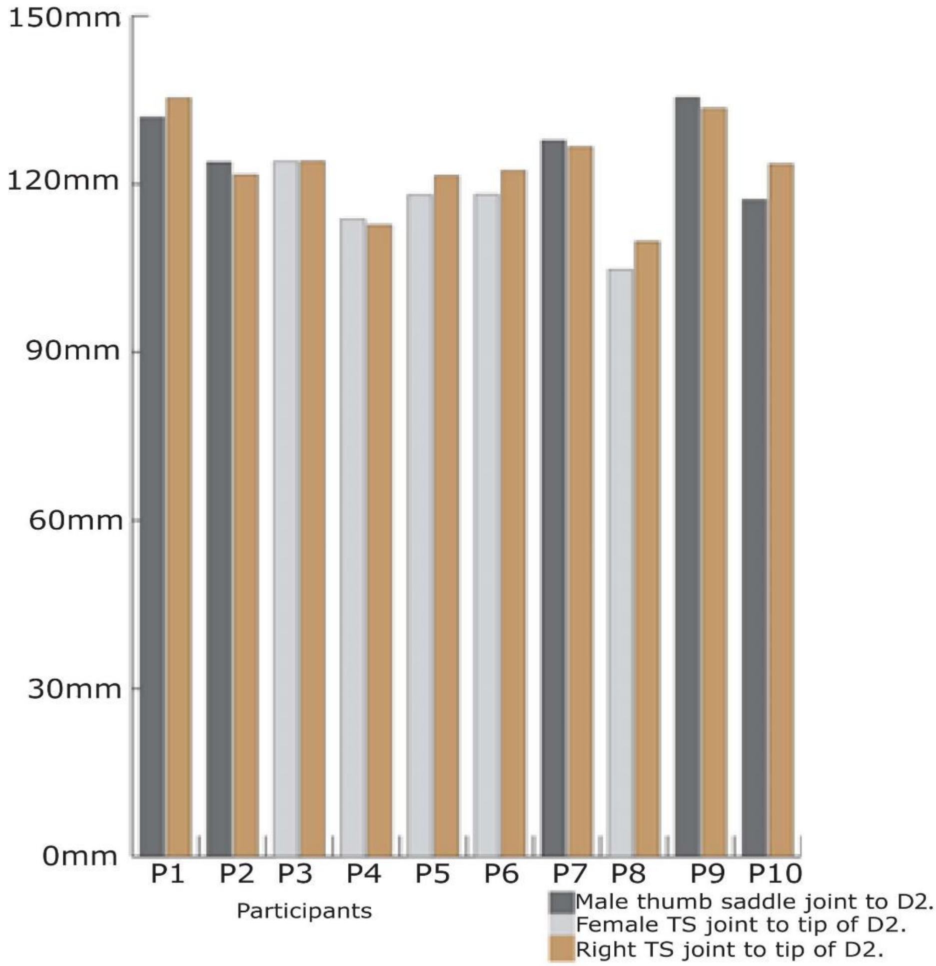


Figure 4-18:Measurements from thumb saddle to tip of digit D2.

Participant P9 has the potential for a long stretch into a pot, whereas participant P8 has less of a reach. Participant P4 had a short hand length but had long fingers despite the short length.

4.4.7 Grip Measurement

The grip results in Figure 4-19 show that two female participants (P4 and P8) have less grip strength than other participants. Participants P1 and P7 have greater grip strengths compared with the rest of the group. 80% of female participants have greater strength in their dominant right hand. Participant P8 conversely has seemingly greater strength in her non dominant hand despite having right hand dominance. Participant P7 has significantly more grip strength in the right hand than the left hand.

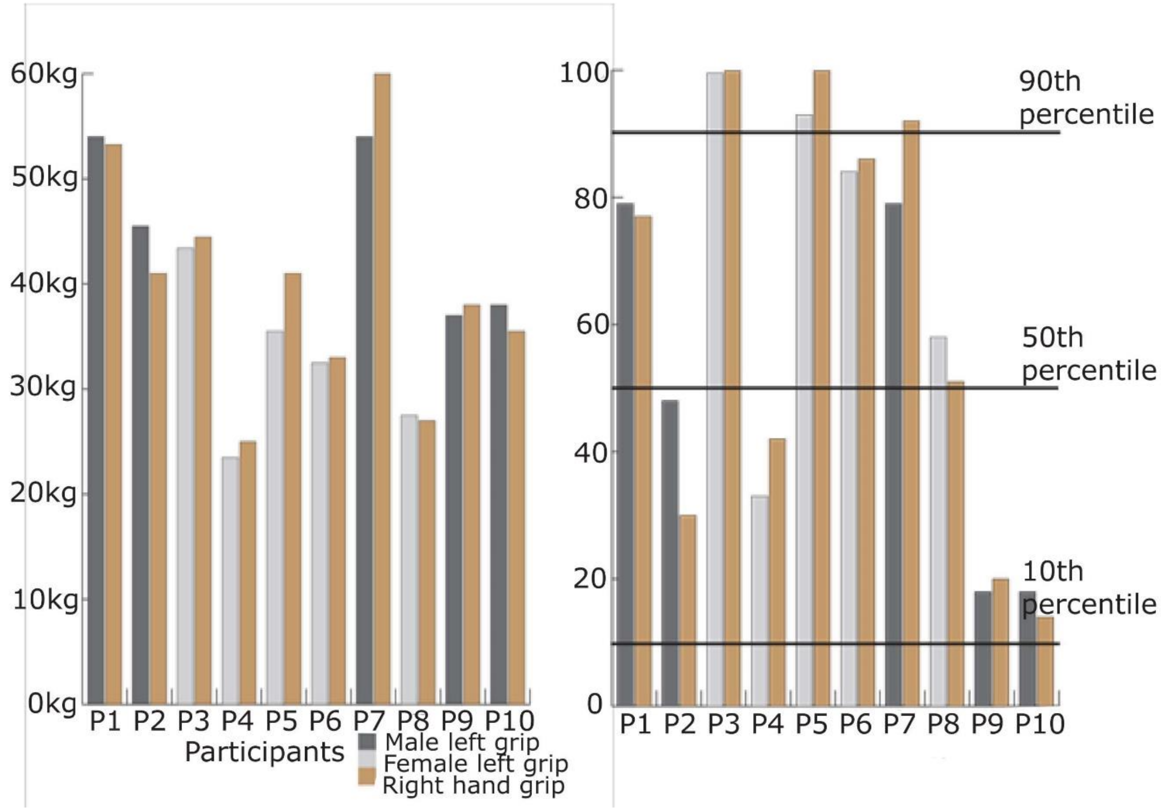


Figure 4-19:Grip measurements and percentiles of participants.

4.4.8 Pinch grip measurements

Participant P7 had the strongest pinch grip of all the participants; the strongest pinch grip was with the non-dominant hand. 80% of the pinch grip scores were greater in the non- dominant hand. The remaining 20% was divided equally between a male and a female participant. Weaker pinch grip scores were recorded by female participants. Participant P9 had the greatest difference between left hand and right-hand scores; this would be explained by a former injury to the right hand. Participant P3, however, had the least difference between pinch grip pressures.

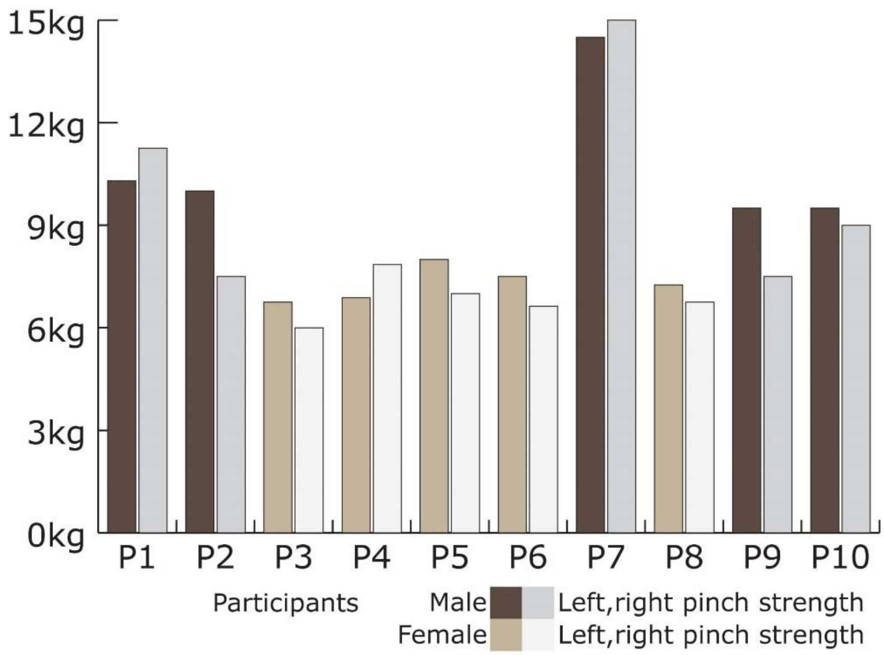


Figure 4-20:Participant pinch measurements.

4.4.9 Hand preference.

The study design required the knowledge of hand preference as a potters' wheel generally operates in an anticlockwise rotation, which is a suitable direction for many of the pot throwing participants. The method by which the information was elicited from the participants was by asking the simple question? Which hand do you write with? The completion of the consent form confirmed the information.

The result reflected the commonly accepted simplistic (Marchant, McGrew et al. 1995: 240) trend of 90% right-handed and 10% left-handed. (Coren 1992: 1). Figure 4-21 represents the ratio of gender and handedness and that the left-handed preference participant is male.

The purposive sample reflected current understanding that the ratio is 10% of the population has left hand dominance and 90% of the population has right hand dominance. Exactly 10% of participants had left hand dominance and the remaining 90% of participants had right hand dominance. When gender was applied females had 100% right hand preference and males 80-20% right hand preference.

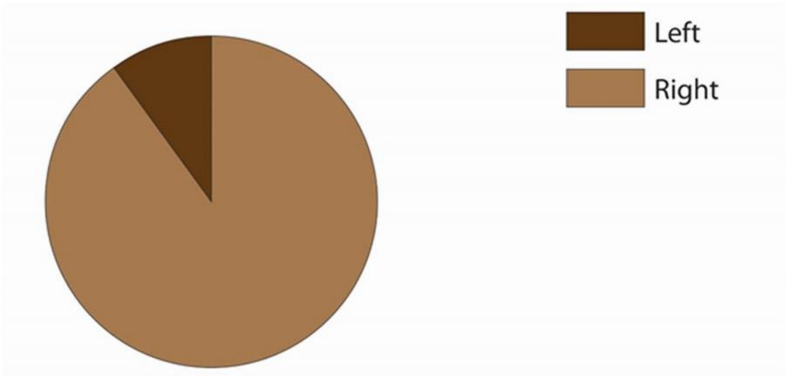


Figure 4-21:Hand dominance of participants.

4.4.10 Anthropometrical conclusions

Figure 4-22 demonstrates the percentile scores of anthropometrical measurements, for each participant.

- Stature,
- Shoulder breadth
- Upper limb length
- Hand length and
- Hand breadth

These percentiles are collated and displayed in a Bar chart format. The percentiles are shown in terms of

- <10% percentile,
- >10% and <50% percentile
- > 50% and < 90% percentile
- 90% percentile
- >99% percentile

P1, P3, P5 and P6 scored a greater number of results representing >99th percentile. This confirms that 99% of the rest of the UK measured population had smaller anthropometrical measurement results. P7, P9 and P2 had at least one or more 90th percentile sections, where they had measurements greater than 90% of UK population. P8 had the most above

50th percentile scores, the above average scores. Whereas P4 and P10 had percentile scores less than 50th percentile, less than 50% of the UK population. Figure 4-22 displays participants in numerical order rather than gender order. Female participants scored generally above the 50th percentile except for P4 having the shortest hand measurements.

When considering the 'stature' percentiles 30% of the participants were placed above 99th percentile, 30% more placed above the 90th percentile mark, therefore 60% of the participants were very tall in stature. The remaining 40% were placed above the 10th percentile.

However, 'shoulder breadth' measurements were not as extreme in size, as 30% of participants were placed above the 90th percentile, 50% of participant scores were placed above 50th percentile mark, but less than 90th percentile and the remaining 20% of scores were placed above 10th percentile mark but below the 50th percentile mark.

The upper limb length measurements 40% of measured participants scored plus 90th percentile.50% of participants measured greater than the average percentile and 10% scored greater than 10th percentile.

Hand length scores 60% of participants placed in the greater than 90th percentile section. 20 % scored above average over 50% mark. 10% of participants scored over the 10% mark where only 10% of measured UK population measured smaller than participant scores. A participant measured lengths alongside the smallest recorded measurements of the UK. than 10th percentile mark.

90% of hand breadth scores measured above the 50th percentile. 40% of participants had measurements > 90th percentile, a further 50% of participants recorded measurements above 50th percentile. 10% of participants measured less than 50th percentile but greater than 10th percentile.

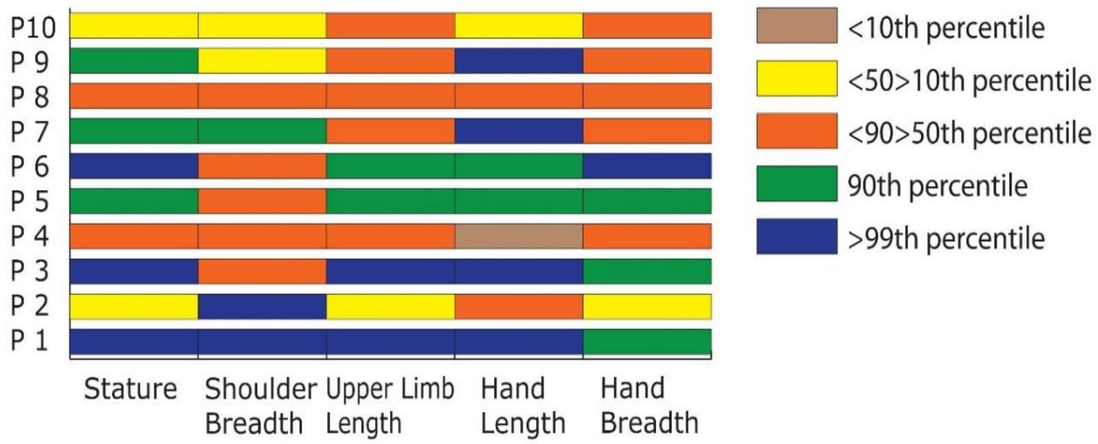


Figure 4-22:Collated percentile results from anthropometrical measurement.

These purposively sampled participants have a wide range of physical percentile differences. P1 who is measured at over the 90th percentile in all measurements. P3 has just one measurement less than 90th percentile, the shoulder breadth. P2 and P10 measure to 50th percentile or less in three areas.

4.5 Hand temperature measurements

Hand temperatures were measured to observe whether there was an impact of hand temperatures on a throwing performance. The results from recording the hand temperatures prior to commencing the throwing performance and after the performance, ranged between the highest temperature of 34°C and the lowest temperature of 21°C. Figure 4-23 shows the results from the recording of the temperatures of both hands. The upper line denotes the greater of the two temperatures. The lower marker shows the lower of the start and/or finish temperatures. An arrow denotes the orientation from start to finish. Both hands seemingly had different temperatures. Some participant hands remained at the same temperature measurement. Other measurements increased in heat and others decreased their temperature. Participant P8 had a significant raise in temperature of the left hand. The maximum difference recorded was for participant P1; the left hand recorded a drop-in temperature of 6°C.

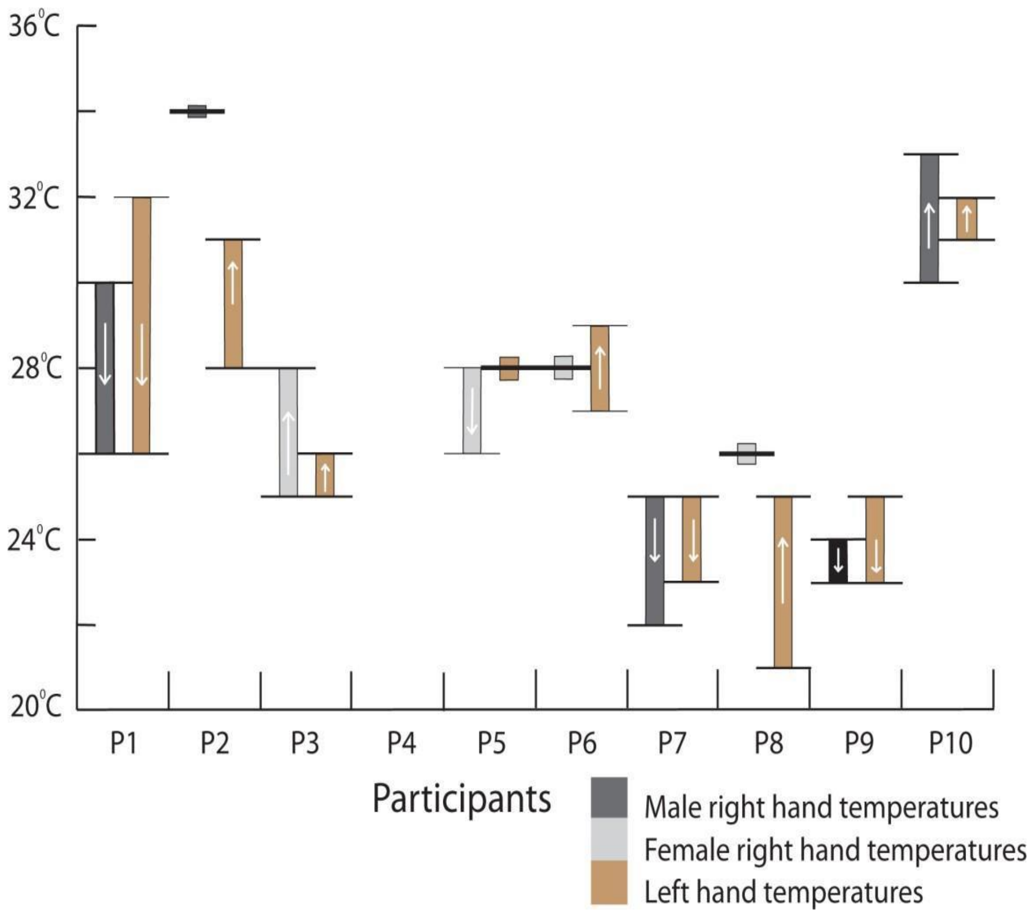


Figure 4-23:Participant hand temperature data.

4.6 Performance

Throwing performances were timed and recorded to be analysed further. Each performance was analysed action by action. From here each action was labelled as an event, therefore each performance became a series of events constituting an entire performance. These performances were categorised and coded to distinguish different parts. An Excel spreadsheet was used as a structure for analysis data. Each event was placed in an excel cell. Initially brief comments were made to explain each event. The text remains on view as a record. The colours denote the situational segment of for each cell within a throwing performance. When the parts of the performances are scrutinised in isolation, there are similar events with each practitioner. Some performances were parsimonious in achieving the section in a minimum of events, other performances achieved after reviewing events. Figure 4.24 displays three throwing performances from participant P9.

Participant P9, commences each performance by starting the wheel. The first performance starts with checking and tidying the wheel after the previous participant, P7. The 1 kg. clay ball is placed on the wheel head and for two out of three performances adds water to this beginning sector to lubricate the clay material. This is named as the centring part of the performance. The clay material was manipulated up into a tower and down into a lump. This action was completed twice ensuring that clay molecules were in alignment and that water moisture was redistributed within the clay material. Participant P9 then made a dip into the top of the clay material and added water for lubrication. A hole was made, leading into compressing the base, to add strength. The next sector is the formation of a cone shape as a base for the cylinder shape. P9 performed a check on progress before adding water. Following this sector, the walls are 'pulled' increasing the height of the pot with each pull. P9 iterated the first pull twice more and with each pull compressed the rim and tidied the foot of the pot. The final sector of removing excess moisture from inside the pot followed by stopping the wheel and taking the pot off the wheel. The performance was finished.

	Participant 9		
1	Start wheel	Start wheel	Start wheel
2	Clean wheel	Place clay on wheel	Place clay on wheel
3	tidy loose clay	Water hand	Manipulate clay up
4	Place clay on wheel	Manipulate clay up	Manipulate clay down
5	Water	Manipulate clay down	Make a dip
6	Manipulate clay up	Make a dip	Water
7	Manipulate clay down	Water	Making hole
8	Manipulate clay up	Making hole	opening up
9	Manipulate clay down	opening up	Compressing base
10	Make a dip	Compressing base	Start cone
11	Water	Finish compressing base	Make cone
12	Making hole	Begin cone	Check
13	Opening up	Make cone	Add water
14	Compressing base	Check	Add water
15	Finish compressing base	Add water	First pull
16	Add water	First pull	Compress rim
17	Start cone	Compress rim	Collar pot
18	Make cone	Collar pot	Compress rim
19	Check	Compress rim	Add water
20	Add water	Collar pot	Add water
21	Add water	Compress rim	Touch wall
22	1st pull	water	2nd pull
23	Compress rim	Touch sponge on pot	Compress rim
24	Water fr wheel to bowl	2nd pull	Collar pot
25	Water fr wheel to bowl	Compress rim	Compress rim
26	Add water	Grab sponge	Collar pot
27	add water	Dry out centre	Grab sponge
28	2nd pull	Collar pot	Dry inside
29	Compress rim	Tidy foot	Tidy foot
30	Collar pot	Rid of loose clay	Collar pot
31	Compress rim	3rd pull	3rd pull
32	Grab sponge water	Compress rim	Compress rim
33	Tidy foot	Tidy base	Tidy foot
34	Add water	Wheel stop	Wheel stop
35	Grab sponge water	Wire	Insert shape R
36	Splash	Wheel spin	Manually move wheel
37	Splash	Wheel stop	Insert shape L
38	Water	Pot lifted away	Start wheel
39	3rd pull		Compress rim
40	Compress rim		Wheel stop
41	Touch pot		Wire
42	Collar pot		Wheel spin
43	Compress rim		Wheel stop
44	Tidy foot		Pot lifted away
45	Grab sponge		
46	Squeeze sponge		
47	Dry out pot		
48	Wire		
49	Wheel stop		
50	Poke pot		
51	Pot lifted away		

Figure 4-24:Throwing performance details of participant P9.

Participant P8 begins each performance by placing the clay on a motionless wheel. She then starts the wheel. P8 adds water or rinses hands before entering a routine of centring the clay. Her pattern for centring is to manipulate the clay on the wheel upwards and then downwards twice. This aligns platelets within the clay and distributes moisture already present. The clay is flattened and dipped in preparation for making a hole. In the first two performances the wheel is slowed before adding water. Next a hole is made in preparation to making the shape of the pot. The routine evident in all three performances is that the hole is made, which is then opened-up then water is added. This then transfers into the next routine of making a cone shape, the pre-shape to a cylinder. Care of the developing thrown pot is shown in the latter two performances, as performance 2 shows that excess moisture is sponged away and in the third and final performance the foot of the pot is tidied, where excess clay is removed. The first performance has a total of six pulls to complete the pot. In between each pull there is a sensory checking motion of fingers feeling down the walls of the rotating pot, finishing this section with a drying out of the pot. The second two throwing performances equivalent pulling sections are shorter with five pulls and three pulls. In between each pull the pots are checked for excess moisture, foot shape and debris. A following routine of checking the walls up and down, several times, continues before wiring the pot to separate from the wheel head and stopping the wheel to lift the finished vessel away from the wheel.

Each participant completed the task of throwing three, cylinder pots with similarities and differences. Similarities of stages within each performance, and differences in checking, moisture control and an action of compressing the rim of the thrown pots during the performance.

Each segment of the throwing performances was completed differently, albeit slightly, by participants.

Participant 8		
Clay placed	Clay placed	Clay placed
Start wheel (knob)	Add water	Start wheel (knob)
Wheel stop	Start wheel (knob)	Rinse hands
Wheel start	Rinse hands	Smooth ball
Add water	Smooth ball	Increase speed
Add water	Manipulate clay up	Add water
Smooth ball	Add water	Manipulate clay up
Manipulate clay up	Manipulate clay up	Manipulate clay down
Add water	Manipulate clay down	Manipulate clay up
Manipulate clay up	Manipulate clay up	Add water
Manipulate clay dow	Add water	Manipulate clay down
Manipulate clay up	Manipulate clay down	Add water
Add water	Add water	Flatten ball
Manipulate clay dow	Flatten ball	Tidy foot
Add water	Flatten ball	Add water
Manipulate up	Tidy foot	Flatten ball a
Manipulate down	Add water	Flatten ball b
Add water	Flatten ball	Rinse hands
Make a dip	Making hole	Add water
Water	Slow wheel	Making hole
Flatten ball	Add water	Slow wheel
Slow wheel	Speed up wheel	Add water
Add water	Make hole	Opening up
Making hole	Opening up	Add water
Opening up	Add water	Start cone
Add water	Start cone	Rinse hands
Start cone	1st pull start	1st pull start
Add water	Grab sponge	Grab tri tool
cone	Dry out pot	Tidy foot
Add water	Add water	Rinse hands
1st pull	1st pull	Collar pot
Fingers down cone	Debris	1st pull
2nd pull	1st pull	Consolidate rim
Fingers down cone	Slow wheel	pull again
3rd pull	Fingers down cone	2nd pull
Compress rim	Consolidate rim	Slow wheel
Fingers down cone	Rinse hands	Rinse hands
Fingers down cone f	Speed up wheel	2nd pull
4th pull	2nd pull	Consolidate rim
Compress rim	Consolidate rim	Rinse hands
Rinse hands	Tidy foot tri tool	Sponge inside of pot
Grab tri tool	Rinse hands	Sponge inside of pot
Tidy foot	Sponge outside of pot	Grasp tri tool
Grab sponge	Sponge inside of pot	Tidy foot
Sponge inside pot	3rd pull	Rinse hands
Sponge removed	Fingers down cone	3rd pull
5th pull	4th pull	Fingers down pot
Fingers down pot	Fingers down pot	Fingers up pot
6th pull	5th pull	Consolidate rim
Fingers down pot	Consolidate rim	Rinse hands
Fingers up pot	Fingers down pot	Check walls
Fingers down pot	Fingers down pot	Check down walls
Check rim	Fingers up pot	Check up walls
Dry out pot	Fingers down pot	Fingers down pot
Check walls up	Grasp tri tool	Grasp tri tool
Check walls up	Tidy foot	Tidy foot
Check walls down	Consolidate rim	Rinse hands
Consolidate rim	Fingers down pot	Sponge inside of pot
Grasp tri tool	Fingers up pot	Check walls up
Tidy foot	Check rim	Check walls down
Wire	Check walls down	Check up walls
Wheel stop	Check rim	Consolidate rim
Pot lifted away	Sponge inside of pot	Check walls up
	Check walls up	Check walls down
	Check walls down	Grasp tri tool
	Slow wheel	Tidy foot
	Wire	check wall up
	Wheel stop	Check inside
	Rinse hands	Check rim
	Pot lifted away	Wire
		Wheel stop
		Pot lifted away

Figure 4-25:Throwing performance details of participant P8.

4.6.1 Pre-throwing events

Figure 4-26 shows firstly the itemised pre-throwing events. These events were categorised into groups. They are placed in the figure in no particular order. When adding water, the few participants who added water either, dampened the wheel- head or directly moistened the clay. The actions to the clay were performed prior to the clay being placed or slammed onto the wheel-head. A patting motion was either performed by one hand while the other hand was holding the mass of clay, or the clay was passed in a patting motion between both hands, a more vigorous motion was slapping the clay. As a participant might have held the mass of clay it was merely held or grasped, a more active notion of holding. When housekeeping, around the wheel, the participants cleaned the wheel-head by picking off extraneous clay found from a previous throwing performance. The study wheel was clean for the start for each participant.

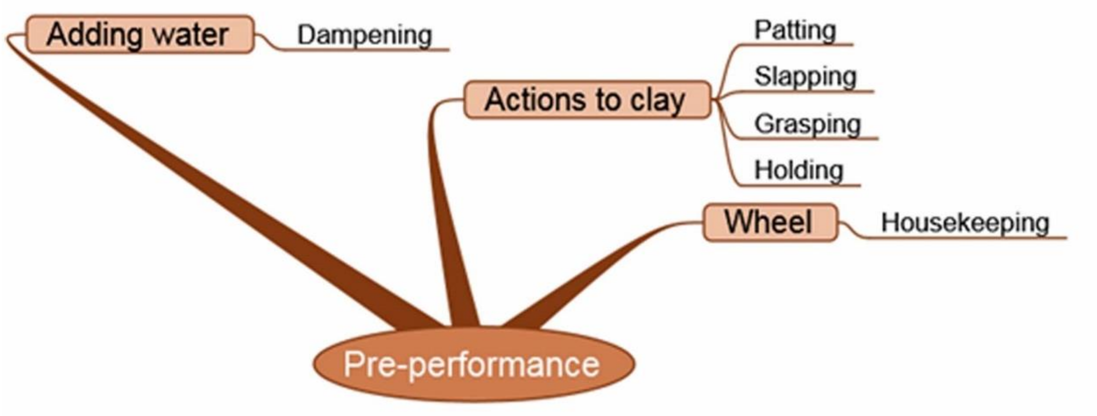


Figure 4-26:Pre-performance activities.

As the participants prepared for the performances, there was an assortment of activities. Figure 4-27 shows a range of these actions directly involving clay. These might be thought of as focusing activities. These actions mentally prepare the participants for the imminent pot throwing performance. The hands and digits would be preparing the sensory receptors for the sensory feel of the mass and texture of material. The sensory elements of thought would potentially be the wetness, the firmness, the texture, and the weight of the clay for each throwing performance.

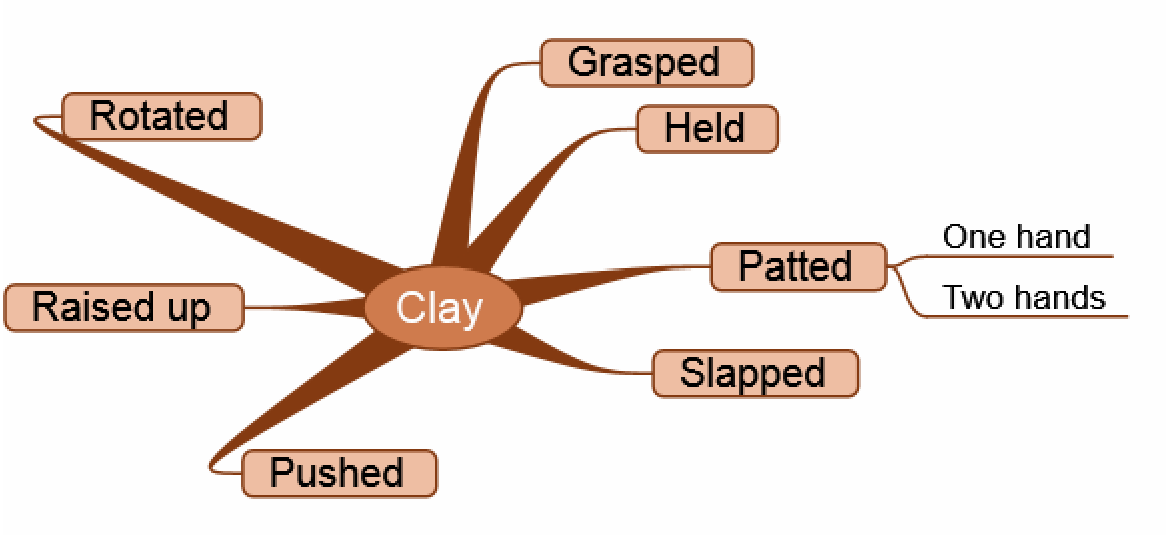


Figure 4-27:Activities prior to putting the clay material on the wheel.

4.6.2 Centring the clay material

Centring events included manipulation of clay and lubrication between the material and the hands in the form of water. Centring is a linear event as the individual starts the process with an un-centred ball or cone of clay and finishes the key procedure with a centred hump of material ready for further development. The shorter the centring element, more proficient the practitioner, in that they can sense the feel of the centred clay, all factors are in place. Therefore, they are ready to make the throwing performance. Those who take longer to centre may or may not be less proficient practitioners but other factors impacting on a swift centring could be and not limited to, the condition of the clay, unfamiliarity of equipment, the pressure of a perceived level of expectations of a well-managed centring element and the added pressure the of throwing performance being 'videoed'.

Participant P1 is shown centring the clay material in Figure 4-28, P1 is positioned sitting well balanced, bearing in mind that the study potter's wheel is low and participant P1 is tall. The shoulders appear relaxed and upper limbs and hands working equally to centre the clay. The lower limbs are forming a secure base on which to support the upper limbs below the elbow. Both hands and digits are engaged in the activity.

Figure 4-28:Participant P1 centring clay.

Participant P7 shown in Figure 4-29 appears less comfortable with the study wheel. Participant P7 is similar in stature to participant P1.

Figure 4-29:Participant P7 engaged in centring clay.

The lower limbs are placed similarly, but not in a supportive position as the feet and ankles are tucked behind the knee. This position may provide extra imagined power. The shoulders not as relaxed as seen in participant P1. However, the left arm is tucked securely into the hip for extra support and the right arm is providing oppositional force to centre the clay. Centring events are displayed in Figure 4-30.

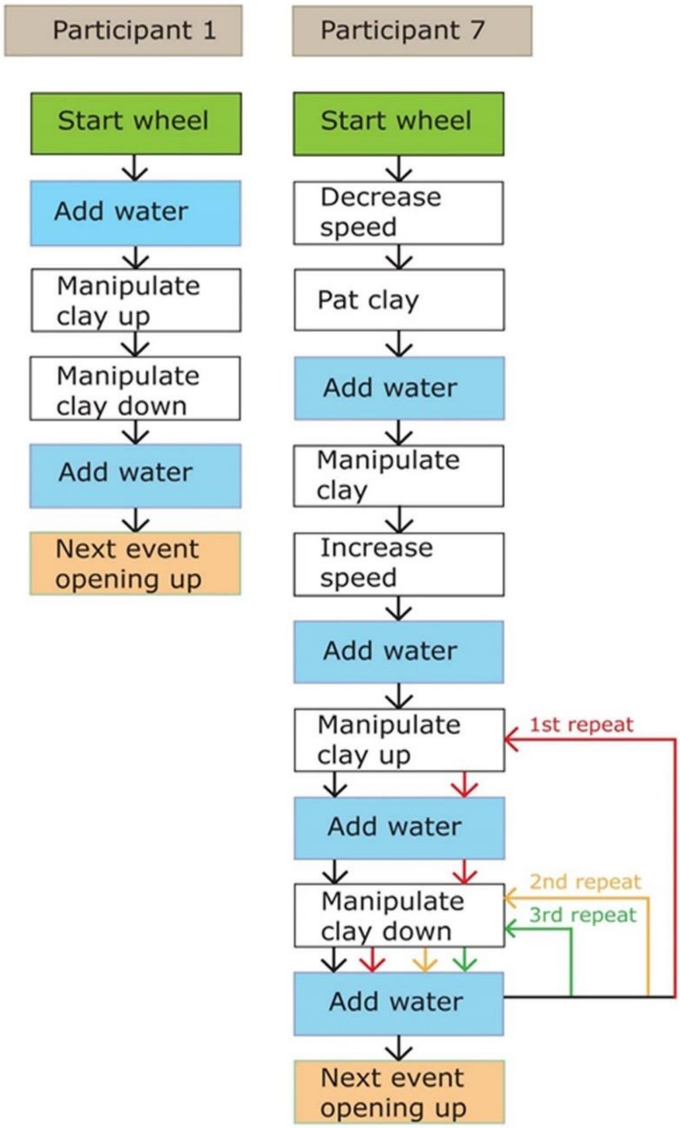


Figure 4-30:Detail of centring events for participants P1 and P7.

Participant P1 recorded the shortest list of events to achieve a centred mass of clay. Whereas participant P7 logged a longer list of events before needing to repeat the actions of manipulating the clay mass up and down for four times in total compared with participant P1. A comparison between the smallest number of events whilst centring and the most events while centring, had common features, adding water, manipulating the clay in an upwards direction and then a downwards direction before moving on to the next series of events. Where the longer centring sequence got held up was in the recognition and the actual centring of the clay. Therefore, when the clay mass did not feel 'centred', the sequence was repeated. Speed of the potter's wheel was also an issue for participant P7 as velocity was decreased after the start, then increased after a manipulation of the clay material. The second performance from all participants was selected revealing four common centring events for male participants,

- place clay,
- add water,
- manipulate up, and
- manipulate down.

Female participants recorded six common centring events, an increase of two on the list from male participants

- wheel start
- flatten ball

Other events not common to all participants included similar elements about adjusting the speed of the wheel and a variety of actions to the clay material.

4.6.3 Opening up events

Opening events, seen in Figure 4-31 and Figure 4-32 show a comparison between two participants and their approaches to 'opening up'. Participant P10 and participant P8. Participant P8 sits compactly at the study wheel. The left elbow tucked into the hip for support. The shoulders are providing support to the upper limbs. The right leg is raised due to the chosen positioning of the accelerator pedal. The slight raise of the right leg offers support for the right upper limb at the elbow. Both hands and digits are employed in the opening up activity in the throwing performance.

Figure 4-31:Participant P8 opening up with digit D1 for left and right hands.

Participant P10 has adopted a similar throwing position to participant P8, with a slight raise of the right leg to operate the operating pedal. A noticeable difference is in the positioning of the hands and digits. The left hand is performing in a supportive role whereas digits D1, D2, and D3 of the right hand were actively working, D4 and D5 are working as support and balance.

Figure 4-32:Participant P10 opening up with D2 and D3 of right hand.

Events of the opening up routine in the performance are displayed in Figure 4-33. Participant P8 performed in a sequence without repetition. Whereas participant P10 needed to check and re-perform both in making a hole and in ‘opening up’. Events, contributing to the ‘opening-up’ phase, were generally fewer in number than for centring the clay.

Analysing events across all participants, there were three common events utilised in this routine,

- Making a hole
- Opening up
- Adding water

Additional events included such activities as speed adjusting events, changing of velocity to reflect the activity. Consolidating the base of the pot, was an event that not all participants performed. Consolidating the base involves a compression of the newly formed internal base to strengthen that portion of material, as it will be supporting the walls of the pot where the next phase of the throwing performance will be focussed. There was evidence of moisture removal by sponge from inside the cavity of pots from several participants. Excess moisture can affect the consistency of the clay and thus may impact on the ability of the walls to support a pulling up routine part of a throwing performance.th Participants P7 and P10 had a greater number of events involved in ‘opening up’ than participants P1, P2, P8, and P9. The fewest number of events were performed by participant P8, followed by P9, P1 and P2. Other participants (P3, P4, P5 and P6) had on average 9 events. Figure 4-33 displays opening up events of participants P8 and P10.

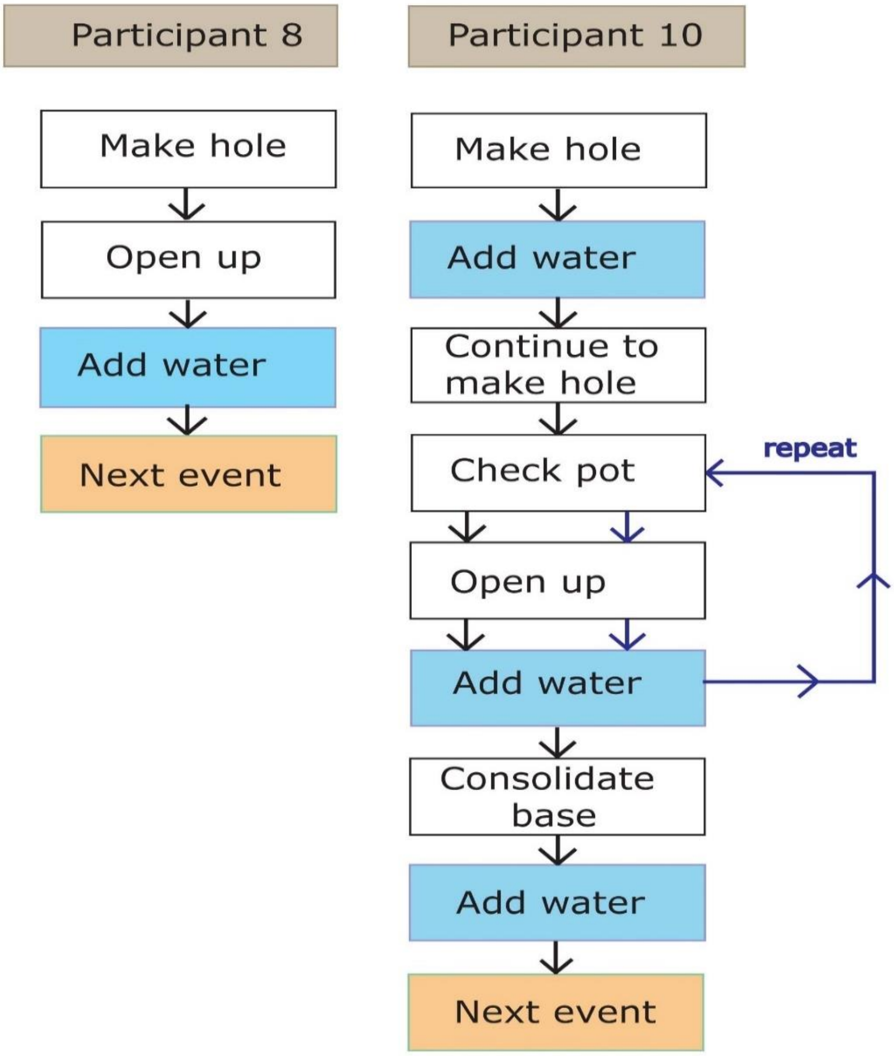


Figure 4-33:Comparison of opening events for participants P8 and P10.

4.6.3.1 Element of making a cone

Figure 4-34 shows participant P5 engaged in making a cone shape in preparation of throwing a cylinder pot. 80% of participants used this routine as part of their throwing performance. Participant uses her right hip and leg to support and stabilize the right upper limb. The left leg is supporting the left forearm. Both lower legs are in stabilizing positions. Both hands and digits are engaged in the shaping of the clay.

Figure 4-34:Participant P5 engaged in making a cone shape.

Participant P10 is shown involved in making his cone shape. The lower limbs are supporting and steadying the upper limbs. The hands are engaged in creating the cone shape with left Digits 1, 2 and 3 and right Digit 1 with support from D1 Digit 5 on the left hand is lifted away from the cylinder cone.

Figure 4-35:Participant P10, making a cone shape.

Cone making events are inserted into a throwing performance after 'opening up'. Each performance of the cone making step; where there was a cone making step, followed similar pattern of events to the two examples shown in Figure 4-36.

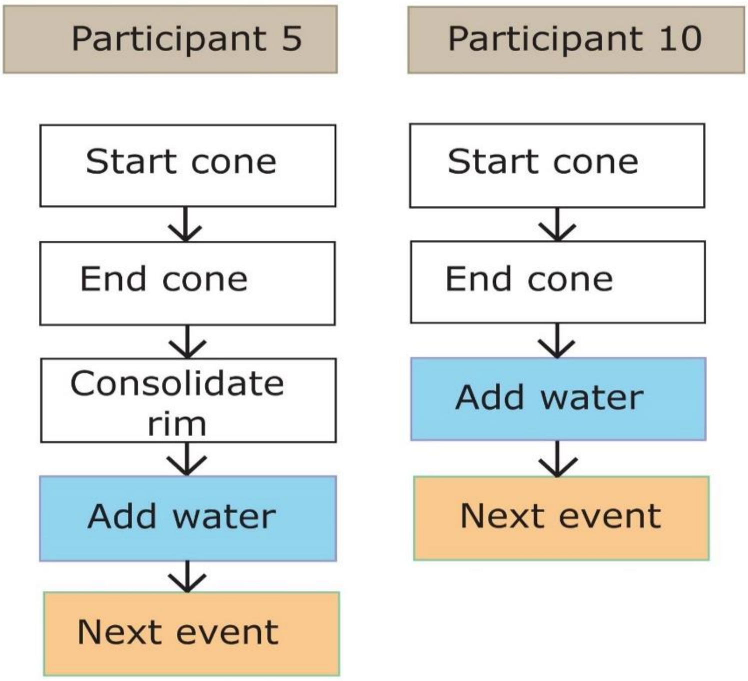


Figure 4-36:Making a cone event detail from participants P5 and P10.

Each participant using this cone making routine used two common events,

- Make cone
- Add water

Other events related to individual participants involved compressing or consolidating the rim of the pot to stop the rim from being delicately narrow and to smooth the edge. Tidying the foot was another activity that was performed at this point. The final point concerned moisture control, damping the walls and. sponging excess moisture from the interior of the pot.

4.6.4 Pulling up walls

This event is a lengthy process, dependent on the standard of finish required under normal pot throwing conditions. Some participants made drinking vessels in their usual studio work therefore the finish would increasingly refined, compared with participants creating large thrown pieces of work, where finesse could be a drawback such as in the supporting walls, more robust offer more structural support than finer walls. Figure 4-37 shows participant P6 occupied with pulling up the walls of the pot. The torso is bent over resting the right shoulder onto the right leg. Both hands are involved in the process with selected digits. Right hand digits are D2 and D3 working the walls, Left hand Digit 1 is held out of the area of focus, while D2 and D3 are working the walls on the interior

Figure 4-37:Pulling up walls from Participant P6.

Participant P9, shown in Figure 4 38, is in the process of pulling up the walls of a pot. The legs are positioned to be both for balance and support. The right leg is supporting the right arm as the right hand works on the exterior walls of the pot. The left hand is working internally on the walls of the pot, against the pressure from the exterior digits.

Figure 4-38:Performance of pulling up walls from Participant P9.

Events from pulling up walls are seen in Figure 4-39. The figure illustrates the main vital points of the pulling up routine, Pulling, making the walls taller and consolidating the rim, which involves smoothing the top of the walls to prevent thinning and compacting clay particles together to strengthen the edge to the wall. Both participants P6 and P6 consolidated the rims after each pull. The addition of water aids lubrication in the raising of the walls of the cylinder pot. Events surrounding the vital events are individualised. They include

- Moisture control
- The adjustment of speed
- Changing hand position
- Collaring to prevent the pot from expanding laterally, and,
- Checking the pot
- Tidying the foot

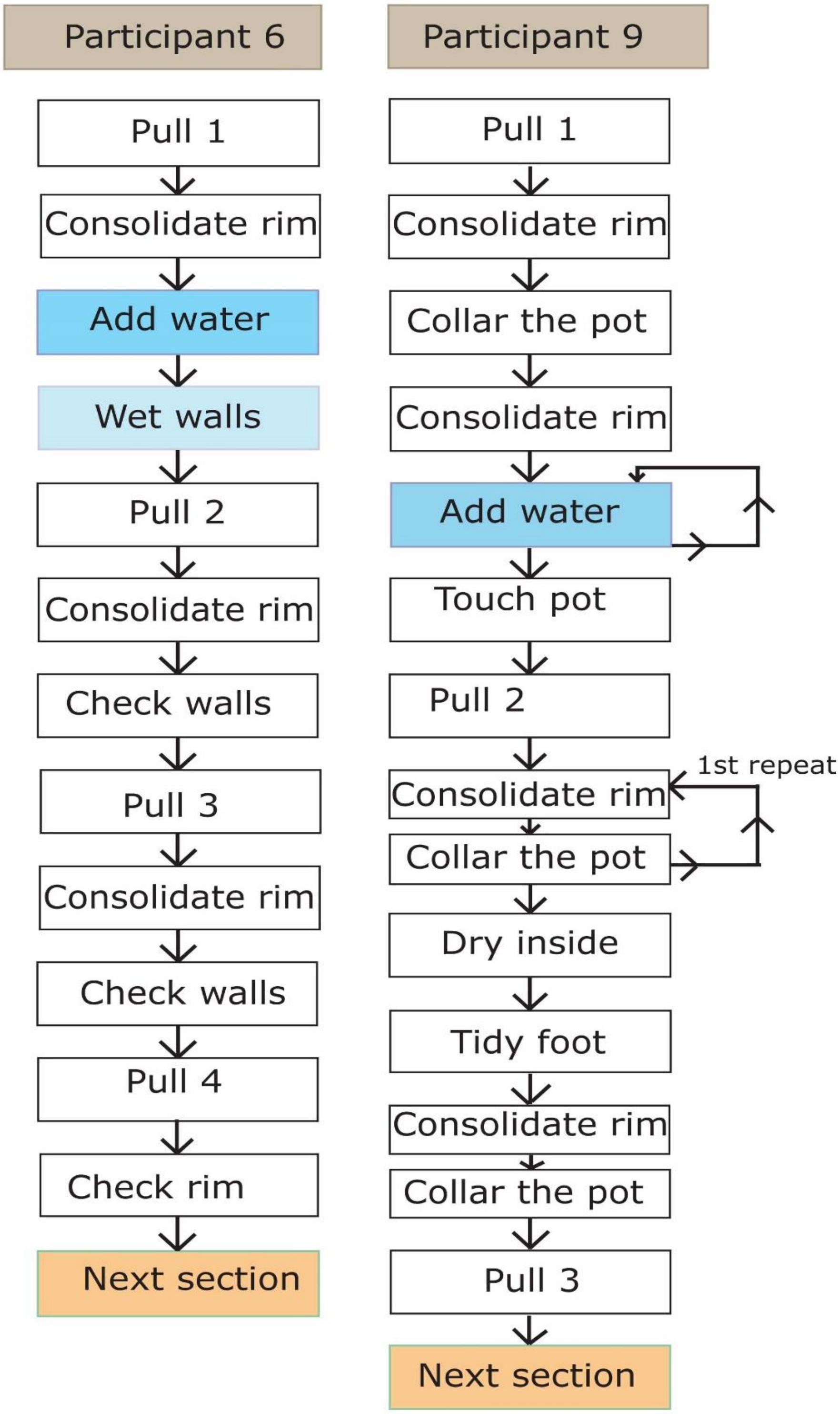


Figure 4-39:Event details for pulling up walls for participants P6 and P9.

The number of pulls each participant varied from three pulls to six pulls. Consolidation of rim actions ranged from just one consolidation to five consolidations of the rim. Participants P3 and P5 had equal pulls to consolidation of rims in a rhymical sequence.

4.6.5 Checking events

Checking events as a separate routine in the throwing performance was a female activity. 60% of female participants used this routine. 40% of male participants checked their progress throughout the throwing performance, the remaining percentage, tacitly checked their pots or were so certain of their throwing practice, that participants may have instinctively been certain of the throwing performance outcome.

Participant P5 is shown in Figure 4-40 checking the thrown pot for inconsistencies and refining the form. The torso is twisted and bent onto the right elbow, which is tucked into the right hip. The left upper limb is held away bent at the elbow from the body. Digits D2 and D3 on both hands are active, working on either side of the wall, using fingertip pads for information.

Figure 4-40:Participant P5 checking a cylinder pot.

Participant P8 is engaged in checking a thrown cylinder pot as seen in Figure 4-41. Her torso is bent over her right elbow and twisted in order to closely view the form of the pot. The left upper limb is bent and held away from the torso to allow digits to work together in the checking process part of the throwing performance. Digits D2 and D3 from both hands are the tools being used in this process.

Figure 4-41:Participant P8 checking a cylinder pot.

Checking of the pot within performances was completed by some but not all participants. Some checking was completed before deciding to move on to the next events. Others checked towards the end of their throwing performances and sometimes added in an extra pull up of the walls. Figure 4-42 shows checking actions of P5 and P8. Participant P5 performed a brief and simple check on the pot, noted by the fewer events. Participant P6 had a greater number of elements to check, including the feel of the pot walls both in an upwards direction and a downwards direction, in order to detect any anomalies in the surface. These extra checks added time on to the throwing performance.

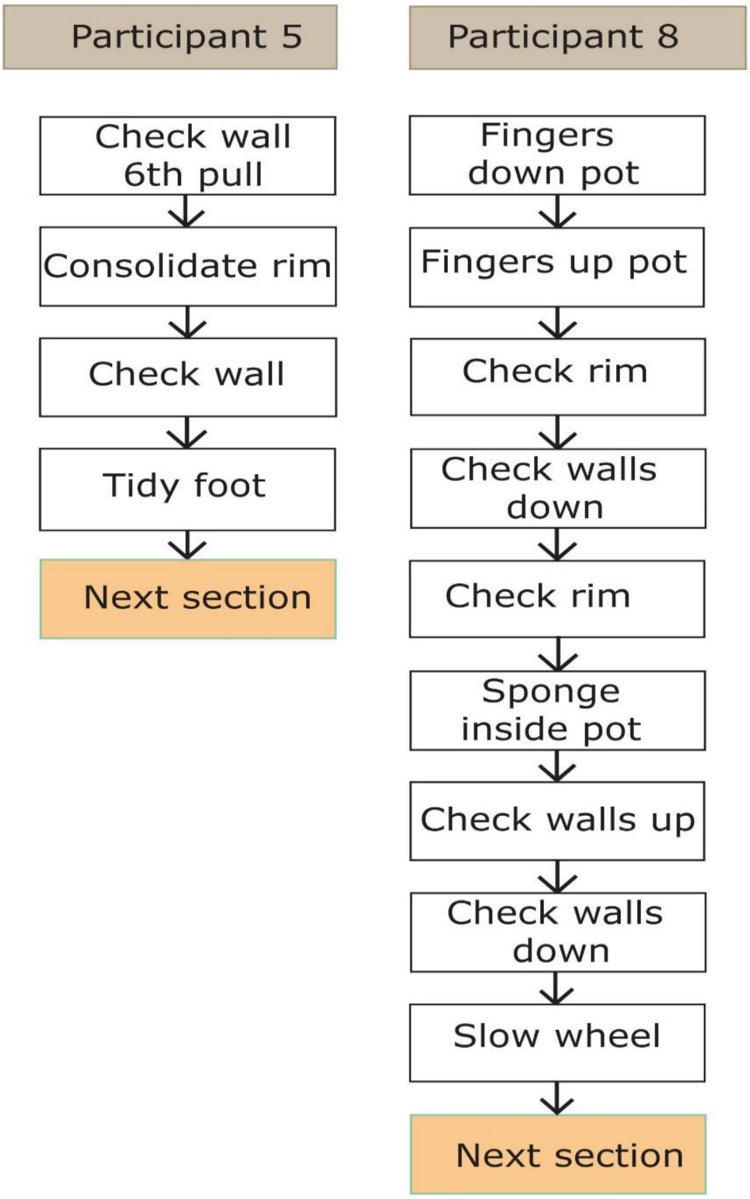


Figure 4-42:Event checking details for participants P5 and P8.

4.6.6 End of a pot throwing performance.

Figures 4-43 and 4-44 and show participants P4 and P9 at the of their pot throwing performances where the cylinder pots are removed from the wheel head.

Participant P4 shows the use of a cheese wire in the removal of a thrown pot from the potter’s wheel. The torso is twisting to allow the upper limbs to achieve the angle needed for using the cheese wire equipment. The torso is balanced by the positioning of the legs.

Figure 4-43:Pot removal by participant P4.

Participant P9 shows balance and support from the lower limbs. The back has a slight twist to the right as the cheese wire is propelled in a dragging action across the wheel head through the base of the clay.

The actions from all participants included

- Moisture control
- Use of a cheese wire
- Wheel stop

Some participants tidied the wheel head after the wheel stop, others lifted the pot away from the wheel to begin drying out, the next stage of the pot making process.

The wheel would then be tidied and prepared for the next throwing activity.

Figure 4-44:Pot removal by participant P9.

Figure 4-45 shows activities performed during the end of a pot throwing performance. Both participants stopped the wheel before getting a wire to cut through the base of the pot close to the surface of the potter's wheel head.

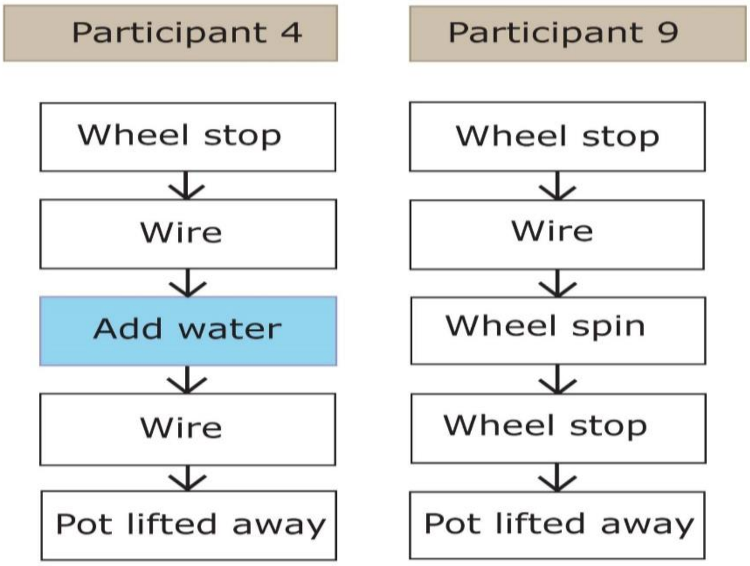


Figure 4-45:Event detail for pot removal by participants P4 and P9.

Participant 4 added water as a lubricant to slide the pot towards the edge of the wheel head, the additional wire event would have forced a proportion of the added water beneath the pot to aid removal. Participant

P9 rotated the wheel at speed to cut the pot from the wheel head and lifted it away to a throwing batt placed close for the pot to dry out in preparation for the next part of the pottery making process. There was a choice between lifting the pot from the throwing performance from the wheel head and gliding with lubrication to the edge of the wheel head and onto a board, for drying.

4.7 Time

Time taken for each performance was measured in seconds. The longest duration of a throwing enactment was performed by participant P4 for 468 seconds. The briefest performance was from participant P2 with a duration of 68 seconds. Both performances achieved the outcome of a cylindrical thrown pot. Table 4-6 illustrates time taken in seconds for each performance and, the average time taken over the three throwing performances. It clarifies, also, the position of each throwing performance, whether it is the shortest or longest performance. Throwing performance 1 was neither the longest nor shortest operation, with equal participants making their extreme throws for the first enactment. Throw performance 2 had a mix of shortest undertakings and middle length throws, but no long performances. The final throwing enactment throw 3 shows more long performances than middle performances. Male participants have been marked in blue. The longest and shortest throwing performances have been compared by individual. It might have been anticipated that the first performances would have been the longest as participants would have had to experience familiar material interacting with largely unfamiliar equipment.

Participants would have to recall how to create a cylinder shape with a possibly larger than usual or smaller than usual amount of clay. The second throw might have thought to have been slightly shorter as experience from the first throw informed the second throw and then the third throw would be faster still as experience is gathered.

However, this appears not to be so. The first throw has extremes of time from fastest performances to slowest performances.

Table 4-5: Position of fastest, middle and slowest performances.

Throwing performance	Performance 1	Performance 2	Performance 3
Shortest	40%	50%	10%
Middle	20%	50%	30%
Longest	40%	0%	60%

The second has fast and middle lengths of throwing and the third throwing performance has a greater number of slower performances. A suggestion for this might be that the participants, learning and gaining experience from the previous performances gave greater care and thought to their throwing actions. Conversely it could also be that they are tired from the two performances performed immediately prior to the third performance. However, the practitioners are experienced and robust enough to withstand the rate of performances.

Figure 4-6 indicates the placing of the throwing performances and the average time for a throwing performance for each participant.

The first throwing performance records equal percentages (40%) of longest and shortest performances and only 20% scored the first performance as their middle throwing time.

Of the second throwing performances, 16.6% were recorded as the shortest throwing performances and 16.6%, recorded as being of middle length performances. There were no longest performances during the second throw.

The third and final performance recorded 3.3% of all performances as the fastest throwing performance. 20% of all performances were recorded as longest performances during the third performance and 10% were recorded as middle length performances.

The length of time recorded for each throwing performance is not indicative of the time taken to throw a pot. Some participants wished to contribute their thoughts and so idled the wheel speed whilst they explained their point. The performance was then continued. Throwing times did not adhere to a pattern. It might have been predicted that the first throw would have been the longest due to the following reasons,

- the design intention might be in different to the designs normally thrown by the participants,
- the weight of the clay might be greater than was the habitual throwing weight for participants
- The wheel was unknown by most participants.

There was no definable pattern for the length of times used within each throwing performance occasion. It could be said that the first throwing occasion had extremes of both short and long throwing times where-as the other two throwing occasions had either short and middle, as in the case of throwing occasion two and middle and long in the case of the third and final throwing occasion.

Table 4-6:Length of throwing performances in seconds.

	Shortest throwing time	Longest throwing time		
Participant	Time (seconds)			Average time
	Throw 1	Throw 2	Throw 3	
P1	102	106	175	128
P2	119	68	90	92
P3	185	238	242	222
P4	304	342	468	371
P5	211	188	176	192
P6	226	185	208	206
P7	444	245	420	370
P8	308	322	334	321
P9	149	120	154	141
P10	270	257	295	274
Average	232	207	256	232

4.8 Events

When analysing each pot throwing performance, each action occurring became an element or event.

Consideration was given to the length of throwing performance and the number of events recorded within the throwing performance. Table 4-7 shows the length of performance and the number of events and the outcome of the length of time potentially taken for each event.

All participants with differing events reached the design intent of a cylinder pot. Some participants were more efficient in the way that they achieved their aim with fewer events than others. 70% of participants used their familiar clay body to demonstrate a throwing performance on a common wheel. Those who had more events involved in their throwing performance generally had less familiarity with the clay body and also with the wheel.

Individually similarity in timing of elements of throwing performances there were two female participants who achieved consistent event timings across their performances. Participant P5, a 0.26 second difference for each event between the fastest performance and the slowest performance. Participant P8 achieved 0.28 seconds in difference. Participant P9 recorded the most regularity for male participants at 0.58 seconds in difference.

When the throwing performances were categorised into individual elements and matched against the duration of each performance different patterns emerged. Table 4-8 shows throwing performances ranked in the average time for each event in seconds from 1.47 seconds (P2) to 5.14 seconds per event (P4). Throwing performances from male participants ranged between 1.47 seconds per element from participant P2 to 4.82 seconds per element from participant P10, a difference of 3.35 seconds per element. Female participants ranged between 2.55 seconds (P5) and 5.14 seconds (P4), a difference of 2.59 seconds.

Table 4-7:Throwing performance lengths, events and average time for each event.

Participant	Throw	Time in Seconds	No of events	Event time in seconds
2	2	68	46	1.47
2	3	90	40	2.25
5	3	176	69	2.55
5	2	188	71	2.64
2	1	119	44	2.70
4	2	342	123	2.78
5	1	211	75	2.81
9	1	149	51	2.92
4	1	304	101	3.00
9	2	120	39	3.07
3	2	238	77	3.09
1	1	102	33	3.09
7	2	245	79	3.10
1	2	106	33	3.21
10	2	257	78	3.29
6	2	185	56	3.30
10	3	295	85	3.47
9	3	154	44	3.50
3	1	185	52	3.55
6	3	208	58	3.59
6	1	226	55	4.11
3	3	242	57	4.24
1	3	175	41	4.26
7	1	444	99	4.48
8	2	322	70	4.60
8	3	334	72	4.63
7	3	420	90	4.66
10	1	270	56	4.82
8	1	308	63	4.88
4	3	468	91	5.14

4.9 Wheel Speed

Wheel speed was captured from each performance. The study wheel accelerated from 0 revolutions per minute (rpm) to 235.5 rpm. Figure 5-53 shows the speed in depth of shading. The darker the shading the higher the speed. The highest speeds were generally recorded in the first half of the performances, when most if not all participants were centring their clay. The lighter shading shows a slowing of speed in the throwing performances when participants would have been creating the shape of their pots. There is an example of high speed in the second half of their performance from one participant (P7). The remainder of the participants throws chose slower speeds towards the end of their performances.

4.9.1 Performance start

The study wheel would be motionless at the start. The participant would then operate the accelerator to action the wheel into rotation, to commence a performance. Figure 4-46 shows the first 15 units of velocity measurement (time markers) from all participants.

Time markers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P1-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	220.3	220.3	223.4	223.9	223.4	223.9	224.4	224.4
P1-2	0.0	0.0	217.2	216.2	216.7	215.7	215.2	215.2	214.6	215.2	216.2	214.6	213.1	214.1	213.1
P1-3	0.0	0.0	0.0	0.0	0.0	216.7	221.3	223.4	223.9	223.9	220.8	219.8	219.3	215.2	214.6
P2-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P2-2	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0
P2-3	0.0	0.0	0.0	0.0	38.6	50.0	77.8	93.2	119.4	128.2	148.3	174.0	181.7	192.5	196.6
P3-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
P3-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P3-3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.6	1.1	1.6	0.6
P4-1	0.0	0.0	0.0	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P4-2	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P4-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.0	91.6	91.6	91.6	93.2	93.2	93.2
P5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P5-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
P5-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	148.3	149.8	151.9	153.4	155.5	156.0	159.6
P6-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
P6-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	183.8	184.3	184.8	184.3
P6-3	0.0	0.0	0.0	0.0	0.0	0.0	9.8	15.0	24.2	28.3	38.6	43.8	54.1	64.9	68.5
P7-1	0.0	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
P7-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.5	69.0	69.0	69.0	68.5	68.5	68.5
P7-3	0.0	57.7	55.6	55.6	56.7	57.2	57.2	57.2	56.7	57.2	57.7	56.1	56.7	56.7	56.1
P8-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P8-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	224.4	223.9	224.4	225.5	224.9	224.9	223.9
P8-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	179.1	178.1	178.6	178.6
P9-1	0.0	0.0	0.0	10.3	8.3	7.8	7.8	7.8	7.8	7.8	8.8	10.3	10.8	11.9	16.5
P9-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.1	149.8	153.4	158.6	159.1	160.1	160.1	160.6
P9-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	216.2	216.7	216.7	216.2	217.7
P10-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	217.7	216.7	215.7	214.1	212.6
P10-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	205.4	204.4	203.3	202.8	202.3	201.3	201.8	200.8
P10-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.1	0.6	0.6

Key
Revolutions 0 <50 <100 <150 <200 <220 220+

Figure 4-46:Wheel speed detail from time markers 1-15.

Participants P1 and P7 had immediate responses to start with first recorded speeds of 217.2 revolutions (rev) and 57.7 rev. Two differing starts in terms of speed. Participant P3 was tentative in starting with no speed recorded in performance 1 or 2 and very minor movement in performance 3, speeds of 0.6 rev to 1.6 rev.

4.9.2 Centring

Centring commanded greater speeds to manipulate the ball of clay into balance. All participants operated speeds greater than 200 rev. Figure 4-47 displays velocity details for time markers, 100, 200, 300 and 400.

	100	200	300	400
P1-1	211.0	222.9	87.0	106.1
P1-2	189.4	199.7	215.2	213.1
P1-3	222.4	224.4	210.0	230.1
P2-1	205.9	229.1	201.3	152.4
P2-2	200.2	220.8	184.8	152.9
P2-3	195.6	188.4	169.9	147.7
P3-1	202.8	213.6	216.2	222.9
P3-2	169.9	184.8	178.1	179.1
P3-3	202.3	207.4	218.8	223.4
P4-1	150.8	147.2	136.4	131.8
P4-2	151.3	153.4	145.7	153.4
P4-3	130.8	136.4	132.8	103.5
P5-1	0.0	191.0	190.5	193.0
P5-2	202.3	136.4	188.9	193.5
P5-3	186.9	179.7	181.7	182.2
P6-1	105.5	194.1	196.6	218.8
P6-2	205.4	201.3	208.5	219.8
P6-3	207.4	199.2	191.5	218.2
P7-1	56.1	1.6	49.4	47.4
P7-2	68.0	217.2	211.0	212.1
P7-3	164.7	186.9	196.1	188.9
P8-1	0.0	0.0	47.9	197.7
P8-2	219.8	214.1	205.9	225.5
P8-3	211.6	210.5	194.6	205.9
P9-1	185.8	162.7	174.0	180.2
P9-2	185.3	185.3	168.8	181.2
P9-3	217.7	202.3	211.6	181.7
P10-1	209.0	204.9	203.8	144.1
P10-2	207.4	216.7	215.7	202.8
P10-3	91.6	207.4	143.1	132.3

Key

0 revolutions
<50
<100
<150
<200
<220
+220

Figure 4-47:Wheel speed detail from time marker selection 100, 200,300 and 400.

As performances differed in length, patterns of speed equally differed too. Figures 4-46 through to 4-49, are time marker samples of velocity readings. Each throwing performance is at a differing place in routines, therefore there are a range of speeds. Participants P1 and P2 had brief throwing performances and so speed indicates that they were entering the pull up phase of their performances. Participant P3 recorded a longer performance

Time markers 100, 200, 300 to 400 span the centring period to opening out and pulling up. Participant P3 regulates the speed of the performances for this time selection within a band width of 20 revolutions.

4.9.3 Pulling up

The velocity recorded for this selected section of performance speeds, is less rapid than for centring routines. Figure 4-48 displays time marker references for pulling up walls routines of a throwing performance. Speeds have mostly slowed and participants P1 has completed two out three performances, P2 has completed three performances, and P9 completes two out of three performances.

	800	900	1000	1100	1200	1300
P1-1						
P1-2						
P1-3	115.3	119.4	116.3	105.5	105.0	0.6
P2-1						
P2-2						
P2-3						
P3-1	188.4	184.8	190.5	141.1	142.6	144.1
P3-2	185.8	182.2	78.3	104.0	105.0	106.1
P3-3	132.3	146.2	148.3	147.7	147.7	149.3
P4-1	143.6	145.2	139.0	128.2	130.2	131.3
P4-2	155.5	144.1	153.4	142.1	143.6	130.2
P4-3	161.1	159.1	165.2	166.8	168.8	141.6
P5-1	184.3	186.9	182.2	181.7	181.7	181.2
P5-2	173.0	167.8	167.8	161.6	159.1	158.0
P5-3	145.2	145.2	146.2	147.2	141.1	141.6
P6-1	203.3	209.5	179.7	182.2	162.7	151.9
P6-2	179.7	176.6	137.4	132.3	133.3	117.4
P6-3	183.8	175.5	154.4	159.6	132.8	130.8
P7-1	227.0	234.7	0.6	46.4	0.6	0.6
P7-2	219.8	121.0	121.0	146.2	131.3	117.4
P7-3	193.0	195.6	195.6	196.6	110.7	135.9
P8-1	131.8	117.9	101.9	147.7	142.6	136.4
P8-2	186.9	125.1	106.6	107.1	121.5	122.5
P8-3	148.3	146.7	147.2	113.3	100.9	101.9
P9-1	171.4	165.8	165.2	159.1	55.1	62.3
P9-2	167.3	138.5	95.8			
P9-3	123.0	121.0	122.0	0.0	53.0	
P10-1	167.3	163.2	167.3	140.5	137.4	136.9
P10-2	174.0	138.5	139.0	136.4	135.9	136.4
P10-3	158.0	162.2	161.6	156.5	160.6	161.1

Key
- Performance end
- 0 revolutions
- <50
- <100
- <150
- <200
- <220
- +220

Figure 4-48:Performance speed sampling from time marker 800.

4.9.4 Finishing off

The time markers selected to illustrate this section of a throwing performance are from 2300 to 2800. Speeds have decreased mostly from the pull stage routines; a majority of speeds are recorded under 150 revolutions. Five participants have already completed three throwing performances. Figure 4-49 indicates data from time marker 2300 to time marker 2800.

	2300	2400	2500	2600	2700	2800
P1-1						
P1-2						
P1-3						
P2-1						
P2-2						
P2-3						
P3-1						
P3-2	0.0					
P3-3	72.1	0.0	0.0	0.0	0.0	
P4-1						
P4-2	109.7	110.7	109.7	110.2	110.7	110.7
P4-3	109.7	195.1				
P5-1						
P5-2						
P5-3						
P6-1						
P6-2						
P6-3						
P7-1	228.5	140.0	139.0	110.2	110.2	108.1
P7-2						
P7-3	106.1	104.0	104.5	103.0	104.0	
P8-1	127.2	123.6	141.6	132.8	78.8	
P8-2	122.0	122.0	122.0	120.5	122.5	122.0
P8-3	100.9	101.9	101.9	102.5	100.4	101.9
P9-1						
P9-2						
P9-3						
P10-1						
P10-2						
P10-3	131.3	1.6	0.6	0.6	73.1	72.1

Key
- Performance end
- 0 revolutions
- <50
- <100
- <150
- <200
- <220
- +220

Figure 4-49:Performance speed sampling for ends of performances.

4.9.5 Performance timings

The pattern of speed captured from each performance in the forms of a graph and radar charts. The wheel head revolutions were recorded in short intervals from the moment the wheel was powered. The least amount of rotations was recorded as 0.5 revolutions to the greatest 235.5 revolutions. Graphs show an X axis marked with individual pieces of data count and the

Y axis is marked with the speed of revolutions. Using both graph form and radar chart a comparison can be made between throwing performances in terms of incidences of speed. A first point of interest is the differing lengths of performances. Not all performances lasted a similar length but are represented in a graph of a similar size. The markings on the horizontal X axis have ever increasing numbers, time markers. The shortest performance recorded had time marks to 501, and the longest performance had time marks numbered 3495. When analysing individual performances, it was found that when looking at the performances in isolation, it was difficult to detect the length of the performance compared with others, because the markings on the X axis changes with differing time length of performance. A second point of interest is in the fluctuating differences in speed. The performances appear less than smooth which is not detected purely by observation. All performances started with sections of higher speeds which then dropped to slower speeds when performing manoeuvres e.g. ‘opening-up’.

At the start of a throwing performance, the speed of the wheel begins at 0 revolutions for all participants and rapidly climbs in the diagrams as the wheel is powered, through the amount of acceleration. The steeper the line, the faster the acceleration. Where there is great acceleration, the initial trace is increasingly vertical. Most participants started their throwing performances briskly, participants P7, P9 and P1, shown by almost vertical traces. Other participants have less than vertical traces conveying considered starts. Performances then differ as speeds are adjusted to the element of the throwing performances, as the cylinder pots are formed.

Figure 4-50 explains a graph representation of a throwing performance. The X axis marks out time intervals from the data recorder, whereas the Y access marks revolution speeds of the study wheel. The performance displayed shows rapid acceleration into a centring routine, from 0 revolutions at time marker 1 to 203.3 revolutions at time marker 23. The performance peaks in revolutions at time marker 162 to 226 revolutions, at the end of the centring events. A short period of rapid deceleration follows to time marker 171. Revolutions then increase into opening up events, followed then by the first pull up of the walls. The speed of the wheel has decreased from the speeds of centring and opening up. Both hands are involved in the pulling up of the walls. The clay material is more fragile and reactive to speeds at this point. Too much speed and the thrown pot will spread out of the intended shape with a centrifugal force. Too little speed and manipulating the shape of the pot is increasingly difficult. The walls are pulled up, the throwing performance moves into the final routines before finishing. Routines of tidying the foot of the pot are often actioned here, consolidating the rim, firming, and smoothing the rim of the pot, and moisture control, the removal of excess moisture. A moment of excess speed is recorded between time markers of 551 and 573, when the foot of the pot may be tidied in preparation for the next stage of the pot creation after drying, turning the pot.

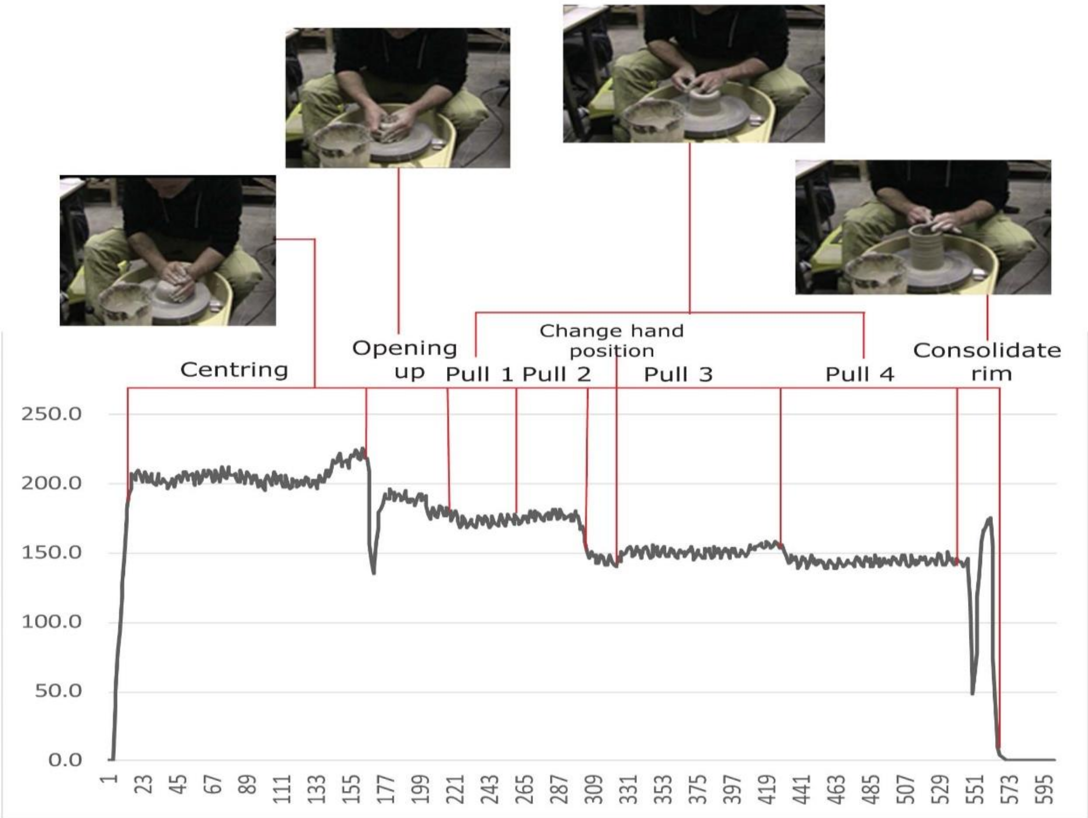


Figure 4-50:Performance detail from performance P2-3.

Figure 4-51 presents the same information as seen in Figure 4-50 in a circular radar chart. The radar figures evolved from an investigation to portray the information in a clearer illustration. This tool visualises information into a circular format. The rotational speed data was inserted into the graphical application.

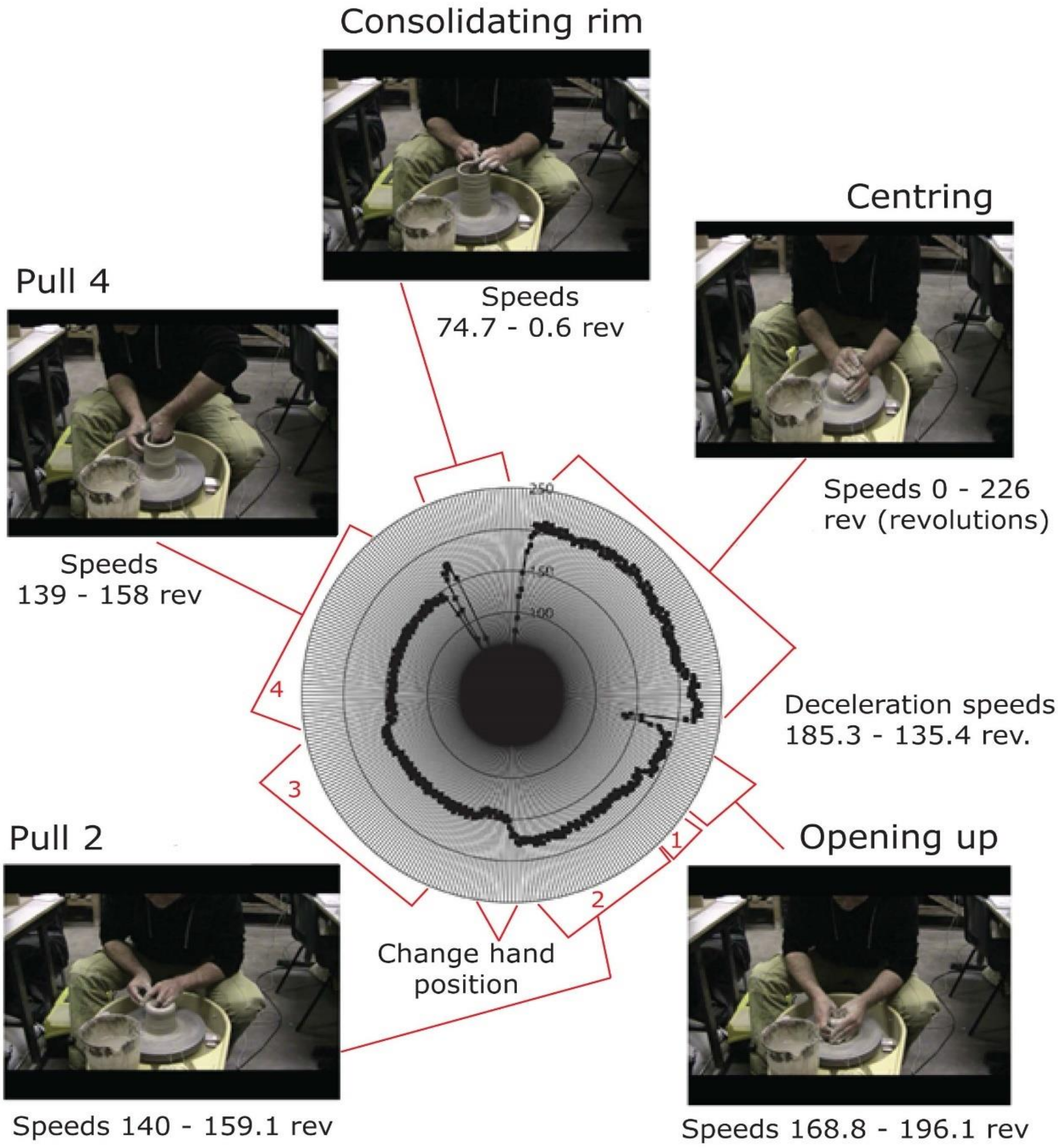


Figure 4-51:Performance detail in radar chart form from performance P2-3.

The resulting images show the speed of rotation with a strong circular trace. The dark central core is darker in relation to longer throwing performances. The radiating circles show a range of speed within the rotational speed. The inner rings having fewer recorded rotations than the outer rings. The complete circle depicts the entire throwing event.

All participants started and completed their three pot throwing performances.

4.9.5.1 Participant P1

Figure 4-52 displays radar charts of the three throwing performances of participant P1 with accompanying identical information in graphical form. The X axis comprises of time markers to 1255. The Y axis displays revolutions to 250 revolutions.

The first two throws, P1-1 and P1-2 similarities can be seen in performance style. An immediate acceleration to 220.3 revs, a period of similar velocity while centring and opening up takes place and pulling up of walls until a rapid deceleration to 86.0 revs. This is followed by a plateau of speed of approximately 103.0 revs for consolidation and refinement of the thrown pot, before decreasing speed to 1.6 revs, finishing the performance.

The third performance broadly follows the pattern of performance of the first two throws, as it shares the immediate burst of power on time marker 1 but differs in clarity of velocity changes of throwing performances 1 and 2. The end of the performance decreases speed from 109.0 revs to 1.1 revs, the wheel head is still turning at very reduced speed.

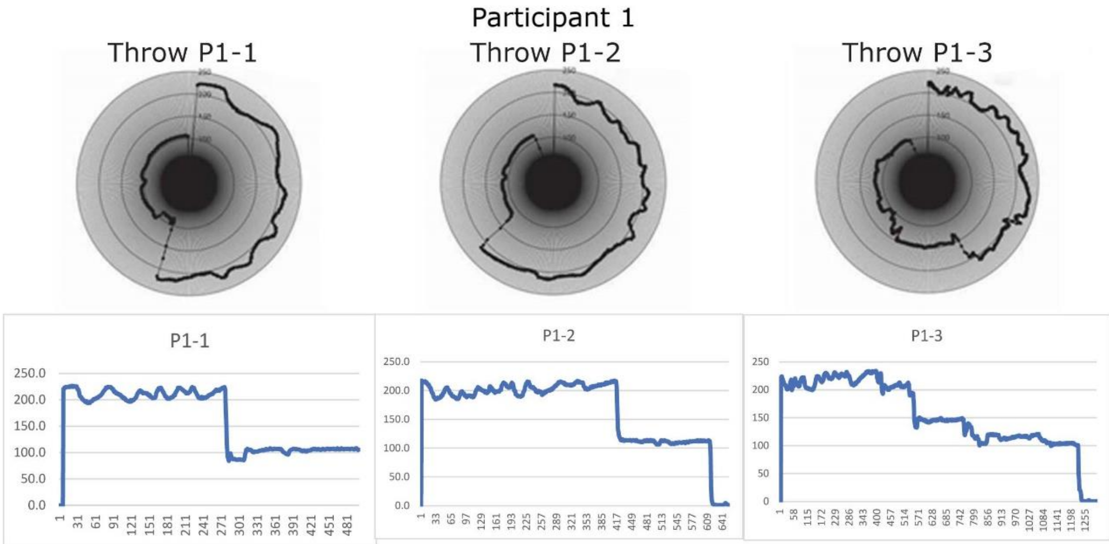


Figure 4-52:Participant P1 performance velocity.

4.9.5.2 Participant P2

Figure 4-53 displays Participant P2 has a gradient of speed to reach 202.2 revs, where centring and opening up take place. Pulling up of walls are marked with a staged decrease in velocity to approximately 150 revs.

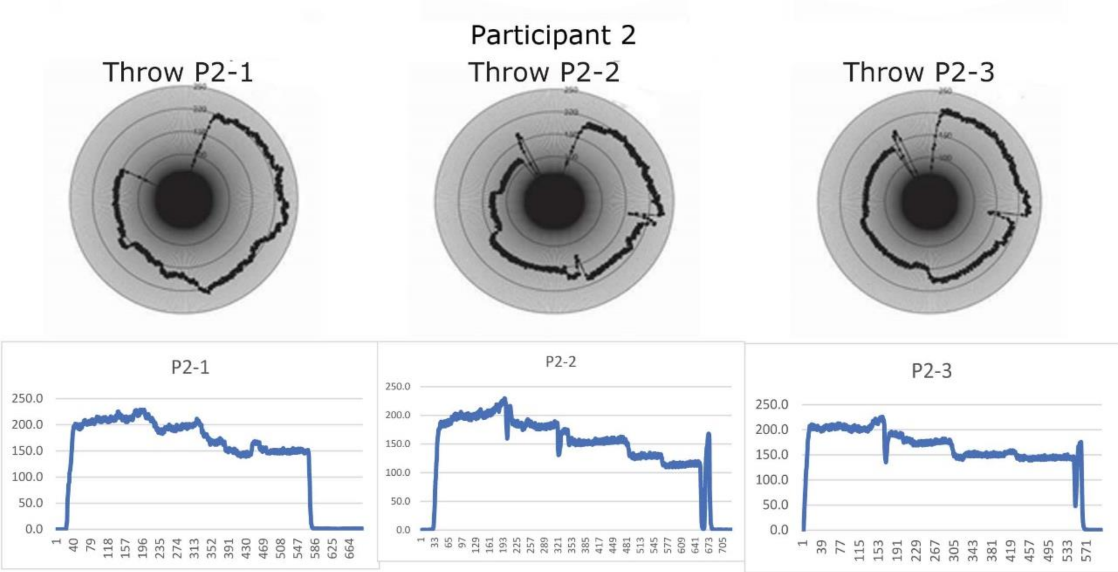


Figure 4-53:Participant P2 throwing performance velocity.

Performance P2-1 finishes with a rapid deceleration and a plateau of slow speed. Performances P2-2 and P2-3 differ in finish, by having a final burst of speed before completion.

4.9.5.3 Participant P3

Participant P3 seen in Figure 4-54 has performed three similar timed throwing performances. The paths marked out on the linear graphs show similar patterns of speed. Each performance begins with rapid acceleration to the point of centring. There follows a sustained period of centring, opening up and pulling up of walls before an almost instantaneous deceleration to 150 revs. For throwing performances P3-1 and P3-2 the speed appears regular until the finish. Throwing performance P3-3 varies by having yet another point of deceleration before finishing

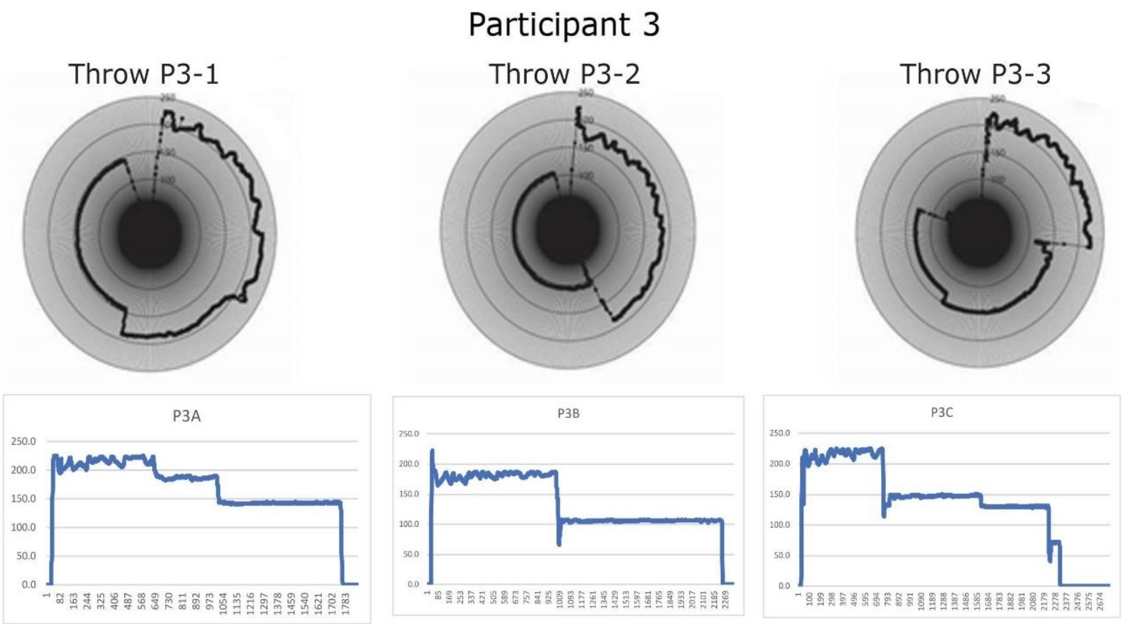


Figure 4-54:Participant P3 throwing performance velocity.

P3-1 and P3-3 then have further moments of deceleration whilst progressing through the sub-routines of a throwing performance such as pulling up of walls or consolidating the rims of the throwing cylinder pots.

4.9.5.4 Participant P4

Figure 4-55 shows participant P4 notably as having a much slower first performance, gradually increasing initial speed across all three performances. A point of interest, the lack of speed was not easily detected from visual observation. Similarities across the throwing performances are that each throw starts with a burst of rapid acceleration and a rapid deceleration to finish. Performance P4-1 and P4-3 centre the clay material at slower velocities than P4-2. They increase speed during the initial pulling up routines, then decrease speed for the subsequent pulls. The two performances plateau, at velocities approximately 100 revs. This is briefly mirrored in performance P4-1, where the recorded velocity is a part of a decrease in speed to conclusion.

From pure visual observation these differences would have been missed as on the surface each performance was visually little different to other participant performances.

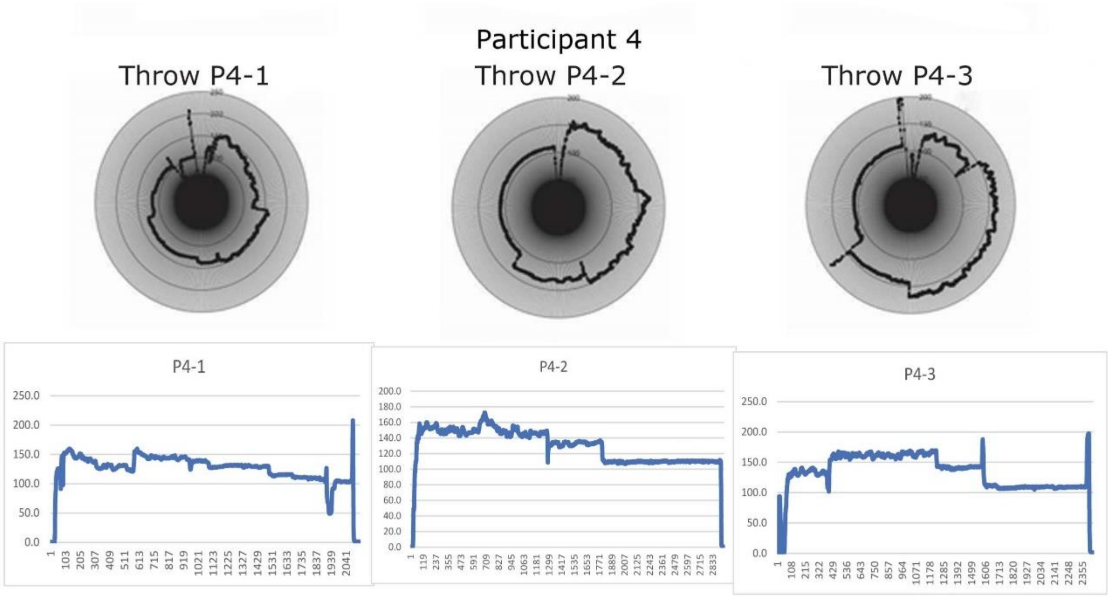


Figure 4-55:Participant P4 throwing performance velocity.

4.9.5.5 Participant P5

Throwing performances from participant P5 are seen in Figure 4-56. They indicate a more continuous use of velocity throughout a performance. Each performance begins with the greatest velocity of the performance duration. Performance P5-1 continues with small speed fluctuations and a gradual decline in speed to approximately 178 revs before a rapid deceleration (to 58.2 to 21.1) to conclusion. Performance P5-2 has an unusual feature in a dip of velocity after the initial peak, from 189.4 revs dropping to 126.6 revs then recovering to. a velocity recording of 179.1 revs and then begins a steady decline in speed to 150 revs. A rapid deceleration from 134.9 to 0.6 revs completes this performance.

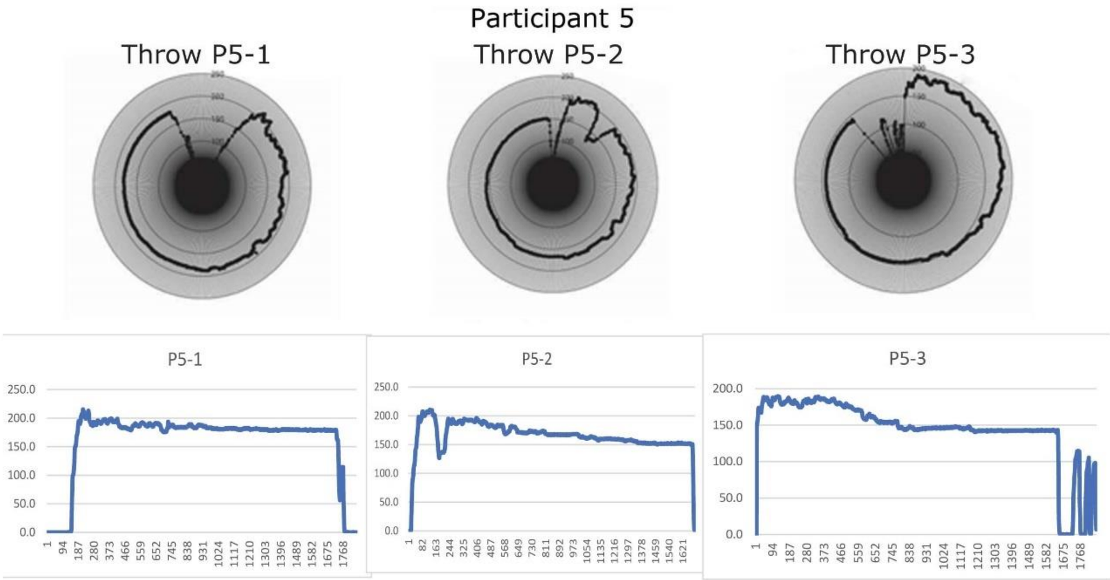


Figure 4-56:Participant P5 throwing performance velocity.

4.9.5.6 Participant P6

Figure 4-57 displays the throwing performance speeds of participant P6. Each performance has recognisable velocity patterns when compared with the other two throwing performances. There is a steep initial period of acceleration to start the throwing performance, which for performance P6-1 reaches 199.7 revs by time marker 123 and P6-3 the velocity reached is 210 revs by time marker 102. Velocity levels out before starting to decrease. Then performances rapidly slow to a continuous speed, of 151 revs and 130 revs, more than 50 revs slower than previously.

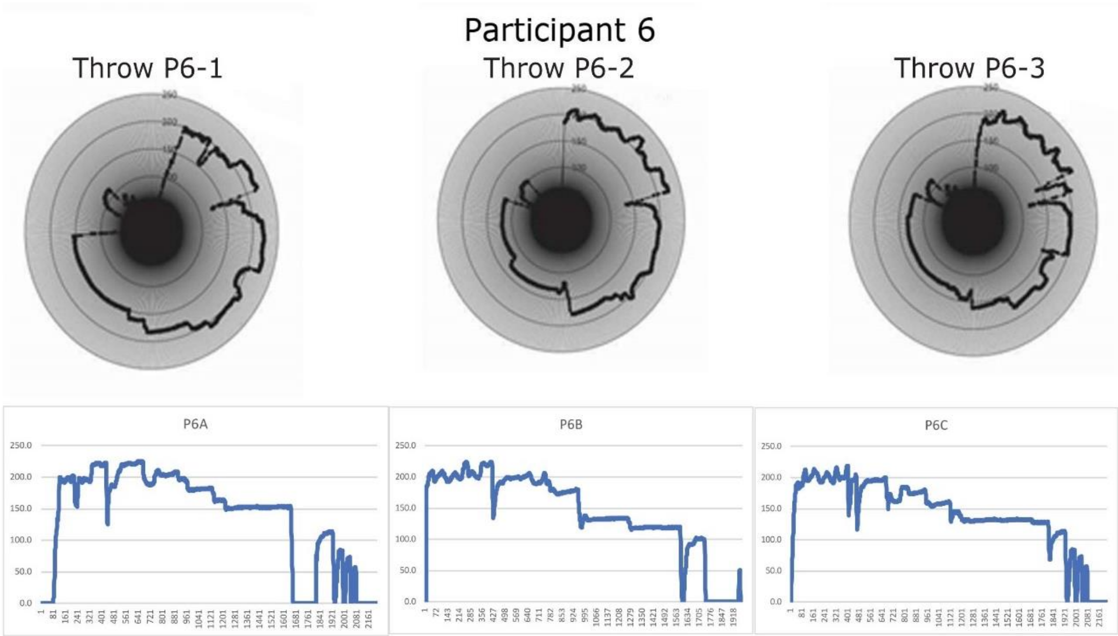


Figure 4-57:Participant P6 throwing performance velocity.

4.9.5.7 Participant P7

Performances from Participant 7 are demonstrated in Figure 4-58. Each of the three throws have similar pattern of velocity, the first throw has more extremes of speed and is more irregular in approach to a throwing performance. The second throwing performance has less extremes of speed and can be seen as developing towards throw three. Throwing performance P7-3 has more defined control than the first two performances. The first burst of speed gets an increasingly quicker start throughout the three performances. Speed increases in duration after the first acceleration across from throw P7-1 to throw P7-3.

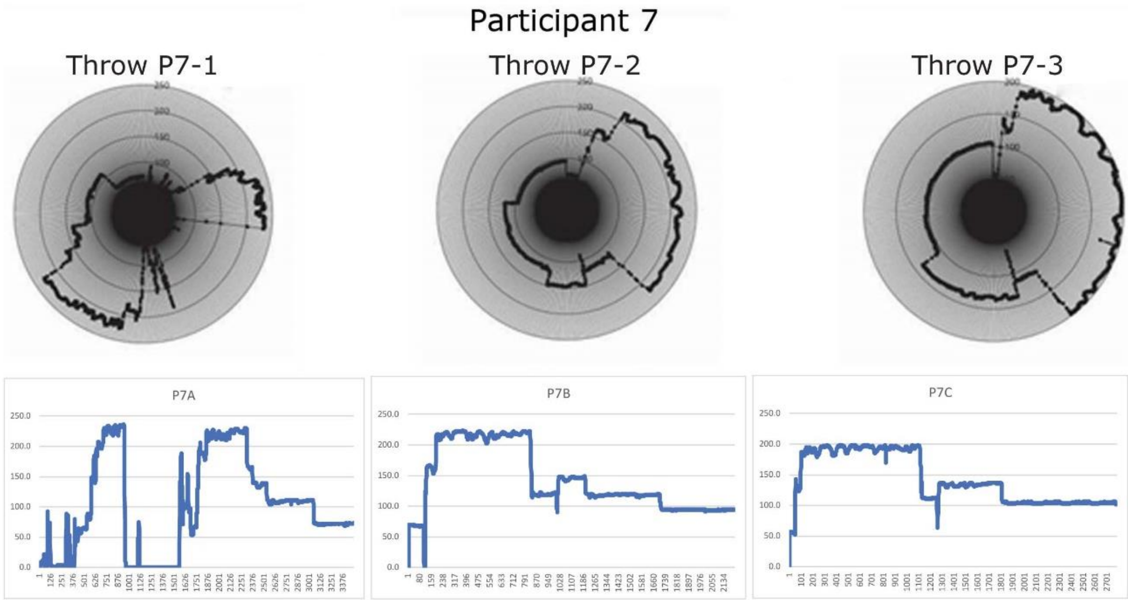


Figure 4-58:Participant P7 throwing performance velocity.

4.9.5.8 Participant P8

Figure 4-59 shows that participant P8 had two similar performances after a testing first performance.

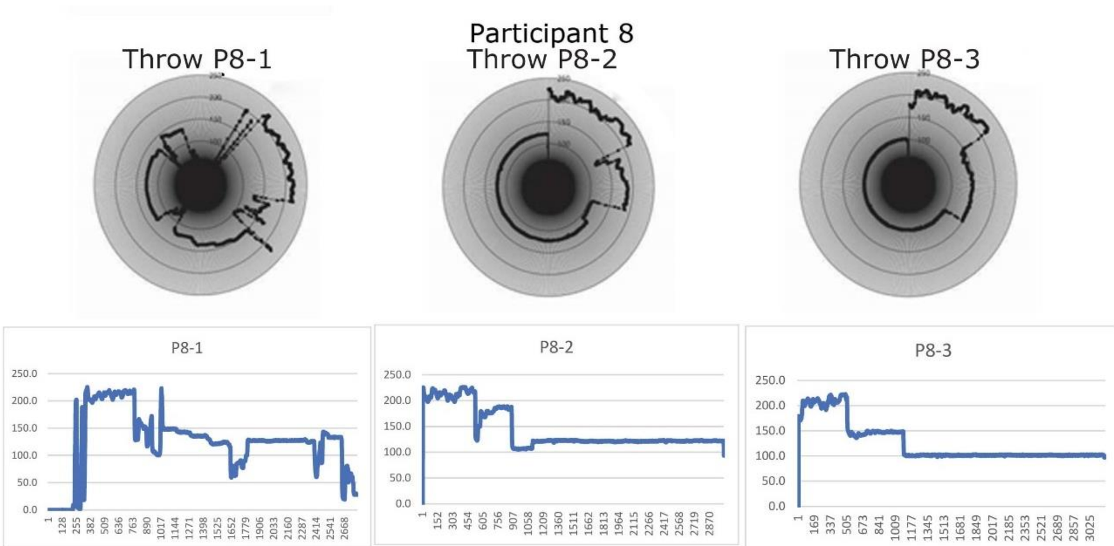


Figure 4-59:Participant P8 throwing performance velocity.

The first performance tested the study wheel for capabilities rather than a smooth regulated performance. Speed peaked at 225.5 revs and 222.9 revs and dropped firstly to 77.8 revs and then 19.1 revs before finishing. Performances, P8-2, and P8-3 have a similar profile. P8-2 started with great acceleration to 224.9 revs, then decelerating to 203.3 revs eventually plateauing at 122.5 revs to the end of the performance.

P8-3 accelerated to 210 revs to centre and open out, velocity decelerated to 147 revs whilst pulling up of the walls occurred. There was another deceleration to 103 revs whilst adjustments were made and checking of the walls followed.

4.9.5.9 Participant P9

Elements from throw P9-1 are evident in both P9-2 and P9-3. Figure 4-60 Throw P9-1 has similar acceleration timing across all three throws. Revolutions reached differ.

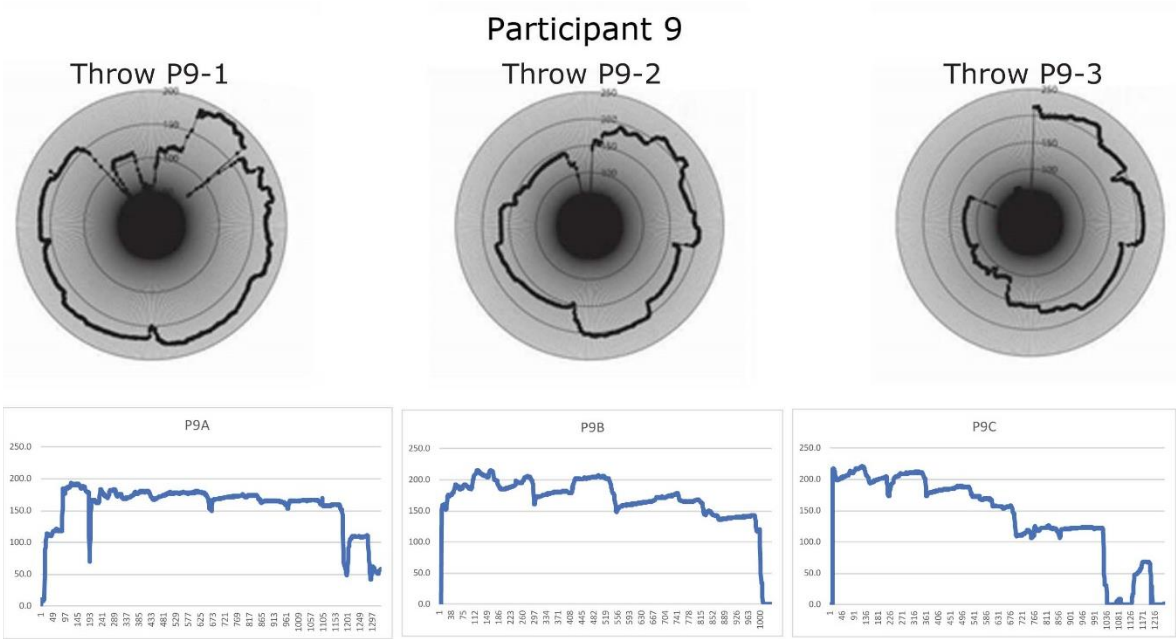


Figure 4-60:Participant P9 throwing performance velocity.

The results are displayed in a radar chart for each participant. All three performances placed side by side in throwing performance order. Graph representations of each performance are placed below each radar chart.

Performance style for participant P9 indicates visual similarities between each performance. Throws P9-2 and P9-3 reach greater speed than the initial throw P9-1. Velocity for each performance start is rapid, evidenced by an almost vertical trace. Throw P9-1 displays a more constant speed than either P9-2 or P9-3, this would suggest a tentative approach to using an unfamiliar wheel. Throw P9-3 has a more measured performance, starting quickly and a gradual but staged decline in speed before a false ending and starting speed again briefly. Throw P9-1 and P9-3 finish similarly with a short burst of acceleration in the final elements of the throws.

4.9.5.10 Participant P10

The throwing performances of participant P10 seen in Figure 4-61, have similar elements. They all have times when wheel velocity is in excess of 210 revs. Each performance has a drop in velocity positioned mid throw. All performances have a time of rapid deceleration towards the close of the occurrence. Velocity gradually decreases over all after the initial burst of acceleration.

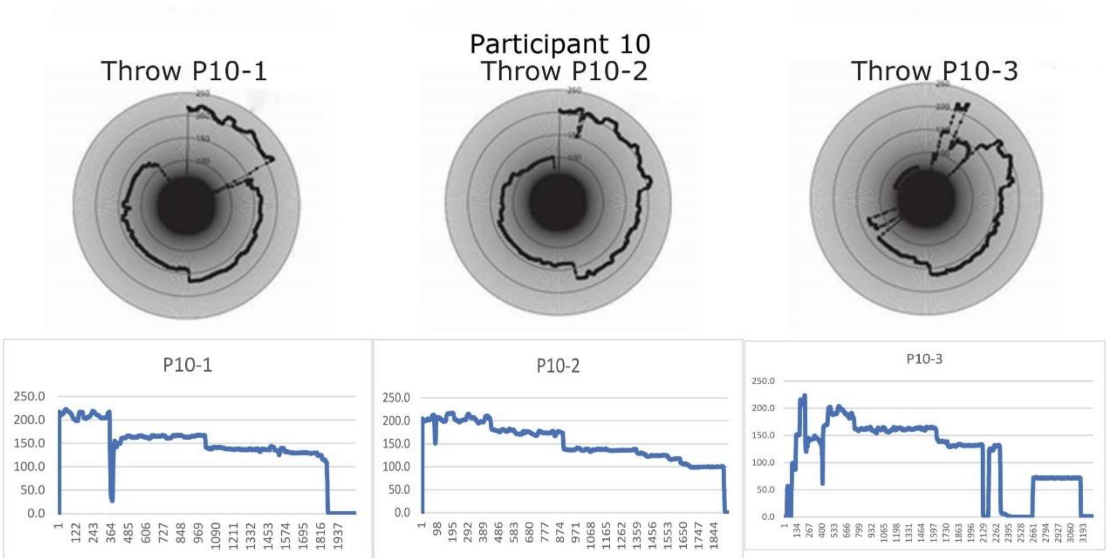


Figure 4-61:Participant P10 throwing performance velocity.

4.10 Water

4.10.1 The Use of water

This section reports on both water temperature and water usage during the throwing performances. Water is an important element of the throwing process, providing lubrication for the interface between individual and material. Too much and the material responds erratically and too little and the material snags on the hand and fingers.

4.10.2 Water temperature

The temperature of the water involved in the performance was measured to enquire whether there was a consensus of water temperature usage among the participants. Figure 4.62 displays the results of measuring water temperature. Temperature was similar for 60% of the participants. The highest temperature was recorded for Participant P8, the explanation offered was that due to arthritis in the finger joints, P8 discovered that her hands worked better when using warm water. Cooler temperatures of water constricted movement in the hands, and the throwing performance was less comfortable.

Participant P10 made no comment concerning the temperature of the water. Figure 5-56 shows the water temperature measured for participants in their space of data capture. Participants P2, P4 and P10 used the same working area. The water temperatures measured similarly. Likewise, participants P7 and P8 used the same working area, the water temperatures were comparable. The water temperature for participants P3, P5 and P6 working in the same studio were alike.

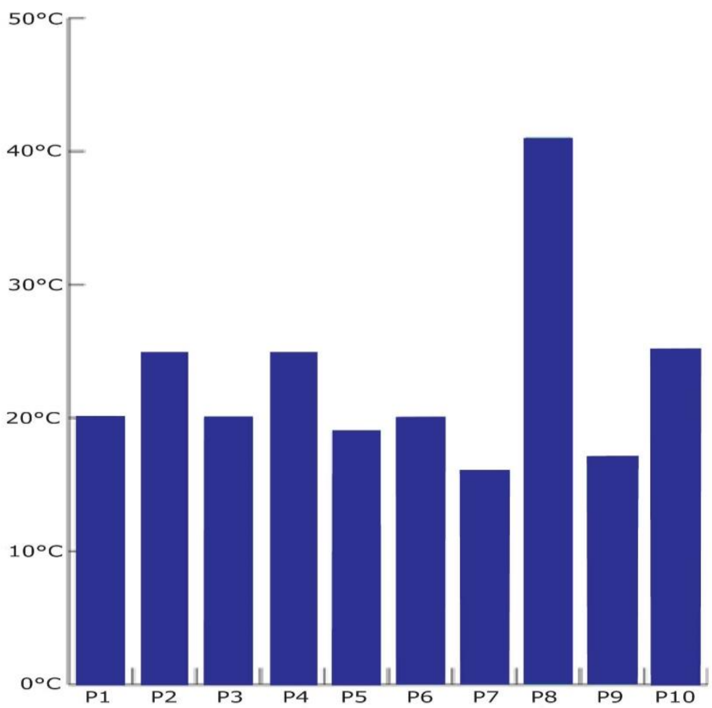


Figure 4-62:Temperature of water used in throwing performances.

When considering as to whether water temperature influenced a throwing performance, the results were inconclusive. P8 performed with the hottest water temperature which resulted in neither rapid nor the slowest performance times, but participant P8 would have performed with more comfort. The cooler water temperatures assisted both faster performance times for P9 and slower performance times for P7.

Figure 4.63 shows participants in water temperature order and length of throwing performances.

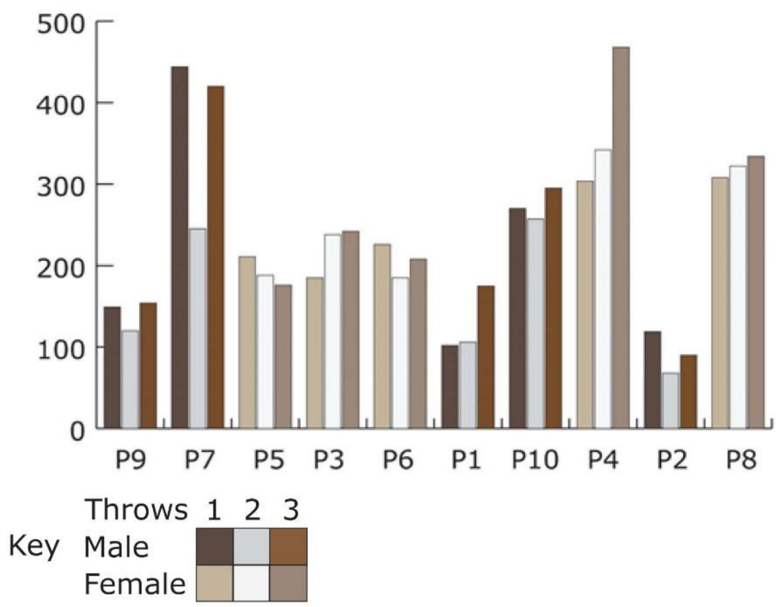


Figure 4-63:Performance times from cooler water to warmest water.

4.10.3 The Application of water

The application of water is a notable activity for providing lubrication at the interface between hand and clay material combined with rotational movement. The purpose is to reduce friction, drag, which may mar the pot shape. Some quantity of the splash of water may modify the malleability of the clay material causing it to become unstable.

Actions were analysed for a potential ratio of total events in a throwing performance, against the number of water events. Table 4.12 presents the total number of events or actions detected in a throwing performance and lists the number of events using water.

The range of water events for all participants first throwing performance ranged from 6 events through to 26 events. Participant P1 recorded the least water events counted at 6 events from 33 total events, which in percentage terms is 18.18% of the performance. Participant P7 recorded the most water events of 26 out of 80 total events, 32.5% of the performance.

Throwing performance 2 for participants recorded the least usage of water from participant P9 of 4 events from 38 total events,10.53% of total events. The most water usage was logged from participant P3, 23 water events from 59 total events, 38.98% of the performance was engaged in water focussed activities.

Recorded from the third throwing performance data, Participant P9 logged the least use of water at 11.36%, 5 water events from 44 total events. Most use of water is noted from participant P7 having 23 water events and 70 total events.

Both participants P1 and P9 recorded low usage of water during their throwing performances. Participant P1 was performing on the study wheel using his home studio clay. It would be a familiar material, which would be used for all other throwing projects. P9 equally was working in his home studio with familiar material and performing on the provided study wheel. Therefore, would be more at ease with the throwing performances. Whereas participants P3 and P7 were recorded as having the most water events. Participant P3 was throwing in her usual place of work, with the expected clay body, on the study potter’s wheel. The results from all throwing performances indicate that she may habitually use much water, although not recorded as having the most water events throughout the three throwing performances. Participant P7, was not throwing in his usual workplace, but was familiar with the studio and the clay material. He was however, performing as a left-hand dominant participant on a wheel rotating for right hand dominant participants, therefore, the addition of more water may have eased sensory messages controlling the hands and the fingertips. Table 4.8 shows throwing events in percentage terms.

Table 4-8:Total throwing events and water events.

Participant	Throw 1	Water	Throw 2	Water	Throw 3	Water
P1	33	6	33	7	41	10
P2	35	7	35	7	30	7
P3	39	12	59	23	62	20
P4	69	20	79	22	57	14
P5	62	13	59	10	56	10
P6	44	7	44	9	41	6
P7	80	26	63	18	70	23
P8	63	12	70	11	72	16
P9	51	13	38	4	44	5
P10	56	13	58	18	64	18

A graphical representation is seen, in Figure 4-64, of the number of actions or events made by the participants in all three throwing performances and the associated number of water events. The graph was designed to have the water events placed alongside the throwing events for comparison Points to note, participant P2 was constant in his number of water events across all three performances. The graph appears to show, participant P7 with the most water activity, but this is misleading as he also had many throwing events, therefore, the ratio of throwing actions to water events spreads out across the performance. Participant P3 comparing throwing events to water events had the most water action.

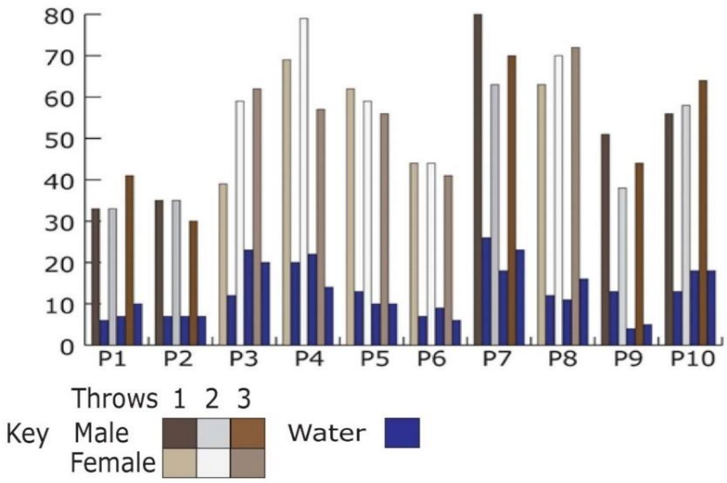


Figure 4-64:Total performance events and water events.

Table 4.9 displays only the water events as a percentage of the total events made during each throwing performance. The far-right column exhibits an average for each participant across the three throwing performances. The least water usage was made by participant P9, 16.54% of all actions during the throwing events involved the use of water. Whereas the most water usage was more than double the amount at 34.38% on average of all action events concerned the use of water. Participant P3 recorded the most water actions

Table 4-9:Water events as an average percentage of throwing events.

Participant	Water Throw 1 %	Water Throw 2 %	Water Throw 3 %	Average percentage of water events
P9	25.49	10.53	11.36	16.54%
P6	15.91	20.45	14.63	17.05%
P5	20.97	16.95	17.86	18.64%
P8	19.05	15.71	22.22	19.02%
P2	20.00	20.00	23.30	21.00%
P1	18.18	21.21	24.39	21.50%
P4	28.99	27.85	24.56	27.32%
P10	23.21	31.03	28.13	27.53%
P7	32.50	28.57	32.80	31.46%
P3	30.77	38.98	32.26	34.38%

across the three throwing performances. There was a 60/40 ratio of those participants having water events in their performances, below the average of 23.44% and those participants having more than an average number of water events.

4.10.4 Placing of Water events

All participants added water during their performances. Participant P1 has been selected for discussion as he was an economical user of water and participant P6 has been selected having similar lengths of throwing performance and for using a smaller number of water events.

Figure 4-65 shows the use of water by participant P1 across all three throwing performances. All three throws start with three events,

1. Placing of clay on the wheel,
2. Starting the wheel,
3. Adding water.

The water added here is for lubrication, the interface between hands and material. The lubrication would enable less friction and a greater chance of manipulating the clay material to a centred position. After this initial add of water participant P1 followed a routine of manipulating the clay upwards into a tower shape and then manipulating the clay back down into a smooth streamlined lump. These two actions introduced lubrication into the clay material to act at a particle level, where the hexagonal clay particle plates would align more smoothly. Throwing performance 1 had one manipulation routine before water was added before making the hole, opening up and compressing the base. Water is then added before entering a cone making routine in preparation for the cylinder walls. Water was then added again before 'collaring' the pot which would prevent the top of the walls and the rim from stretching too far out of shape. Water was then added prior to the first pull up of the walls, for lubrication and reducing friction between clay body and hands. The pot was collared for preserving shape. Water was added and the second pull up of the walls began. Shortly, the speed of the wheel was decreased before a continuation of this second pull. The pot was then collared again to preserve the walls from straying from vertical. This action was followed with a tidy the foot routine where excess clay is removed to prevent the base having excess clay attached and the drying process may cause stresses for the pot. The next pull was the third pulling up of the walls to complete the height of the pot. The rim was compressed to firm clay particles and to ensure the rim had no sharp edges which may have an effect in the decoration element of the pot making process. A sharp edge may cause the glaze to crawl away from providing a smooth glassy finish. Participant P1 then addressed excess moisture through the use of a sponge and sponging the excess away. The performance was almost complete leaving only the wiring of the pot from the wheel and lifting the pot away.

Performance 2 had different points when water was used. There was a repeat of the manipulation routine before adding more water as lubrication prior to making the hole for the pot. After the compression of the base there was a water event, before starting the cone making routine. At the completion of this routine the rim was compressed. The foot was then tidied before continuing with the first pulling up of the walls. At the end of pulling, a water event was performed before collaring the upper parts of the pot walls and compressing the pot rim.

Participant P1		
Throw 1	Throw 2	Throw 3
Ball of clay onto wheel	Ball of clay onto wheel	Wheel moving
Start wheel	Start wheel	Ball of clay onto wheel
Water	Water	Water
Manipulate clay up	Manipulate clay up	Manipulate clay up
Manipulate clay down	Water	Water
Water	Manipulate clay down	Manipulate clay up
Making hole	Manipulate up	Manipulate down
Opening up	Manipulate down	Water
Compressing base	Water	Water
Finish compressing base	Making hole	Manipulate down
Add water	Opening up	Making hole
Make cone	Compressing base	Add water
Add water	Finish compressing base	Opening up
Collar pot	Add water	Compressing base
Add water	Start cone	Finish compressing base
1st pull	Make cone	Add water
Collar pot	Compress rim	Start cone
Add water	Add water	Make cone
2nd pull	Tidy foot	Compress rim
Change speed	1st pull	Add water
2nd pull	Add water	Tidy foot
Collar pot	Collar pot	1st pull
Tidy foot	Compress rim	Collar pot
3rd pull	Add water	Add water
Compress rim	Tidy foot	Compress rim
Grab sponge	2nd pull	Collar pot
Dry out pot	Collar pot	Tidy foot
Tidy wheelhead	Get rib	2nd pull
Dry out pot	Tidy foot	Collar pot
Grab Wire	3rd pull	Add water
Slide near to far under pot	Pot collapses	Tidy foot rib
Pot lifted away	Pot lifted away	open rim
Wheel moving	Wheel moving	2nd pull rib
		Add water
		Collar pot
		Get rib
		3rd pull
		Consolidate rim
		Wheel stop
		Get wire
		Lift pot from wheel

Figure 4-65:Water usage noted from participant P1.

Water was then added before tidying the foot and the second pull up of the walls. The rim was again collared. ‘Getting a rib’ was the use of a potter’s tool. The foot was then tidied once more before performing a third pull. At this point the pot collapses and is removed ready to start the third throwing performance. The duration of Performance 3 was lengthier than the first two throws. Water events occurred prior to centring, between the manipulations of centring. The fourth water event occurs after the hole has been made and before the pot was opened up and the base compressed. Water was added before the cone routine and again after the compression of the rim. After this event, the foot of the pot was tidied, and the first pull occurred followed by a collaring of the upper walls. Water was added before continuing the performance with compressing the rim, collaring the pot again, tidying the foot, before starting on the second pulling up of the walls. The pot was again collared before the next water event. The sequence of tidying foot, opening the rim and an extension of the second pull. A final water event was added before collaring of the pot and a third pull. At the end of the third pull the rim was consolidated and the wheel stopped. The pot was wired through and lifted from the wheel.

Participant P6 commenced her performances with a cone shaped ball of clay. Then started the wheel and added a water event. The next water event occurred between manipulations of the clay during centring. The first throwing performance had water events after sub-routines within the performance. The centring routine, then a water event. Continuing to an opening up and consolidation of the base routine then water. Making a cone routine followed by a water event. The first pull and rim consolidation routine then a water event was charted. The second pull and rim consolidation a water event followed. This was the final water event, for the remaining time of the throwing performance, there were actions without the use of water, e.g. checking the walls. As with participant P1 the foot of the pot was tidied in the final stages of the throwing performance and the wheel was stopped. Figure 4-66 displays detail of water additions by participant P6. The second throwing performance is similar to the first in total event numbers with the use of more water events.

Participant P6		
Performance 1	Performance 2	Performance 3
Cone held	Cone placed ready	Shaping cone
Prep	Wheel start	Manipulate clay up
Cone held	Add water	Flatten
Cone patted bet hands	Shaping cone	Add water
Cone placed	Manipulate clay up	Manipulate clay up
Cone rotation wiggle	Add water	Manipulate down
Stop	Manipulate clay up	Manipulate up
Lifted	Manipulate down	Manipulate down
Cone slammed down	Manipulate up	Add water
Add water	Manipulate down	Raise
Wheel start	Flatten	Flatten
Shaping cone	Change speed	Increase speed
Manipulate clay up	Add water	Make hole
Manipulate clay down	Raise	Stop making hole
Add water	Flatten	Add water
Manipulate down	Add water	Opening up
Flatten	Make hole	End opening up
Raise	Stop making hole	Consolidate base
Flatten	Add water	End consolidation
Add water	Opening up	Add water
Make hole	End opening up	Cone
Attention distracted	Consolidate base	End cone pull
Make hole	End consolidation	Add water
Stop making hole	Add water	Test pull
Opening up	Cone	End test pull
End opening up	End cone pull	1st pull
Consolidate base	Add water	End pull
End consolidation	1st pull	Consolidate rim
Add water	End pull	End consolidation rim
Prepare for cone	Consolidate rim	2nd pull
Check base	End consolidation rim	End pull
Cone	Add water	Consolidate Rim
End cone pull	Wet walls	End consolidation rim
Add water	End wet walls	Add water
1st pull	2nd pull	Check walls
End pull	End pull	End check
Consolidate rim	Consolidate Rim	Tidy foot
End consolidation rim	End consolidation rim	End tidy foot
Add water	Check walls	3rd pull
2nd pull	End check	End pull
End pull	3rd pull	4th pull
Consolidate Rim	End pull	End pull
End consolidation rim	Check wall 1	Check wall
Add water	Consolidate rim	5th pull
3rd pull	End consolidation rim	End pull
End pull	4th pull	Tidy foot
Check wall 1	End pull	End tidy foot
Check wall 2	Tidy foot	Check wall
4th pull	End tidy foot	Check rim
End pull	Wheel stop	Stop wheel
Check wall	Wheel start	Start wheel
End check	Check wall	Check wall
Tidy foot	Check rim	End check
End tidy foot	Check wall	Stop wheel
Wheel stop	End check	Start wheel
	Stop wheel	Tidy foot
		End tidy foot
		Stop wheel

Figure 4-66:Water usage during throwing performances from P6.

The water events are situated at the end of sub-routines within the performance. They cease at the end of the first pull. Pulls 2, 3 and 4 are performed without extra lubrication as there would have been sufficient moisture within the clay body to withstand the amount of manipulation for the clay body.

Performance 3 tracked detail of the first two throwing performances, with water events occurring at the end of sub routines to the end of the cone making routine. At this point the performance differed in that there was no water event after the first pull routine, instead the performance continued into pull 2 and the consolidation of the rim before the final water event occurred. Pulls 3, 4 and 5 continued without additional lubrication. The performance ended with checking the walls and the tidying of the foot before the wheel was stopped. Participant P6 was confident with completing latter stages without additional water support.

Analysis of throwing performances allowed for the calculation of precise number of events for water usage within a throwing performance are displayed in Tables 4-10, 4-11 and 4-12 , Table 4-10 shows water events for throwing performance 1. There were significantly fewer water events than throwing events. Where spaces are left blank, participants omitted that stage from their throwing performance. Participants have more water events during the centring section of their performances than most subsequent sections of their performances, the exception being the pulling up of walls. Participant P7 needs a greater amount of water to get the clay centred than the other participants. P1, P2, P6 and P9 need fewer interventions of water. One notable point is that there is no water used after the pulling up of the walls by all participants.

These tables show the irregular number of water events across the three throwing performances. However, they do not show when exactly the events take place within each key moment of the throwing performance. They are limited to only the number of events taking place.

Table 4-10:Water events in each sub-routine for throwing performance 1.

	Total Events/Water Events						Throw 1					
	Centring		Hole open		Open up		Cone		Pull		End	
	TE	WE	TE	WE	TE	WE	TE	WE	TE	WE	TE	WE
P1	6	2	1	0	4	1	4	2	14	1	4	0
P2	15	2	5	1					8	2	3	0
P3	13	4	2	1	5	1	7	2	21	6	8	0
P4	35	8	2	0	6	2			44	6	9	0
P5	17	4	1	0	10	3	4	1	35	4	1	0
P6	10	2	4	0	7	1	3	1	16	2	5	0
P7	47	13	2	1	8	3	6	2	23	3	8	0
P8	22	8	3	1	2	1	4	2	26	1	9	0
P9	11	2	1	0	4	1	5	2	23	7	7	0
P10	15	6	4	2	4	2			24	3	9	0

Water event details for the second throwing performance are shown in Table 4-11. The format of the table is identical to Table 4-10. P4 had the greatest number of water events during the second throwing performance. Centring for P4 recorded the most water events. Participant P3 recorded most water events during the section of pulling up the walls in the throwing performance, 10 water events out of a total of 33 events, whereas P9 used water once out of 19 events during the same section of the throwing performance. As with Table 4.10 showing the events in the first throwing performance, Table 4-11 also notes that no water was used during the pot throwing performances after the pulling up of walls.

Data for the number of water events during the third set of throwing performances are shown in Table 4-12. This third performance shows a less extreme number of water events when centring from the participants.

Table 4-11:Water events of throwing performance 2.

	Total Events/Water Events						Throw 2					
	Centring		Hole open		Open up		Cone		Pull		End	
	TE	WE	TE	WE	TE	WE	TE	WE	TE	WE	TE	WE
P1	9	3	1	1	4	1	5	1	12	2	3	0
P2	13	3	5	0					8	2	3	0
P3	15	6	1	1	7	2	8	3	33	10	10	0
P4	44	13	3	0	6	0			49	7	13	0
P5	15	4	1	0	7	4	4	1	31	5	8	0
P6	15	4	4	0	5	1	3	1	20	2	9	0
P7	25	9	2	0	12	3	3	1	32	4	3	0
P8	20	5	1	0	2	1	5	1	27	2	13	0
P9	7	2	1	0	3	0	3	1	18	1	5	0
P10	17	6	4	1			9	3	42	6	3	0

This trend of fewer water events follows across all sections of this third throwing performance.

Table 4-12:Water detail of throwing performance 3.

	Total Events/Water Events						Throw 3					
	Centring		Hole open		Open up		Cone		Pull		End	
	TE	WE	TE	WE	TE	WE	TE	WE	TE	WE	TE	WE
P1	10	4	2	1	4	1	5	1	17	3	4	0
P2	13	2	4	0					9	2	3	0
P3	18	5	8	3	2	1	4	1	33	6	8	0
P4	27	8	2	0	9	2			31	5	9	0
P5	20	4	1	0	8	1	4	1	27	4	1	0
P6	12	2	3	1	5	1	5	1	20	1	5	0
P7	28	9	5	1	12	4	2	1	36	7	8	0
P8	18	5	3	1	2	1	2	1	31	6	9	0
P9	6	1	1	0	2	0	5	2	19	2	7	0
P10	20	6	4	1	8	3			47	4	9	0

The sections of centring and pulling had the most water events. There were distinct methods of adding water to the throwing performance. Some participants would splash or drip or damp the hands when adding water to their performance. Each method would add a different amount of water lubrication to the throwing performances. 90% of all water events finished the opening key section of throwing performances.

4.11 Biomechanical Aspects

The next analysis of the visual data was to observe the amount of movements the participants made when engaged in a throwing performance. This involved using the 'Quintic Biomechanic' software, where it was possible to mark body positions during a review of the throwing performances. The first body position analysed, was the use of the arms.

4.11.1 Upper limb movements.

Quintic Biomechanic software enabled a frame by frame analysis of movement. As expected, the upper limbs, the arms change position many times during the performance. Marks were made with yellow and red lines indicating the movement of the upper and lower arms. In each example the upper arm made fewer extreme movements than the more active lower arm. Figure 4-67 shows the patterns of arm movements of participant P9. This participant kept his right elbow tucked in towards his right hip, therefore the lateral movements of this arm were restricted at the elbow by his torso and right leg, thus the movements occurred across the upper right leg. The hip provided a point of stability for the body frame The upper arm had a lesser degree of movement, as seen in the fewer yellow lines, than the lower arm which moved necessarily, creating many more movement marks, to accommodate the actions needed to complete the sub routines of centring, opening up and pulling up the walls, and tidying the foot of the pot during the throwing performance. Left lower arm movements have a shared direction, traversing the left upper leg.

Figure 4-67:Arm movements of participant P9.

Figure 4-68 displays arm movements of Participant P2, yellow lines indicate that during the throwing performance the upper body leaned forward over the wheel. Both arms were equally involved in the performance as the yellow upper arm marks are balanced. Lower arms had more action, indicated by red markings. The right lower arm made fewer extreme movements, confining any movement to a narrow area across the right upper leg. The left lower arm made many more lateral positional adjustments than the right lower arm.

Figure 4-68:Arm positioning of participant P2.

Participant P4 appears to have used both arms in the throwing performances. Movements from the right upper arm have remained located on the right side of the torso, whereas the left upper arm has worked on the left side and has moved during the throwing performance towards a proximal central position Figure 4-69 indicates that the lower arms have made many more actions, and repeated actions converging on an area to the front of the participant, a ventral position. This pattern of movement differs from the prior example, participant P2 and has more similarity with participant P9. Other participants had a centralised pattern of movement keeping close to the core strength of the torso. P2 has the most economical movements as there are fewer red and yellow traces.

Figure 4-69:Arm movements of participant P4.

The left upper limb moved far more than the right upper limb as the left hand would be involved manipulating the clay from the interior of the pot. Therefore, there would be increased movement marks reflecting this. The right upper limb worked on the exterior of the pot wall opposite to the left-hand digits. The clay would be manipulated between the tips of digits D2 and D3 of both hands. The right elbow would be supported by the hip whereas the left elbow would be acting as support at an angle, along with the left shoulder.

Participants P1 and P2 use far fewer movements during their throwing performances different patterns of movements to those of female participants. P10 has a centralised pattern of arm movement with an increased number of actions. Participants P7 and P9 have similar pattern traces to the female arm movement patterns, both wider and busier than the other three male participants.

4.11.2 Lower limb positioning.

Each arm movement pattern relied on the legs for support. Leg movements were far fewer than arm movements for all participants. Participant P2 is shown in Figure 4-70 to have moved his legs, little. There are two markings for the right leg of denoting movement, and two markings for the left leg indicating a minimum position change.

Figure 4-70:Leg movements of participant P2.

Participant P2 restrained movement his lower limbs to support and balance the upper body. Leg movements marked will show the flex needed when the upper body leaned forward during centring and pulling routines. The legs flex slightly generally in an outward direction, whilst still acting as support and balance for the upper torso. Participant P3 movement marks show that the legs had little movement during the throwing performance. Figure 4-71 displays markings indicating leg movement for participant P3. The left leg flexed laterally keeping the lower leg in the same position. The right leg moved more centrally, and closer to the wheel. The lower leg moved little accommodating a speed change.

Figure 4-71:Leg movement markings of participant P3.

Figure 4-62 illustrates that participant P10 flexed the right leg more than the left, as the torso leaned to the right, the right leg adjusted to accommodate the need for space. Whereas participant P4 made small movements in both legs. Participants P6 and P8 made more movement in both legs during their throwing performances.

Figure 4-72:Leg movements of participant P10.

Participant P7 made many movements in both legs. The lower leg was positioned under the upper leg rather than forward which would have enabled more balance and more comfort for the knees. Figure 4-73 displays movements made by the legs of P7.

Both legs, of participant P7 flexed laterally away from the centre, during this throwing performance. The left lower leg, despite the lateral movement moved little.

Figure 4-73:Leg positioning of participant P7.

4.12 Verbal protocol

Prior to each block of three throwing performances, participants explained how they approached throwing a pot on the wheel. This example is from participant P2

> '*Err preparing the clay, and then centring. Err after centring it's opening up the ball of clay and to form the base that is the correct depth and err yep that's the second stage. The third stage is stretching up that clay into a vertical into a cylinder or a bowl or whatever form you are throwing. Refining, refining the shape, I always say there are four stages, centring, opening out, stretching the clay out and then finally refining the form and finishing off.'* P2

An interesting point is about the third stage of pot formation, ‘stretching up’ the clay, the term used in this research study is ‘pulling up’ the clay. It is a hard movement to explain because a potter does not ‘stretch’ the clay particularly, neither do they ‘pull the clay. It is more of a manipulation of the clay, where the clay is forced between the digits of both hands, causing the clay to move in an upwards motion. Thereby creating the walls of the vessel.

4.12.1 Self-reporting discussion

Self-reporting review interviews were initiated post throwing performance as the digital recording was played back by the researcher for comment. It was expected that the participant would have given verbal comments about their own performance. However, it was discovered that the participants were almost totally absorbed in the visual viewing and made very few comments, except in the case of participants P7 and P9, who had thrown in the same studio shortly after each other. This set of circumstances enabled the participants to discuss the other participants performance.

The first comment between participants P9 and P7 was selected because they were discussing the finer points of centring the clay material. On P9’s performance participant P7 commented,

> “*See that’s a nice touch that…… “I like what you are doing with the palm on your right hand….” Carefully guiding your left hand with it. Just coming up with it.* (P7)

Participant P9 commented on the performance of participant P7 about the locking of hands during the centring routine for extra support.

> *‘It looks like your initial throw……… And the locking of hands there’(P9)*

Of his own performance P9 commented:

> *But I’m using that palm there, I’m using it as a knuckle really effectively* (P9)

P7 helps with an explanation of P9 using his knuckle 'really effectively',

> *'It just distributes the pressure of it a bit more doesn't it?'* (P7)

P7's overall performance positioning and posture was discussed:

> *'My posture is not right and again like P9 said,….'*

P7 continues,

> *'… he's got a better throwing technique'* (P7)

P7 then became self-critical about his posture in this throwing performance,

> *'It's ok, I've never been really impressed with my style because I don't think I'm using my limbs properly sometimes, like elbows sticking out a bit too far, back probably a bit bent as well'* (P7)

Commentary turned to materials and the ability to throw with ease.

> *'The clay consistency was alright though…. It wasn't too soft or too stiff"* (P9)

> *'You kind of need a dozen pots to kind of get into the groove as well'* (P9)

P7 continued commenting on posture,

> *'And that's not very efficient I am doing with my hand there look I don't think' (P7)*

He continues with:

> *'I am doing quite a lot more moving around than I should do I am kind of like thinking…..does that make sense …rather than…'* (P7)

Participant P9 mentioned some insightful comments about clay material about the texture not being "too soft" which would have made the material less easy to throw a pot in a throwing performance. Predictably there would have been less water used as there would have been enough moisture already in the clay material. Secondly the soft clay material would not have been suitable for a 1kg clay cylinder pot as the material would be too soft to support the walls.

Participant P9 also made a point that perhaps multiple pots need to be thrown to achieve a state of automaticity and that both body and material would settle into a flow of similar performances.

Other participants made very few comments, apart from appreciating the opportunity to watch their throwing performances.

Chapter 4 has outlined the results of data gathered from throwing performance data collection, physical data, performance data and environmental data. Chapter 5 will discuss the impact these results have on research questions.

5 Comparisons

This chapter will examine similarities and differences between selected data results. The first interrogation was about a potential relationship between anthropometrical measures and other performance data points shown in Chapter 4. A second examination considered a link between performance duration and maximum speeds. The third point of interrogation was the comparison of the tallest participants, P1 and P3, and the shortest participants, P2 and P8.

5.1 Anthropometrical measures

5.1.1 Stature.

This section analyses the impact stature may have on throwing performance times of both male and female participants.

In considering the height of participants and matching the times of their throwing performances, the results have anomalies. The first throwing performance presented a general trend of the taller an individual is then potentially the shorter the throwing performance. Exceptions to this general trend were participants P7 and P2.

P7 presented as a left-hand preference choosing to perform with a wheel rotating anti-clockwise for a right-handed thrower. During the performance, P7 would have multiple differing decisions, regarding material and hand and digit positioning to tacitly make as the performance progressed. Neurologically, synapse movement messages would be working harder to transform fine movement information from left hand guidance into information for a right hand. This fine movement information would be transferred along nerve routes to the right-hand digits. Thus, P7 took longer than would be expected from the trend that taller participants demonstrate a throwing performance more rapidly than shorter participants.

A second anomaly of the trend of taller practitioners performing with shorter performances than shorter participants, was seen in this first performance of participant P2.

Potter P2, is the shortest male, producing a throwing performance aligning with the tallest participant P1, therefore the trend of the taller the male participant, the quicker the throwing performance is not a true reflection. There must be other factors involved.

However, when focusing on female participant data the trend of the taller the participant the shorter the performance. This trend gives an impression of validity in throwing performance 1. The tallest female participant, participant P3 has a shorter throwing performance than the shortest participant P8.

Figure 5-1 shows the height of participants on the Y axis, in order from tallest to shortest and the length of the throwing performance, in seconds, along the X axis for throwing performance 1.

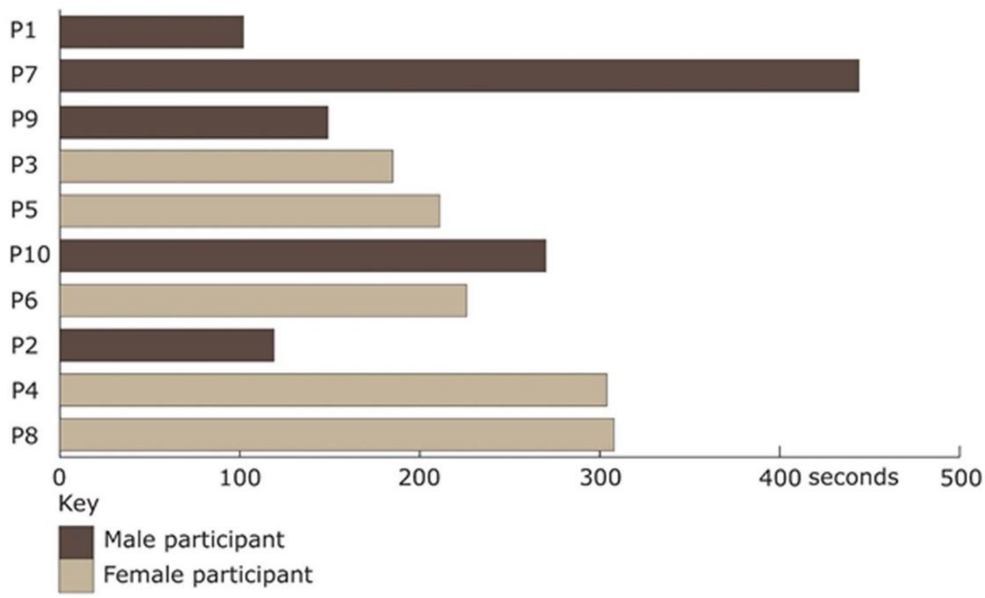


Figure 5-1:Comparison of stature and time for throwing performance 1.

The trend is less visible in throwing performance 2, the anomalies are still visible. P2 remains a shorter participant with a shorter performance. P7 has reduced the time taken in this second performance. P3 the tallest of the female participants has a lengthened performance, longer in time than the second tallest female participant, P5. The shortest female performance time is delivered by P6, which is the 4th shortest time for all participants, yet she is the 6th tallest participant.

Figure 5-2 shows the second throwing performance from participants. Time taken for each throwing performance is displayed in seconds along the X axis. Participants are arrayed in height order from the tallest P1 to the shortest P8 along the Y axis.

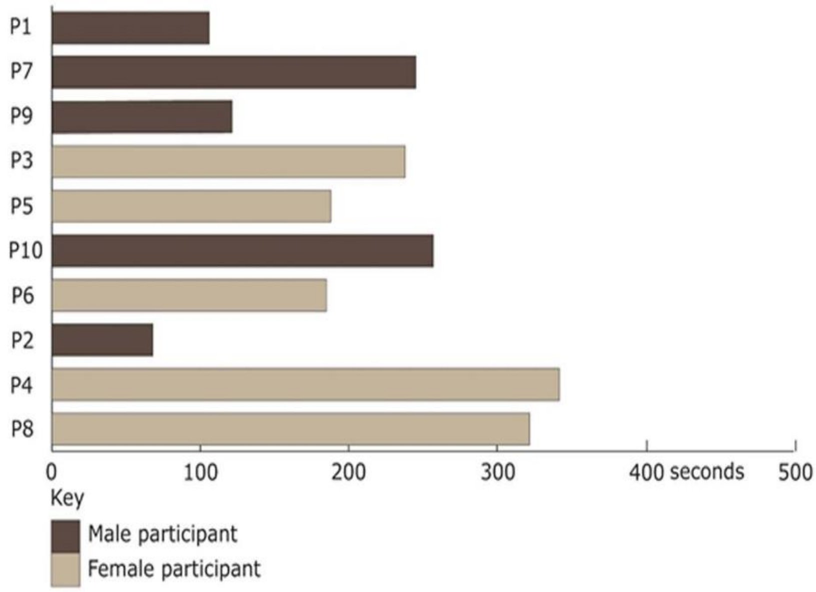


Figure 5-2:Comparison of stature and time for throwing performance 2.

Throw 3

Evidence for the notion that the taller in stature a person is, would, when experienced, result in a shorter throwing performance is not apparent. Performance lengths are longer than the previous two throwing performances. Participant P2, the shortest male, records similar lengths of performances, shorter than the performances of the rest of the group.

Figure 5-3 displays time taken by participants for their third and final throwing performance. The X axis denotes time taken in seconds for the throwing performance. The Y axis shows participants ordered from tallest P1 to shortest P8.

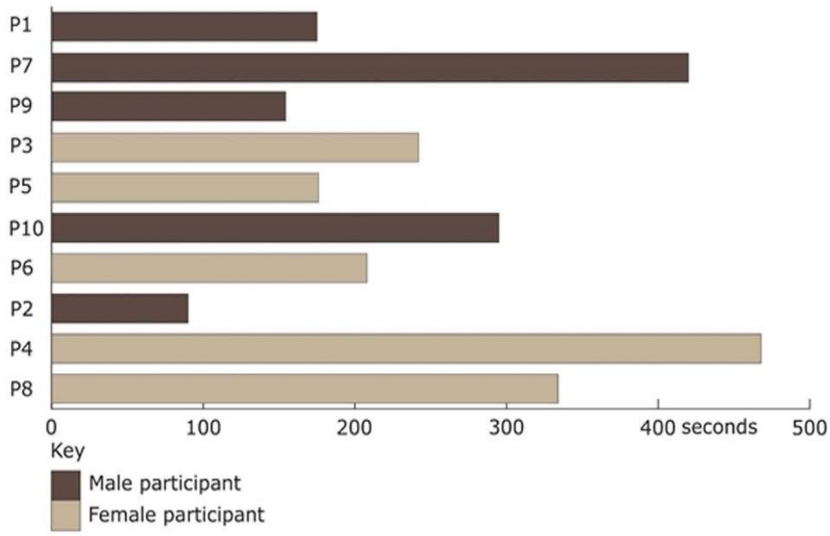


Figure 5-3:Comparison of stature and time for throwing performance 3.

When displaying all data together, the disparity of throw 3 performances is not as noticeable. The participant tallest in stature, P1, performs his throws in similar performance times as the shortest male in stature, P2. Comparing the tallest male and tallest female participant, P1 and P3. Taller stature can perform in a shorter time than the shorter individual. When comparing the performance times of the shortest male and female stature, P2 and P8, the slightly taller male, P2, has considerably shorter throwing performances than the female participant, P8.

Figure 5-4 presents performance timings compared with stature. The X axis details performance timings in seconds and the Y axis features participants in stature order, the tallest stature, P1, to the shortest participant stature, P8.

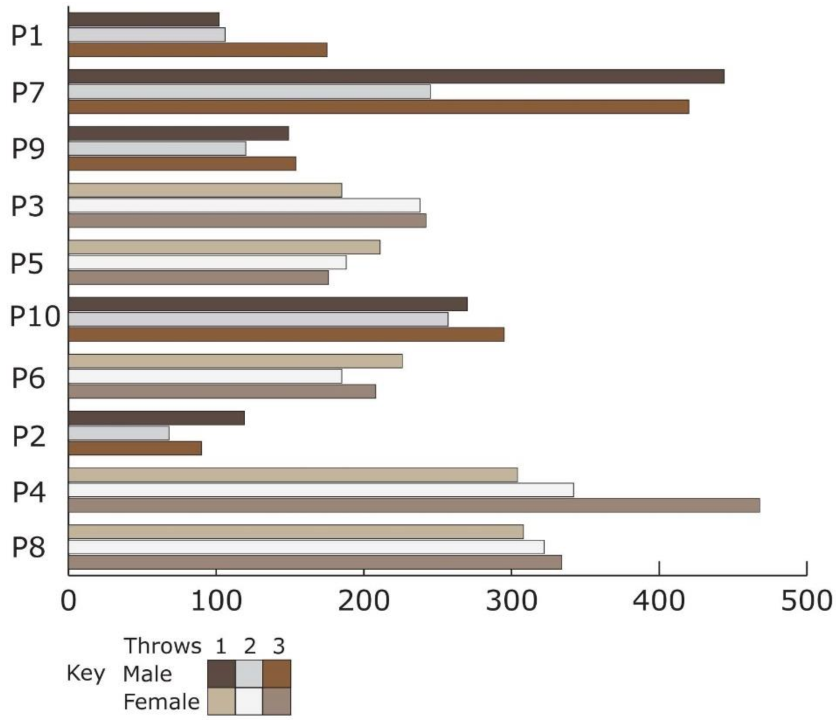


Figure 5-4:Comparison of stature and time for all throwing performances.

Figure 5-4 combines the length of all throwing performances with height for comparison. Time patterns of performances can be categorized into three patterns, 50% of participants (P2, P6, P7, P9 and P10) performed a pattern of a longer first and final performance, and a shorter second performance. Of this 50% of participants, 60% performed the pattern of the longest performance first, followed by a shorter middle performance, and finishing with a performance longer than the middle performance and shorter than the first performance. The remaining 40% had a middle length throwing perform, followed by the shortest performance length, finishing with the longest performance. 40% of participants (P1, P3, P4 and P8) performed in a pattern of short, middle, and longest performance. The final participant (P5) differed in patterns of performance length starting with the longest performance and ending the three performances with the shortest performance. Genders are mixed in throwing performance timings. The participant with the greatest stature did achieve shorter throwing performance times than those with shorter stature, apart from participant P2 who, was short of stature in this sample of potters but, attained shorter throwing performances. There is not the evidence to present that potters shorter in stature often threw pots with shorter throwing performances. Equally it cannot be held that potter's taller in stature throw pot more quickly, as participant P7 does not hold to the tenuous trend.

Stature must be combined with other attributes to have an impact on throwing performance timings.

5.1.2 Shoulder Breadth measurements.

Combining stature data with shoulder breadth data may provide insight of impact on throwing performances.

An interesting point in this evaluation of data, is that shoulder breadth is gender based. All male participants recorded wider shoulder measurements than female participants. Equally shoulder breadth measurements did not correspond with height, apart from isolated elements, e.g. the tallest female participant P3, who recorded the tallest height of female participants, and the broadest shoulder breadth.

Figure 5-5 illustrates the comparison detail between shoulder breadth and stature. X axis notes height in centimetres and Y axis has participant labels from narrowest shoulder breadth, P6, to broadest shoulder breadth, P2.

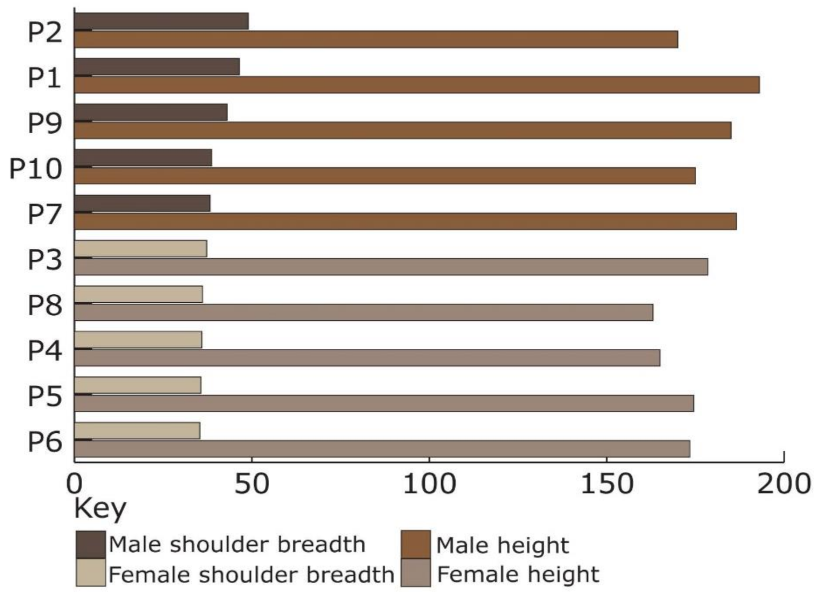


Figure 5-5:Comparison of shoulder breadth and stature measurements.

Wide shoulder breadth appears to impact on throwing performance time. The broadest shoulders of participants have shorter throwing performance times, when scrutinising Figure 5-6. Male Participants P2, P1, P9, demonstrate shorter throwing performance times, than participants P10 and P7 supporting this theory. The evidence for female participants shows that a relationship between shoulder breadth and performance timings is different Participant P3 is broadest shouldered female contributor, and P6 measures with the narrowest shoulders. There is little difference throwing performance times despite a difference may have be expected, following the pattern of male participants. Deliberating on all participants, the theory is then not proven, as participants P10 and P7 mar the line of increase in throwing performance times. Likewise, participants P5 and P6, with narrowest shoulder breadth have shorter lengths of throwing performances than five other participants (P10, P7, P3, P8 and P4) measuring broader shoulder breadth.

Figure 5-6 illustrates the comparison detail between shoulder breadth and performance timings. X axis notes performance times in seconds and Y axis has participant labels from, broadest shoulder breadth, P2.to narrowest shoulder breadth, P6

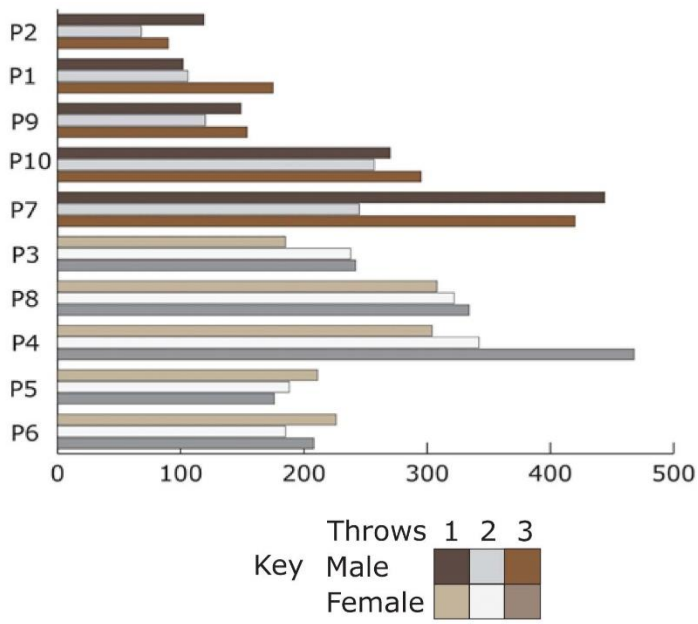


Figure 5-6:Comparison of shoulder breadth and throwing performance times.

Participant P2 measured the broadest shoulders and the shortest performance times, therefore if male this could be a useful attribute However, if female this is not so the broadest shouldered female participant threw similar performance timings as the narrowest shouldered female, P6.

5.1.3 Upper Limb length.

Figure 5-7 displays little correlation between upper limb lengths and times taken for throwing performances by participants. P1 recorded the lengthiest upper limbs to P4 recording the shortest upper limbs. Evidence indicates that a long upper limbed male individual (P1) can execute a throwing performance similarly timed as the shortest upper limbed male participant (P2). Evidence signposts differently for females. Long upper limbed females e.g.P3 or P5 have shorter sets of throwing performances than the shortest upper limbed female participant, P4.

The x axis data is organized with longer upper limbed participants being placed to the left Y axis marks the timings in seconds of throwing performances.

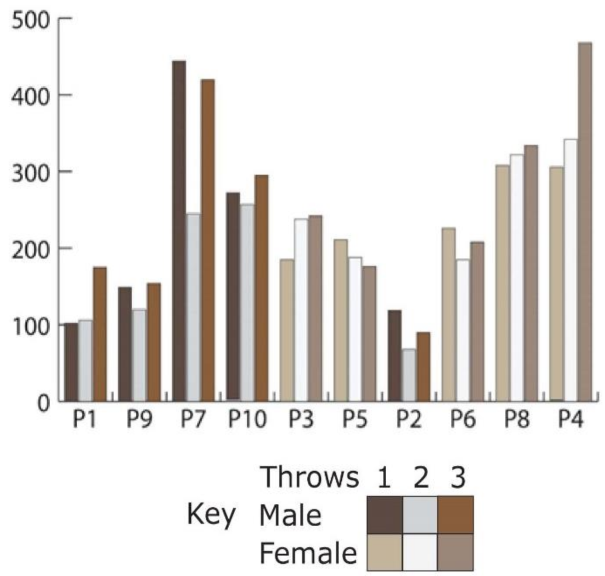


Figure 5-7:Comparison of upper limb lengths with throwing performance times.

5.1.4 Wrist breadths

The broader wrist may indicate wrist stability for use as an anchor for hand and digit movements. Thus, performance times may be shorter. Wrist breadth measurements are gendered in size. The broadest wrist measurement was recorded by participant P1, and the narrowest wrist breadth measurement was logged by participant P6. Figure 5-8 arrays time results from all three throwing performances influenced by wrist breadth.

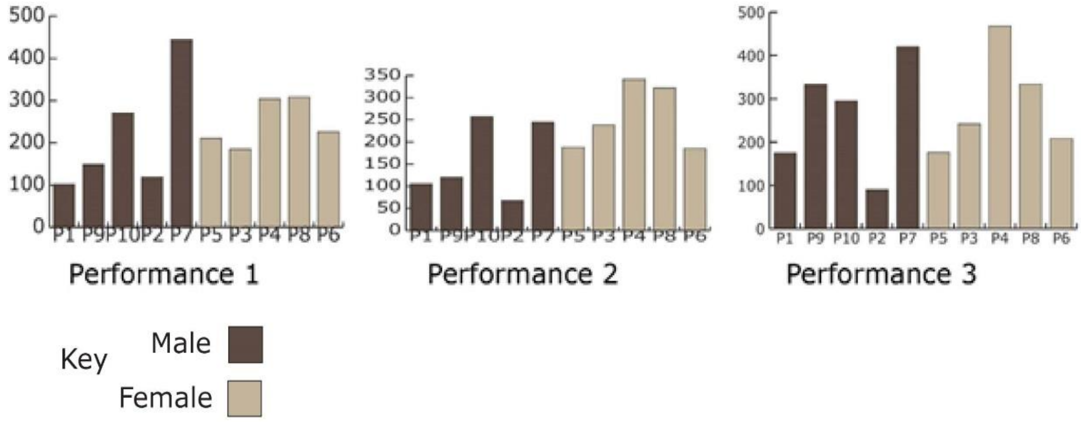


Figure 5-8:Comparison of wrist breadth and throwing performance times.

The impact of a broad wrist breadth measurement potentially should be beneficial on timings of performances as they have a dense area of lower arm bones and muscles linking several ligaments, tendons, and muscles controlling the hands and digits. Evidence suggests that male wrists are broader, demonstrated in this sample, viewed in Figure 5-9. The broader wrists of participants P1 and P9 indicate shorter throwing times. Evidence from P2, indicates that less broad wrist joints can make equal throw timings combined with other attributes.

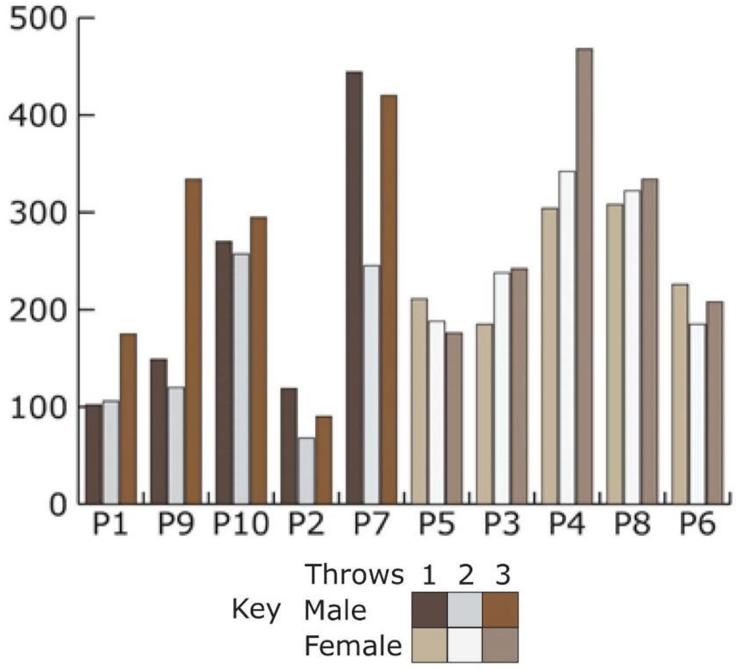


Figure 5-9:Comparison of wrist breadth data on throwing performance times.

5.1.5 Hands and timing

Hand Length and timing

Lengthy hand measurements may prove to be useful to potters for being able to reach and stretch, equally they may be cumbersome in having to adjust hand positioning mid throw. Figure 5-10 displays hand length order along the X axis from longest (P1) to shortest hand length (P4). Performance length is marked in seconds along the Y axis. Performance 1 shows from P5 through to P4 as a group. Timings gradually increase with the shortening of participant hand length. Participant P10 being an exception as he has shorter throwing performances than either of the participants with hand lengths immediately longer or shorter than his. Performance timings for P10 align with the participants with shorter hand lengths.

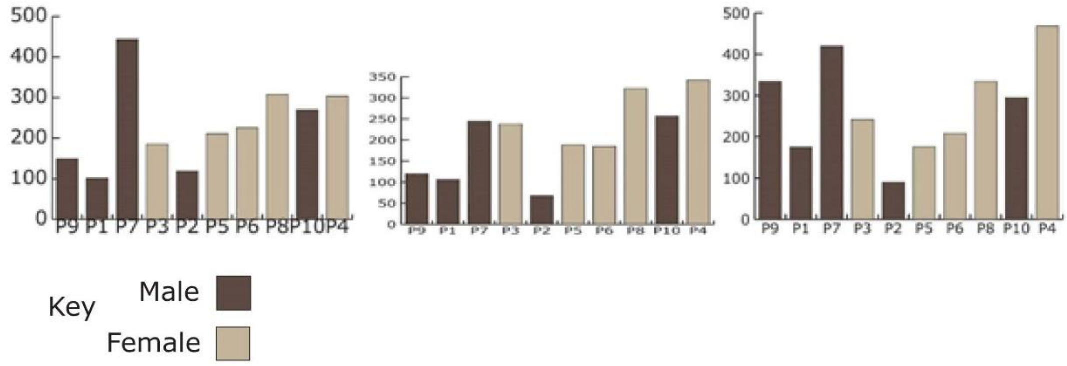


Figure 5-10:Comparison of hand length and throwing performance times.

Participant P2 is an anomaly with mid length hands and shortest performance timings. There could be potential a benefit of having hands of average size, not too long or too short in a throwing performance.

There is a trend when certain performances are discounted P7-1 and P7-3 and those of participant P2. Trend then flows from largest length of hand to the smaller hand lengths. Figure 5-11 combines performance times from each participant into one graph. The x axis noting participants in order of hand length from longest hand measurement of P9 to P4 the shortest hand length. The Y axis marks performance times in seconds.

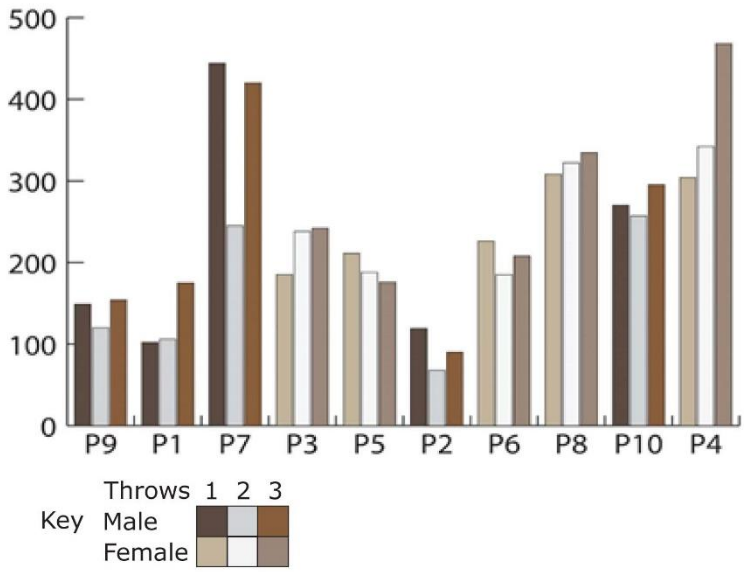


Figure 5-11:Comparison of hand length and all throwing performance times.

5.1.6 Hand Breadth

Hand breadth was the next anthropometrical measurement to be assessed against throwing performance timings. Participant P2 has a middle breadth measurement detailed along the X axis and short performance timings detailed along the Y axis. Participant P9 constructed a narrow cylinder pot during his performances despite having a broader hand breadth. Cylinders thrown by other participants had a wider diameter, allowing more space to manoeuvre, despite having narrower hand breadths.

Figure 5-12 details potential hand breadth measures impact on throwing performances. Participants are placed in hand breadth order from widest, P1, to narrowest, P8 on the X axis. The Y axis notes performance timings in seconds.

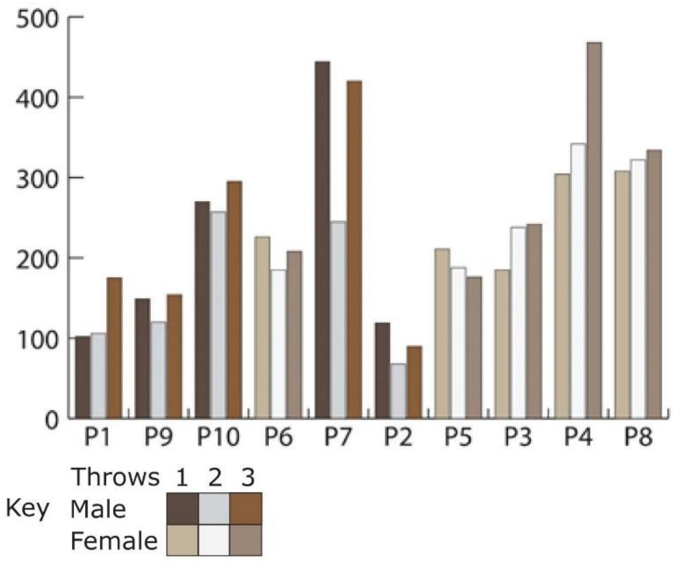


Figure 5-12:Comparison of hand breadth data and throwing performance times.

5.1.7 Thumb Saddle to tip of Digit 2.

Measurement of the Thumb Saddle joint to the tip of Digit D2 would indicate a possible stretch may be achieved by a left hand into the interior of a pot being thrown. Timings of performance may reflect the capability.

Participant P9 had the lengthiest measurement from the Thumb saddle to the tip of D2, which may have aided in performance as these timings are placed in the top 25% of fastest timings. Participant P1 has a long measurement for stretch. Performance timings were placed in the shortest performances. Participant P2 has the briefest length of throwing performances, yet he places 6th in length of measurement. Timings of performances of participants with shorter thumb saddle to tip of Digit D2 are lengthier than those placed in positions 1 to 5, excepting participant P7 who measures into third longest place. His performances have different timings compared with this sample of participants. As the sole left-handed person using a right-handed turning wheel, this participant must translate sensory detail into his non-dominant right hand. Thus, timings are longer than others. Figure 5-13 uses X axis to mark measurement length from long to short. Y axis marks in seconds performance timings.

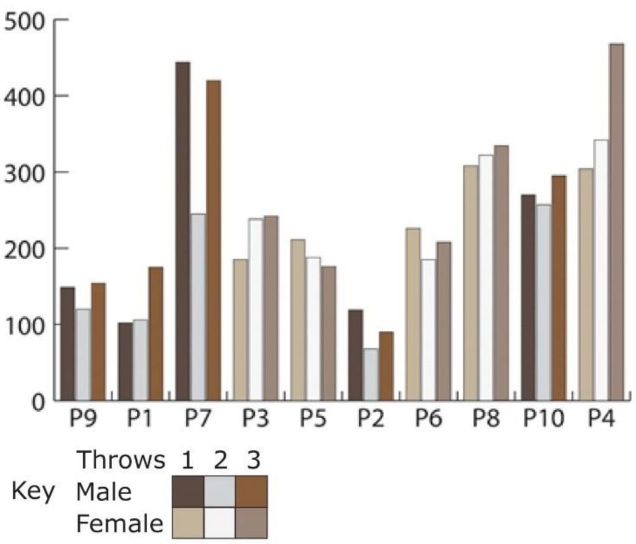


Figure 5-13:Comparison of thumb saddle to tip of D2 data on throwing performance times.

5.1.8 Summary of physical measurements.

Each participant had measured for at least one extreme physical measure. Where a participant had a number of 'greatest' measurements, they did not have a 'smallest' measurement e.g. P1, P3. and similarly, those participants measuring a number of small measures e.g. P4 and P7, had no 'greatest' measures. There were two participants who had measures in both the 'greatest' and the 'smallest' categories, P2 and P6. Table 5-1 marks the number of times that participants were ranked as the top placing (X)or the last placing (0).

Table 5-1:Comparison of physical attributes.

Male	Greatest	Smallest	Female	Greatest	Smallest
P1	XXXX	0	P3	XXXXX	0
P2	X	XXX	P4	0	XXX
P7	0	XX	P5	X	0
P9	XX	0	P6	X	XX
P10	0	XX	P8	0	XX

This comparison shows data compared between two participants who registered in the ‘greatest’ category only, P1 and P3. Both performed their shortest times for their first throw. The second throw was longer by 4 seconds for P1 and by 53 seconds for participant P3. The third and final throw times were the longest of all performances. P1 increased the length of his performance by 69 seconds and P3 increased the final time by 4 seconds.

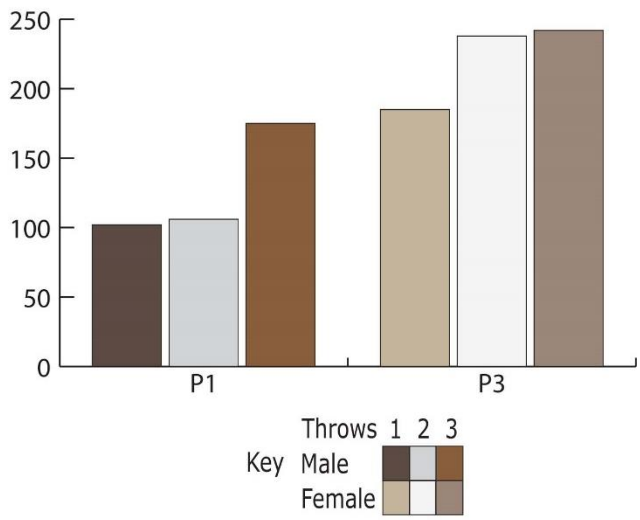


Figure 5-14:Comparison of timings and physical data of P1 and P3.

This comparison between P2 and P6 was completed because both participants scored in both ‘greatest’ and ‘smallest’ categories. Both participants performed a longer first throw, a shorter second throw, and a longer third throw. P2 registered shorter throwing performance times than participant P6.

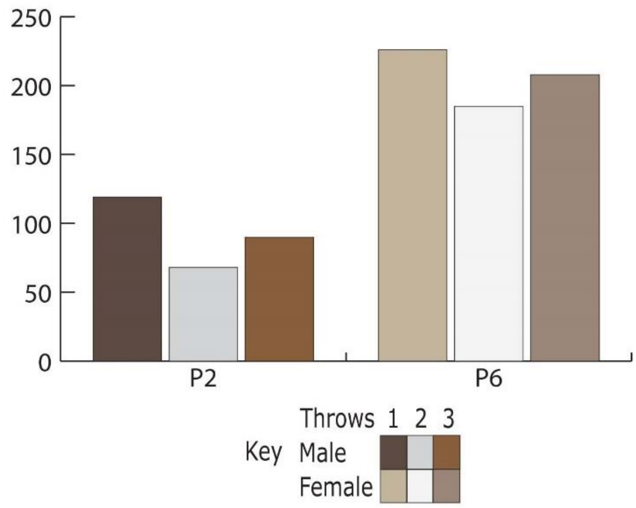


Figure 5-15:Comparison of timings and physical data of P2 and P6.

Participants P7 and P4 are compared because they both have all 'smallest' measurements and no 'greatest' measurements. They have little to compare apart from having three successful throwing performances. Timing patterns for this comparison are such that there are three performances longer than 400 seconds and three performances shorter than 400 seconds. Participant P7 has two performances over 400 seconds and P4 has two performances under 400 seconds. Both participants have longer in duration throws than either the first comparison P1 and P3, or Participants P2 and P6.

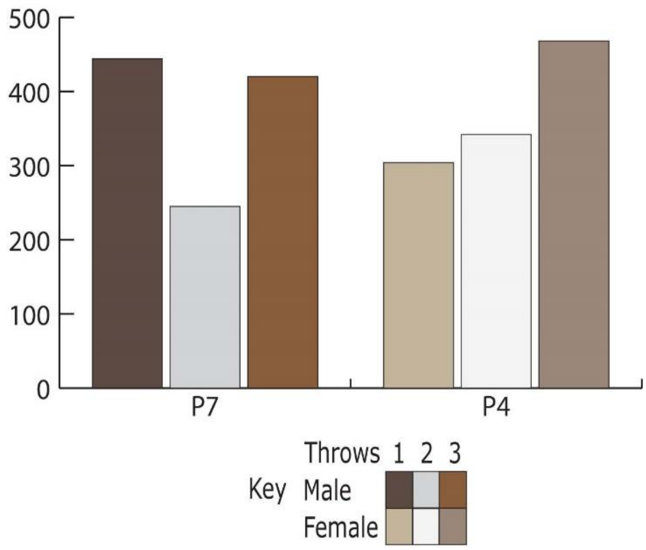


Figure 5-16:Comparison of timings and physical data of participants P7 and P4.

5.1.9 Grip Data

Measuring grip with a grip dynamometer, added another facet of data to the project. Results from analysing the measurements does not show gender difference. The strongest measured grip was from participant P7. Participant P7 completed lengthy throwing performances potentially due to left-hand dominance on a right-hand rotating wheel, and now grip strength, where neurological messages would not only be advising the right hand to operate in a dominant manner but also to monitor strength of hand grips. Participant P4 measured the weakest grip strength and also completed lengthy performances. The strongest female grip strength, P3, made shorter performances. Figure 5-16 illustrates the spread of grip strength and performance durations. X axis displays participant order from strongest grip P7 to weakest grip P4. Y axis, notes performance times in seconds.

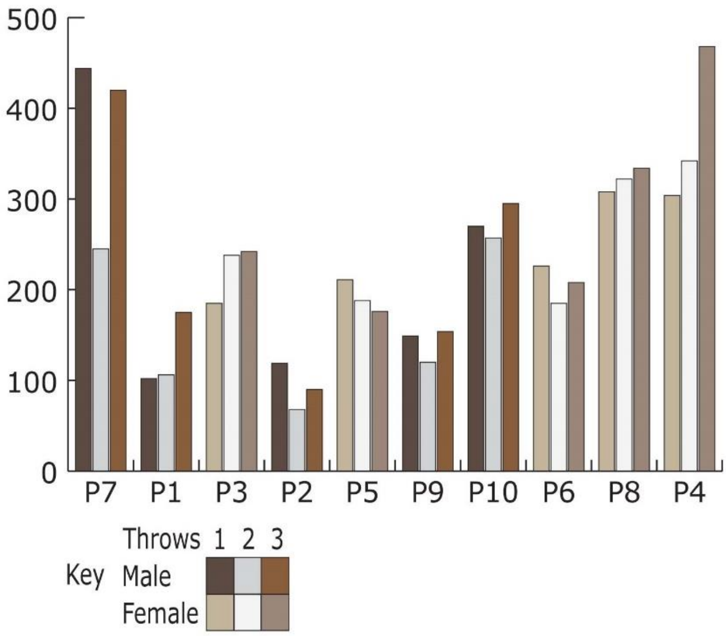


Figure 5-17:Comparison of grip power and performance timings.

Pinch grip data has a complete gender separation. This measurement logged strength between Digit 1 and Digit 2 in a pressing motion. The pressure may be exerted on each side of the wall of the pot and the lip when consolidating the rim. Participant P7 registered the greatest overall pinch strength. P5 measured the greatest pinch strength of female participants. Participant P9 measured the weakest pinch movement for male participants, whereas the strongest measurement for female grip strength P3 measures the least pinch strength. These two participants both recorded the longest hand measurements. Figure 5-17 displays pinch grip data. The x axis noting participant order from strongest pinch strength, P7, to least pinch strength, participant P3. Y axis marks performance duration in seconds.

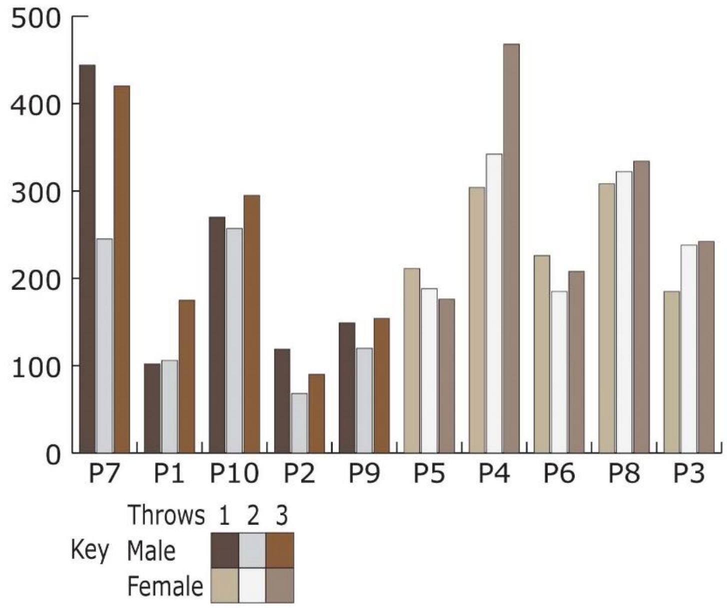


Figure 5-18:Comparison of pinch grip data and timings.

5.2 Performance data.

Participants were requested to participate in three performances for observations to be made, and a consensus may be arrived at through analysis. This section has the performance times as a focus. Although it was recognized that throwing performance timings are not the focus of this research. They can be a vehicle by which patterns can be discovered about participants.

Placements are based on performance timings. Top placements were taken by three male participants, participants P1, P2, and P9, group 1. A second group of similar participants were, P3, P5, and P6, all placing in position 4, 5 and 6. The remaining four participants could be grouped loosely together, having placed performances in positions 7, 8, 9 and 10. However, for a more like comparison the next group is participants P4, P7, P8, and P10, who placed in 7 8, 9 and 10th place. Table 5-2 details placements for each throwing performance. Male participants are marked in blue.

Table 5-2:Performance placings of participants.

	Performance placings		
	1	2	3
P1	1	2	3
P2	2	1	1
P3	4	6	6
P4	8	10	10
P5	5	5	4
P6	6	4	5
P7	10	7	9
P8	9	9	8
P9	3	3	2
P10	7	8	7

Table 5-3 shows groupings of participants according to placements in throwing performances. Group 1 is all male; they all scored an extreme measurement in an anthropometrical measurement. They made throwing performances placing in the top three positions. Participant P1 is the tallest in stature with longest upper limbs and broadest hand breadth. He achieved placements in the top three places. Participant P9 has the record of the longest hand length. The third participant in this group is P2, he is the shortest male with the broadest shoulder breadth, the shortest male upper limb length, the shortest male hand-length, and male hand breadth.

Group 2 is all female. Their throwing performances placed in places 4, 5 and 6. Each member of group 2 registered an extreme measurement in an anthropometrical assessment. Participant P3 is the tallest female participant with the broadest female shoulder breadth, the longest female upper limbs and longest female hand length. Participant P5 scored the largest female wrist breadth. Participant P6 measured the narrowest shoulder breadth, the smallest wrist breadth measurement, and the largest female hand breadth score. The third group of four is a mixed gender group, all placing between seventh and tenth place. Each member of this group has an extreme physical attribute. Participant P4 has the shortest upper limbs and the shortest hand length of the participant sample. P8 measured with the shortest stature and the narrowest hand breadth. Participant P7 registered the narrowest male shoulder breadth and narrowest male wrist breadth. Participant P10 registered the shortest male hand length Table 5-3 shows arbitrary groupings of participants.

Table 5-3:Grouped participants based on performance placings.

		Performance placings		
		1	2	3
Group 1	P1	1	2	3
	P2	2	1	1
	P9	3	3	2
Group 2	P3	4	6	6
	P5	5	5	4
	P6	6	4	5
Group 3	P8	9	9	8
	P10	7	8	7
	P4	8	10	10
	P7	10	7	9

Each group had attributes individual attributes, but non, seemingly common.

5.2.1 Wheel speed

Wheel speed was a crucial aspect of the throwing performance that indicated the flow of the performance. If wheel speed is referred to, in manuals, speed is referred to in terms of faster and slower. As there is no visible speed indicator other than by eye and by touch, it is problematic for a novice to efficiently learn the skill, because it becomes more trial and error. Terms such as faster and slower are subjective to an individual. The study quantified the wheel speeds. The greatest recorded velocity from the throwing performances was by participant P7, 236.3 revolutions in his first performance. The slowest speed of the greatest velocities was performed by participant P4, 159.1 revolutions in throwing performance P4-1. The highest recorded average speed for a throwing performance was by participant P9, an average speed of 168 revolutions for the second throwing performance.

The lowest average speed for a throwing performance was 101.8 revolutions for a first throwing performance from participant P7. Using groupings of participants from placements of performances, Figure 5-18 shows both maximum and average velocity for each throwing performance. Participant P4 worked with the lowest maximum speeds for all throwing performances. Participants P1, P4, and P6 had three similarly powered performances with only 6, 7 and 3 revolutions difference. The greatest difference between average speed performances was a difference of 40.6 revolutions. This difference occurred between the throwing performances of P7. The X axis details participants in groups and Y axis notes speed of the study potter’s wheel. The data refers to the speed of the wheel during performances.

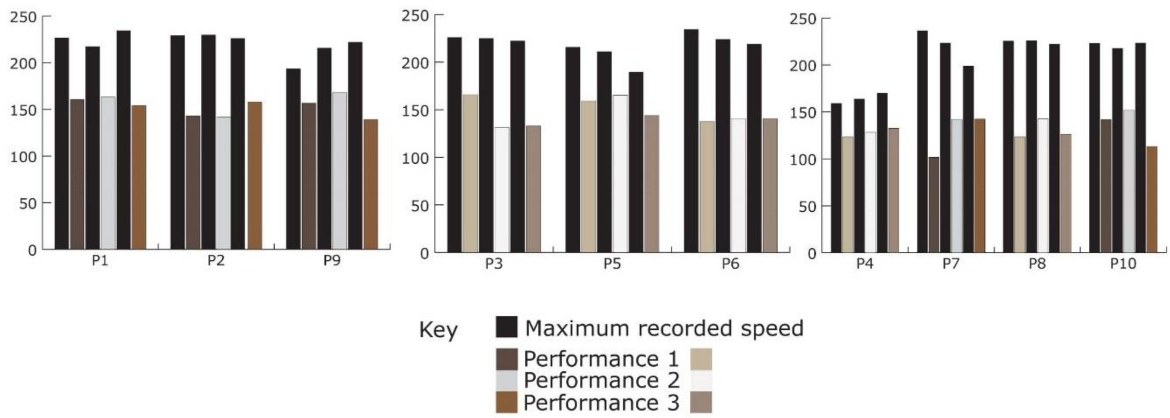


Figure 5-19: Plotting of average and maximum speeds for throwing performances.

Participant P2, made similarly maximum speeded performances with a difference of 3.6 revolutions, P10 was regular with maximum velocity in his throwing performances, having a difference of 5.7 revolutions, seen in Figure 5-19. Whereas P7 had a difference of 37.6 revolutions between his throwing performances, despite throwing the greatest maximum velocity. Differences in average speeds of performances are greatest with participant P7. The difference was 40.6 revolutions, a second participant, P10 had a difference of 38.7 revolutions between the three performance average speeds. Figure 5-19 exhibits velocity data from male participants in order of identifying P and number.

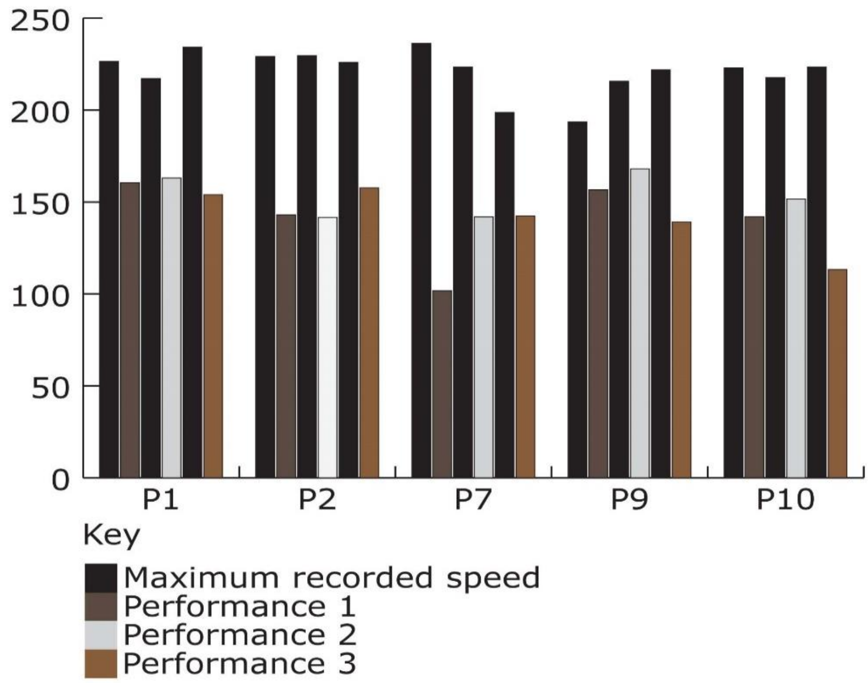


Figure 5-20:Plotting of average and maximum speeds for male throwing performances.

Figure 5-21 shows velocities both maximum and average for female participants. P3 had a close range of maximum velocities, a difference of 1.1 revolutions between performance 1 and 2, and a difference of 2.5 revs between the maximum velocities of performance 2 and 3. Participant P4 made steady increases in speed between the first and third throw. As the maximum velocity increased from 159.1 revs in the first performance, to 169.9 revs in the final throwing performance, the average speeds raised too. From 123.6 revs for the initial performance to 132.5 revs for the last throw. Some maximum performance speeds slowed through the performance P6 was an example. The maximum speed in performance 1 was 234.4 revs. By throw 3 the maximum velocity reached was 218.8 revolutions. Average speeds for P6 remained steady around 137.6-140.9 revolutions.

The maximum speed for all performances was by male participant P7, reaching a maximum velocity of 236.3 revolutions. The highest average speed was recorded by male participant P9 at 168 revolutions. Participant

P6 had the top speed for female participants, of 234.4 revs, and P3 logged the top average speed of 165.9 revs. There is little difference between the speeds of the top male and top female performances, a matter of 1.9 revolutions difference in maximum velocity and 2.1 revs for average speeds. Figure 5-20 illustrates maximum and average speeds of female participants. X axis notes female participants and Y axis notes velocity.

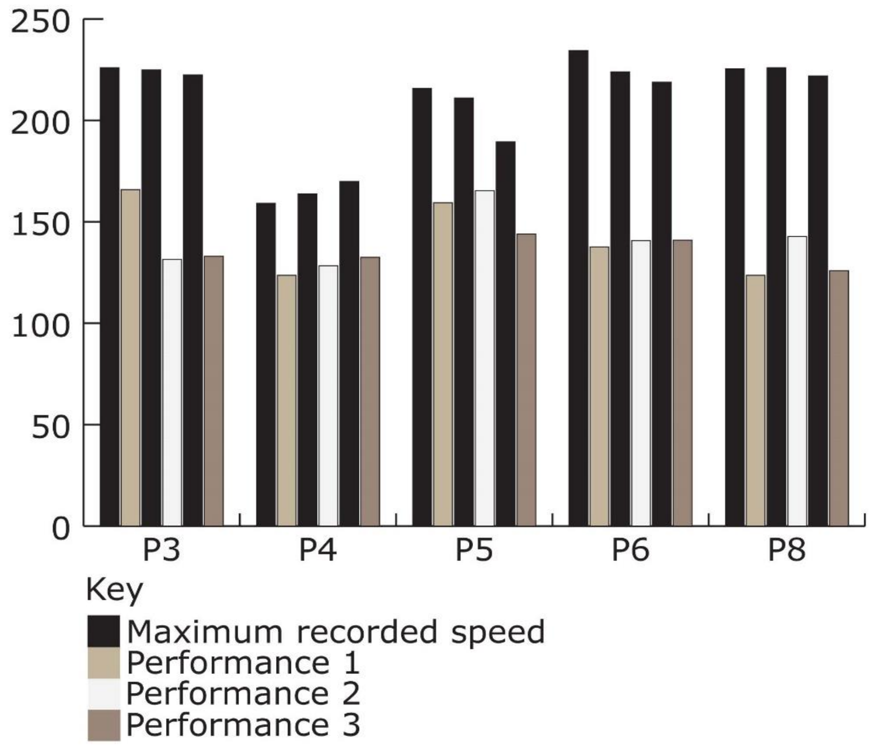


Figure 5-21:Maximum and average velocities of female participant throwing performances .

5.2.2 Maximum speed and performance duration.

The next analysis of wheel speed data is to view maximum wheel velocity alongside timings of throwing performances. Figure 5-22 exhibits data for maximum speed and performance timings. Maximum velocity data gradually reduces in measurement from P7 to the slower maximum velocity recorded by participant P4. Throwing performance data seems not to mirror maximum velocity data, 40% of participants log performances, far longer than maximum speed might predict. Participant P7, has the fastest maximum speed and the longest performance length. This occurs with two other participants, P8, and P10, where maximum velocities are placed in the centre speeds and performance lengths are longer than the participants data placed around them. P4 recorded the slowest maximum speed for this throwing performance, but not the longest performance duration. The X axis for Figure 5-21 displays participants in order of performance maximum velocity, P1 recorded the greatest velocity for throwing performance 1 and P4 logged the least maximum velocity. Y axis marks performance duration in seconds.

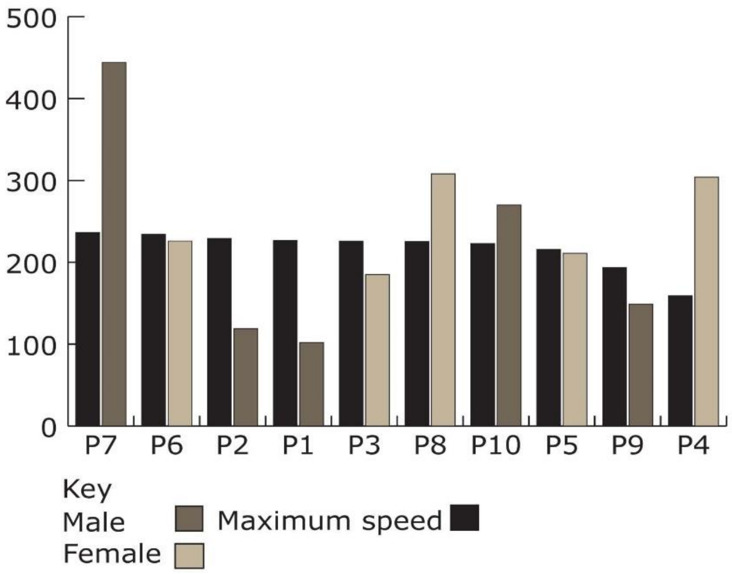


Figure 5-22:Throw 1 maximum speed and performance timings.

Throwing performance 2 was recorded as having similar maximum velocities to performance 1. Participant P2 logged the greatest maximum velocity and the shortest performance timing. whereas participant P4 registered the slowest maximum velocity and the longest timing for this throwing performance. Duration timings for performance 2 were not as lengthy as seen in throwing performance 1. Participants, throwing longer performance durations, P4, P7, P8 and P10, continued to throw shorter but longer duration performances. Participant P3 joined this group of participants. Figure 5-23 notes participants in order of maximum recorded velocity the greatest measured by participant P2 to the slowest maximum speed by P4. Y axis shows times of performances.

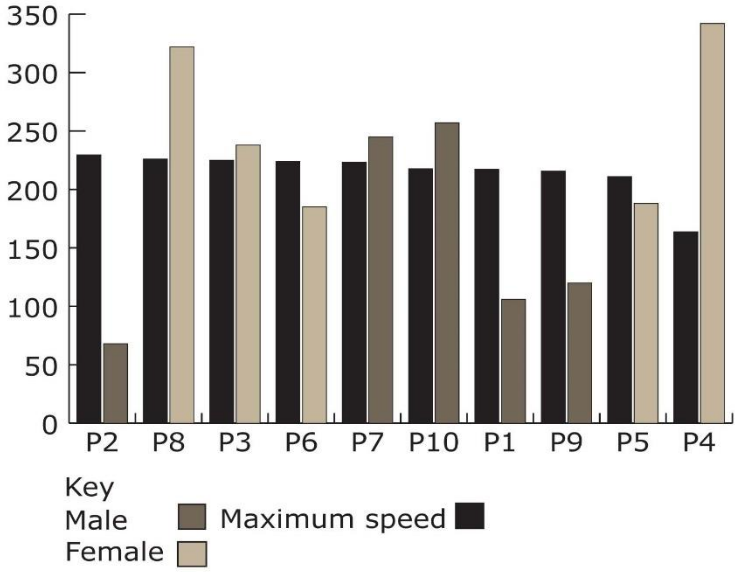


Figure 5-23:Throw 2 maximum speed and performance timings.

The third throwing performance records a similar pattern of maximum speed from, the greatest speed logged by participant P1, to the least maximum speed recorded by participant P4.

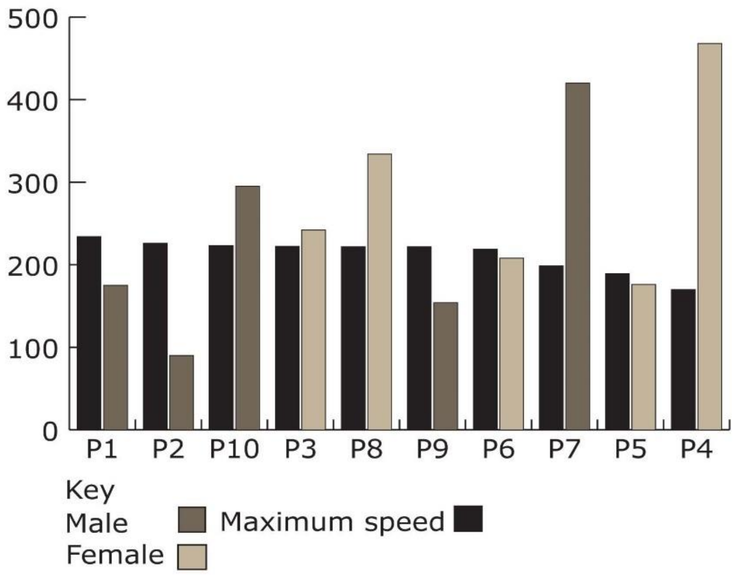


Figure 5-24:Throw 3 maximum speeds and performance timings.

5.2.3 Average speed of performance and duration.

Average speed of performance is marked in black and performance timing/duration is coded in colour. For the first performance, participant P3 recorded the greatest average speed for her performance. P7 logged the slowest average speed for his performance. 30% of participants had short performance duration, P1, P9 and P2. Participant P1 charted the shortest duration for a throwing performance. For this performance he had a high average speed, 2nd highest in the group, and a short performance time. The slowest average speed from participant P7 was combined with a long performance duration. Figure 5-25 displays participants along the X axis in order of greatest average speed from P3 to the slowest average speed from P7. The Y axis marks duration lengths in seconds.

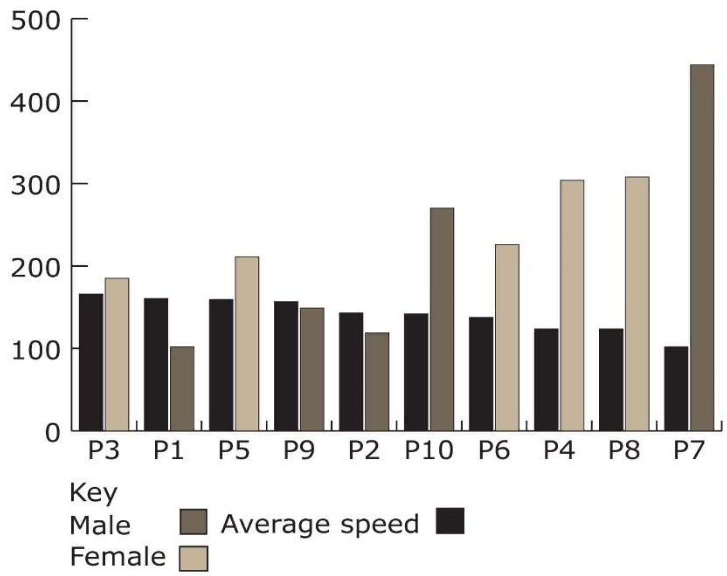


Figure 5-25:Throw 1: Comparison of average performance speed and performance duration.

The second throw had significantly quicker timings of performances, all timings were < 350 seconds. For this performance, Participant P9 had the greatest average speed and P4 the slowest average speed. The same three participants had short performance durations, P1, P2 and P9. Despite registering the fastest average speed, P9 did not register the shortest performance duration. P2 logged the shortest performance duration with a middle ranking average speed. Expectedly the slowest average speed from participant P4 resulted in the longest performance duration. Figure 5-26 presents data from the second throwing performance. The X axis marks average speed order from the quickest average speed from participant P1 through to the slowest average speed of P4. Y axis notes duration of the performance.

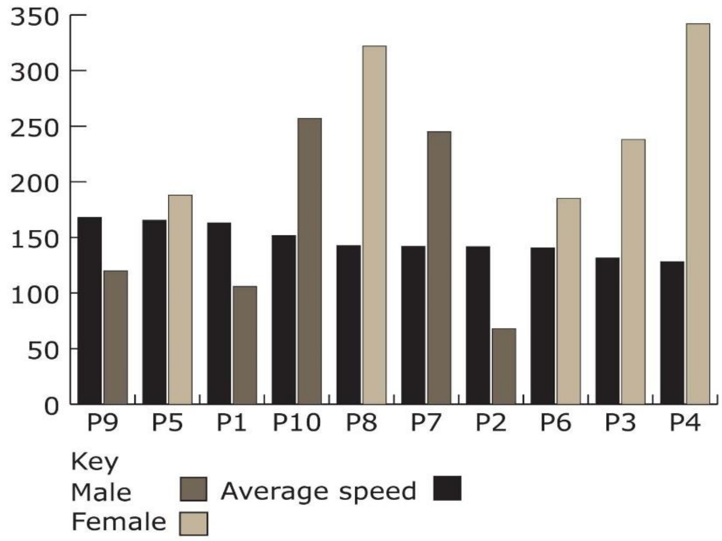


Figure 5-26:Throw 2 average performance speed and performance duration in seconds.

The third and final performance recorded longer performance timings. The participant with the greatest average speed was again P1 and the slowest average speed was participant P10. He did not register the longest duration, there were three participants with a longer duration time than his. Participant P4 had quicker average rotational speed but took longer to complete the throwing performance from start to finish. Figure 5-27 shows the average speed data compared with performance duration. The X axis presents the participants data in average speed order from greatest average speed from P1 to slowest average speed from participant P10. Y axis notes performance lengths in seconds.

A probable explanation for participant P4 having a middle registering average speed and a long duration, would be that perhaps P4 felt comfortable with the rotational speed but found issues with how her pot was forming or time was needed in the checking stage. There might have been repetitions of throwing routines, which delay the finish point of a throwing performance.

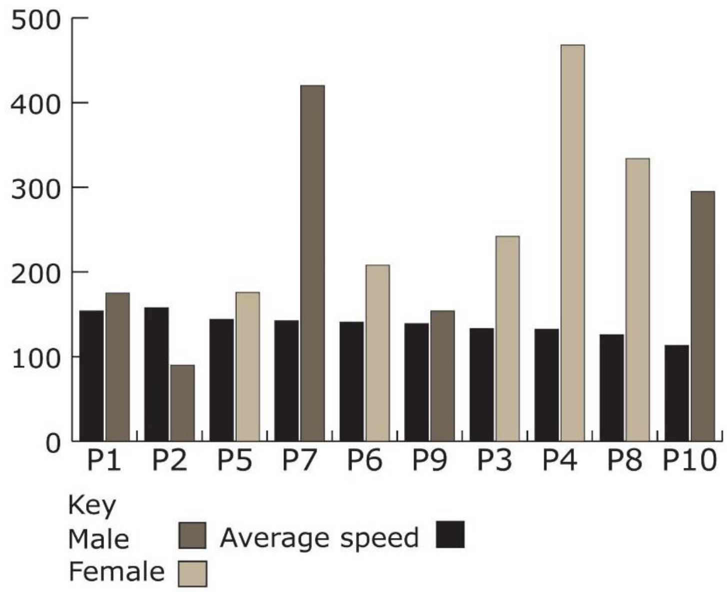


Figure 5-27:Throw 3 average performance speed and duration times.

5.3 Water evidence v performance duration

Figure 5-28 shows the number of water events compared with duration of the throwing performance. X axis displays participants having the least number of water events (P1) to P7 who recorded the greatest number of water events for performance 1. The Y axis marks the duration of performances in seconds.

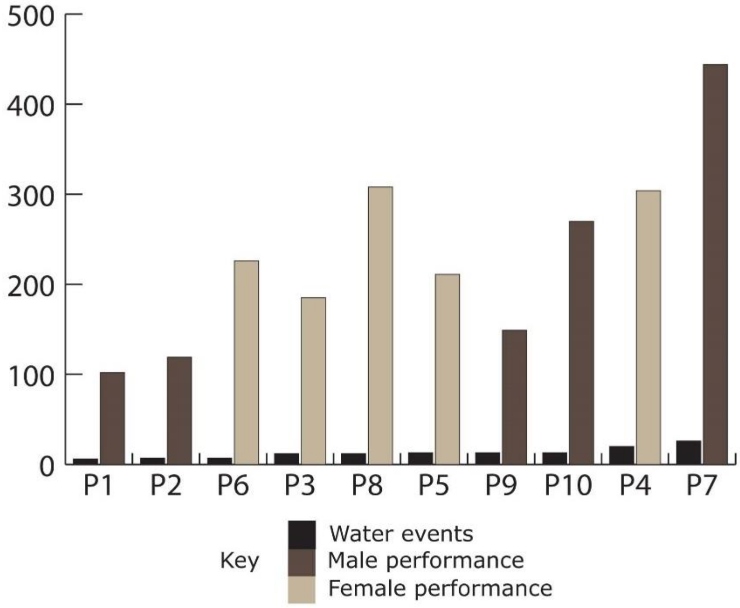


Figure 5-28:Water events and duration for performance 1.

Water events and duration of the second throwing performance is displayed in Figure 5-29. X axis shows participants ordered in number of water events during a throwing performance from the least, P9 to the greatest number of water events, P3. Y axis marks the duration of the throwing performance.

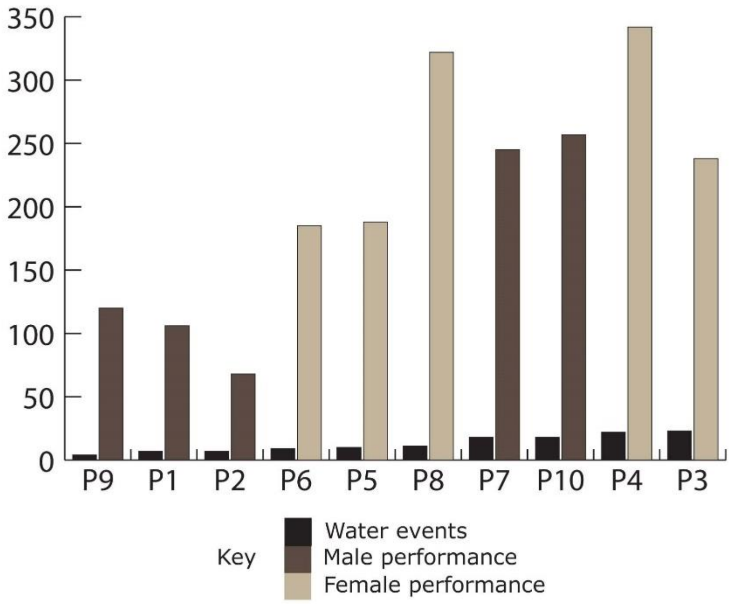


Figure 5-29:Water events and duration for performance 2.

Water events and duration of the second throwing performance is displayed in Figure 5-30. X axis shows participants ordered in number of water events during a throwing performance from the least, P9 to the greatest number of water events, P7. Y axis marks the duration of the throwing performance.

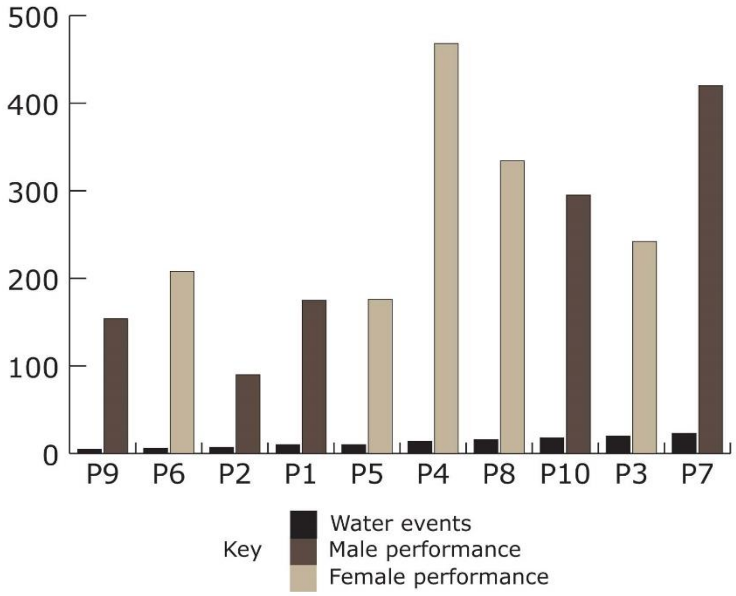


Figure 5-30:Water events and duration for performance 3.

From observing the throwing performances of the participants, water was added at key moments of a performance either before in preparation for manipulation or at the end of the sections before entering the next phase of the throwing performance. The interesting point to note is that the water events may serve two purposes

- to lubricate the clay to aid in the manipulation of the material
- as a thought gathering point.

While hands are busy distributing the lubricant water, the participants will be tacitly making decisions on the next point of action. Therefore, the water events act as punctuation within the throwing performances.

5.4 Summary

Chapter 5 has taken results from Chapter 4 and interrogated such relationships as stature and throwing performance duration. Chapter 6 will look at efficacy of research methods.

6 Research methods review

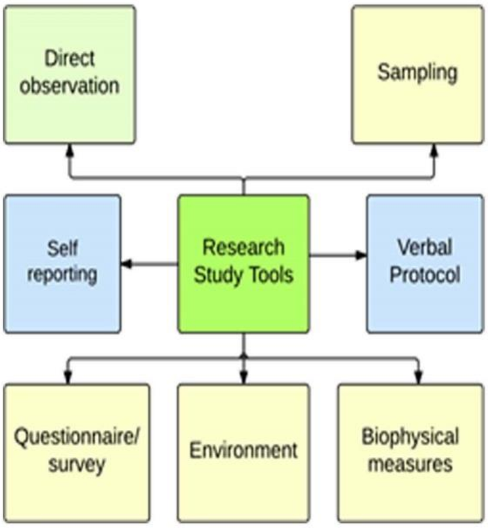


Figure 6-1:Research study tools.

This chapter provides a review of the study tools selected to be used in this study and discusses their efficacy. Figure 6-1 displays the tools to be reviewed. The first tools to be discussed are the qualitative tools of verbal protocol and self-reporting, followed by quantitative tools of sampling, biophysical measures, environment, and questionnaire survey. The observation tool was used as both a qualitative and quantitative tool.

6.1 Verbal protocol

The use of verbal protocol enabled the researcher to ascertain the knowledge of the design intent of the participant. All participants were able to outline the events to happen during the pot throwing performance prior to the performance. Some participants were more explanatory with the protocol than those who chose to be brief. Whether detailed or brief, each of the performances matched the participant verbal protocol. Therefore, the verbal protocol tool was satisfactory in achieving the information needed. However, with increased time allowance a strategy of semi–structured interview might elicit more detail and the opportunity to follow up appropriate points of interest.

6.2 Self-reporting tool

This tool was planned to enable participants to review the digital observational data and comment on what was seen. The researcher accompanied the participant whilst reviewing the performance. This in practicality, worked out differently. The researcher accompanied the participants during the review session and had explained what was required during this part of the participation. Participants were absorbed in observing the recorded data and thus made very few comments about their performance. Remarks were made, e.g. that this was the first time that they had seen themselves visually performing a throwing performance. Therefore, this unique element of viewing their performance had halted their ability to comment on their performance. Where the verbal protocol tool was successful, was in gaining observations during the data collection of P7 and P8 where both participants co-discussed each performance proffering views on events and the rational for these comments. The researcher has considered whether this would bias participants in their reflections of the throwing events; and has concluded that there were more insightful reflections made and discussed than being tacitly reflective.

6.3 Biophysical tools

Using anthropometry tools permitted an insight into the physical aspect of a practicing potter. Studies have neglected this aspect. Considering anthropometrical results from the participants of this study, the general assumption could rashly be made that most practicing throwing potters would be above average height, right-handed and long limbed. This assumption would need to be investigated on a greater number of the pot throwing population. The anthropometric measures worked well although with taking three separate measures each time. It was useful to see whether mistakes had been made with the differing (if only slightly) measurements. The participants were interested in how and why the hand measurements might be useful. However, this discussion did elongate the time spent with the participants within their working day. An expedient method might be in automated capture of measurements as this was business working time. Of the ten participants there were a number who scored over 90th percentile for anthropometrical measurements and one participant P4 who scored less than the 10th percentile for hand length. (See Figures 4-13 and 4-14). These results have implications. Firstly, the wheel size, which is generally standard (See Figure 4-3). Many of the participants have their own taller wheels as their production wheel, where they can transfer from standing to perching on a wheel seat. The height of the participant may be an issue here. The taller the participant the greater ease they may have in the transfer from standing to perching conversely the shorter participant would be stretching to reach the perch on the wheel. The physical strain potentially increased for the participants using the short Shimpo wheel as the research study wheel, there were no complaints. The strain increased with the descent to the height of the stool. An implication for these measurements would be comfort when throwing at the wheel. Most participants had modified the environments of their personal throwing wheels by the addition of extra attainable shelving within easy reach while performing. This feature would eliminate the need for excessive stretching. The Shimpo wheel had the standard limited features. The participants adapted the environment, to minimally accommodate a water bowl, some electing to place the water bowl away and across from the wheel thereby inducing a stretch of the upper torso combined with a twist (P8). Biophysical measures have an impact where equipment is standard and genderless therefore unwittingly potters may be increasing the likelihood of injury, the shortening of their throwing career though injury and lessening of economic rewards. There will be a safe length of time period potters should throw. This is generally unconsidered within Health and safety literature, which is confined to hazardous materials, and the lifting of heavy loads.

6.4 Hand preference

Handedness is discussed by (Forrester and Quaresmini, 2013) who concluded that handedness ‘ *and its origin in hemispheric brain organization*’, is not a new or human-unique characteristic, but rather a property developed through tool use, and a trait that was inherited from an ancestor common to both humans and great apes’. It can be linked to eyes and inconsistent dominance, a phenotypical left eye, a right writing hand against throwing hand (McManus and Porac, 1999) When throwing, a left-hand dominant thrower has a dilemma which may be solved with one of two present solutions. One solution is that the throwing pattern, of a left-hand preference thrower, copies the right-hand preference working patterns but with a certain amount of unease, not having a natural flow of movement. Another solution would be that the wheel head direction be changed to a clockwise direction of rotation where the individual would be working on the left side of the wheel and the clay would have a similar approach through the palms to the fingertip receptors

6.5 Grip strength

According to the study from Habibi, considering the grip and pinch strength of males aged between 20 and 34 years(Habibi and Kazemi, 2013) age is not a factor in lowering pinch and grip strength scores but workload and BMI parameters do have an effect. This study did not set out to include factors of BMI within its research methodology. It does recognise that age might not be a factor in declining grip and pinch strength as the research study was not designed to be longitudinal. (Angst *et al.*, 2010). Swiss pinch and grip data suggested in studies including ages 18 to 96, that average strength peaked for females at 35-44 years and men peaked at around 55-59. (Werle and Goldhahn, 2009). The study outcomes reflect the findings for most female participants that women have higher grip and pinch strength in their dominant hand, however one female participant (P6) has greater pinch strength in her non-dominant hand. The study reflects this paper by agreeing that the participant with having a left dominant hand grip lower than in the non-dominant hand or not at all. It concluded that right hand dominant grips had higher grip and pinch strength in their dominant hand. However, it also throws up a consideration of the definition of handedness. When looking at percentiles the evidence shifts sometimes from what appears to be a strong score; and is not when the results are compared with a much larger population.

6.6 Pinch grip strength

Where some participants score highly with their grip strength, their pinch strength has a different result. Participants must rely on their upper arm and hand strength to manipulate the clay during the throwing performance, where-as the pinch grip strength is less developed, as during the throwing performance the clay has been formed into a vessel and the pinch grip strength is used for fine tuning and checking rather than a great manipulation of material.

6.7 Hand temperature

Hand temperature remained steady between measurements, using the thermistor selected for the study. Had hand temperature been viewed as an important element of the study the data collection would have been designed in a different configuration.

6.8 Environmental tools

All participants participated within safe criteria for this research study. The environmental measures were confined to temperature of the workspace and to the temperature of the water needed within the throwing performance. The temperatures measured complied with the HSE guidelines. The guidelines are suggestions 'the working temperatures in all workplaces inside buildings shall be reasonable' (Health and Safety Executive, 2009)rather than strict measurements to adhere to. Most water temperatures were recorded within a similar range whereas Participants P8 and 10 recorded higher temperatures. Participant P10 made no comment on the temperature of the water. He was participating in the Workspace A; and might have accepted that this was the usual temperature of the water. Participant P8 explained that she was beginning to be troubled by arthritis therefore she found throwing easier with warmer water and cooler and cold water tended to restrict hand movement after lengths of throwing. The cold stiffens her joints and prevents fine motor movements (Elton and Nicolle, 2013). Each measurement fell within Health and Safety recommendations although the degree of lighting was not measured; all production wheels were placed near to a window for natural light.

During the research study participation good natural lighting was observed. The environment for working is in line with the Craft Council report 'Craft in an age of Change' (Yair *et al.*, 2012, p. 61), question MQ18 posed this question to craft practitioners, 'Where do you primarily carry out your practice?' This study mirrors responses for 'Formal workshop on home premises' closely. Where there is a difference is for both the 'HE Institution' and 'Other' where the study figures exceed the UK figure. Two participants work within Higher Education Institutions which is a larger figure than the Crafts Council study found. Three participants work in an established workplace therefore the 'Other' category was the appropriate category to align them with.

Table 6-1:Comparison of places of work with 'Crafts in an Age of Change'.

Place of work	UK figures	Study figures
Formal workshop on home premises	44.60%	40%
Individual workspace away from home rented	17.30%	10%
HE institution	0.50%	20%
Other	2.50%	30%

6.9 Observation tools

6.9.1 Qualitative Observation

Observation can be a complex area as the position of the researcher needs to be explicit from the outset.

For this study, the researcher endeavoured to be non-participatory (Cohen, Mannion and Morrison, 2007, p. 407; Bell, 2010, p. 191), within the period of observing all three throwing performances, as the throwing performances needed to be commonplace as possible, captured in a similar way to any other pot that might be thrown by a participant. However, many participants were interested and curious about the project, therefore, there was an occasional verbal observation made. It was also appreciated that the researcher was familiar with the working practices of a potter then the conversation elevated to an expert level where conversational terms would be understood. Collins discussed this level of expertise (see Ubiquitous expertise, Figure 2-30).The task of observation was made easier by the addition of support of an extra person to set up equipment and to fetch and carry the equipment and to provide practical support.

6.9.2 Quantitative observation

In order to reduce the variables in the observation of each throwing performance, the digital observation equipment use had been developed and rationalised through pilot studies. The protocol for charging the cameras after each use and clearing the memory cards worked well through good practice and there was never any issue with using the equipment This is discussed in Chapter 3 section 3.1.12. The placement of cameras was a variable as place of participation had assorted physical measurements and diverse configurations of furniture offering a variety of challenges. However, this was decreased with several participants sharing a space, therefore the number of installations was not as great as if there were ten differing participation spaces.

6.9.3 Observational Data

Designing that the observational data would be captured from two different angles, a validation of movements was possible because should there be some issue from one camera angle, the other camera data was able to compensate with an opposing angle. The findings from the study are reported mostly referring to the frontal view as this offered a more complete image of the whole event. Two cameras enabled the viewing of all four limbs and the movements, the wheel, and the clay material during the throwing performance.

The length of the throwing performances varied from the quickest throwing performance time of 68 seconds (secs) to the lengthiest time of throwing performance of 468 secs. The average time calculated of a throwing performance from all participants 231.7 secs. The average time calculated for a first performance, performed closely to the overall average with a time of 231.8 secs, where-as the second performance was less lengthy, averaging at 207.1secs and the third performance averaged at a lengthier time of 256.2secs. Rapid speed was not a requirement of the research task; thus, participants were not required to make the fastest performance. Speed of performance does have implications on work output, the faster the throw could potentially generate more physical pots at the end of a day's throwing production than a slower throw. Therefore, the throwing speed element was important to consider with industrial and commercial implications. With these implications in mind, the learning and acquiring safe throwing performance skills and behaviours have economic significance. This would be in terms of the day-to-day operations, to be injury free and for production career longevity.

From observational data, analysis was undertaken of the events involved in the throwing performance. This analysis relates to the length of the throwing performance, and the strategic elements involved. An increased number of events often relates to a longer throwing performance duration. This outcome does not consider the quality of the cylinder pot thrown. Although, the design outcome of a cylinder pot was checked, it was not ranked in assessment criteria. The greatest number of events had a relationship with the length of a performance. An interesting point to note was a consideration that the length of time each event lasted for each throwing performance. Events lasted between 1.47 seconds (P2 throwing performance 2) and 5.14 s (P4 throwing performance 3). The observational digital data garnered from the throwing performances was rich when analysed.

Wheel speed was a crucial aspect of the throwing performance that indicated the flow of the performance. The wheel speed, in manuals suggests speeds in terms of faster and slower as there is no visible speed indicator other than by eye and by touch. The terms faster and slower are subjective to an individual. The study quantified the wheel speeds (see section 5.1.5.1. discussing wheel speed).The method of collecting the data worked efficiently.

6.10 Sampling

Participants sampling was discussed in Chapter 3 section 3.1.14 The number of participants recruited within the time frame, although small, was a purposive sample of practitioners. All were active throwing participants. The purposive sample was selected for throwing attributes and replies to the online questionnaire survey. The participants were totally random when anthropometric measurements were analysed. The participant sample had gender equality. This equality was reflected in potential list of participants collected. The number of males was 247 to females 244. One issue which was considered was that of participant bias where there were some participant data collection sessions where participants had grouped together for practical reasons. This occurred twice the first time the participants freely commented about their throwing styles the comparison with that of the other participant, which incidentally led to some rich data. The second potential session, opportunity for bias was without explicit bias with each participant commenting on their own performance review. There was evidence of transference of knowledge of skills, P5 and P6 had been influenced by P3 and some elements of the throwing style had transferred across the participants. There had been reported discussions about the reasons for the throwing style.

6.11 Questionnaire Survey

The questionnaire survey was a small population- based survey questionnaire. Approximately 8% of the contactable pot throwing craft population. The intention for the survey questionnaire, was that it would harvest rich data from practitioner potters, and that some of the respondents may well be included as part of the main study. Although the return was 40% successful, the author realises that the canvased population is too small to make generalised conclusions or general assumptions. However, it did reveal the individual nature of the craft from the variety of responses made for the survey questions. The terms potters give themselves seem not to include maker p42. The outcomes from the questions were discussed in section 4-1. The narrative response questions gave fruitful comments to the narrative questions.

The questionnaire survey was complemented by the Crafts Council survey Craft in an Age of Change (Yair, Burns et al. 2012). The findings from the questionnaire were discussed in section 4-1, should participants have come to Loughborough to participate, rather than the researcher visiting them in their place of work, recruitment and cost would have been prohibitive.

6.12 The Literature Review strategy

A structure was designed to undertake a systematic literature review, in an economic and effective manner. This structure could be used in future research in either a larger study, and expanded to more than one researcher, or in a small bespoke study. The structure allows the monitoring of the literature, to be reviewed, for quality. The literature review structure; recognises both paper and digital format literature. Digital format literature was not confined to textual literature.

The Literature Review described in a narrative fashion the literature available concerning art, craft and design skills focussing on pot throwing. It was found that the literature concerning directly the pot throwing process to be subjective in nature and if the whole range was read, confusing in technique. It is recognised that a reader would find a comfortable style to read. There was a paucity of peer – reviewed academic literature concerning craft skills or equipment. Thus, the landscape of the literature review needed to be enlarged and academic literature was found that could be appropriate to certain points of the skill. For example, academic papers concerning arm movements were found within Biomechanics and Sports and Science literature.

6.13 Mixed methods

Some studies lend themselves to a complete qualitative or quantitative structure of investigation and analysis. However, for this study, a single structure of investigation would not have answered the research question. The sole use of an interview tool would have potentially given a subjective analysis result. A case study may have offered deep insight into the throwing methods of a selected potter, or selected potters, but the case studies might not have proffered a complete picture of the throwing process. Conversely a purely quantitative study would have not given a complete view either. It would have been potentially a restricted view of the throwing process concentrating simply on the physical aspects. Employing the use of a mixed method framework ensured that the valuable data from both the qualitative and quantitative tools was then able to be analysed. The data collection outcomes showed that there was a plentiful harvest of data from the observation of the throwing performances. One point to consider for future work is to consider the recording of multidimensional movement as the software was excellent at capturing and analysing movement in one plane, but it was much less easy to capture and portray multi directional movement. A purely quantitative study would have had data analysed without the benefit of any views of the participants. The research method selected combined both qualitative with quantitative methods in a mixed methodology. The Framework for Integrated methodology was considered as a structure for this study; however, the fit was not quite as exact, therefore an alternative bespoke design was formulated.

6.14 Summary

> '*Throwing has something of magic in it. The unbelievable happens before your eyes'.*
>
> (Clark, 1970)

This postgraduate study has sought to review elements involved in a craft skill. The selected craft skill focus was the pot throwing of a 1kg cylindrical vessel. Chapter 1 set the context of the study in Art, Craft and Design. It illuminated economic developments within the creative industries. It was felt that this study had value in terms of exploring inclusivity also terms of time economy and efficiency of transmitting a craft skill, ergonomically taking heed of personal body safety.

Craft can be defined as intelligent making. It is technically, materially, and culturally informed. Craft is the designing and making of individual artefacts or objects, encouraging the development of intellectual, creative, and practical skills, visual sensitivity and a working knowledge of tools materials and systems. (NSEAD, 2013)

This study acknowledges that educationally, the art, craft and design curriculum has been in decline for some time. Therefore, any art, craft or design skills must be taught effectively and economically, in a timely manner, within a tiny fraction of the timetable by teachers who might not be specialists within the area.

Despite the decline in the uptake of these creative subjects due to the introduction of the EBACC, and therefore a reduction and decline in the teaching of these skills within compulsory and optional education; tertiary education is still managing to recruit students to courses. These courses are moving away from traditional crafts to more digitally enhanced art, craft, and design. The question arises of the placing of this study within this changing landscape. From the commencement of this research there has been further decline in time provision for Art, Craft and Design education. The prevailing view seems that STEM subjects are to be nurtured at the expense of others.

As the Creative sector is flourishing within a tough economic climate, this study continues to have validity. Therefore, there will be a need for the most economic and effective interface for craft skills to be transmitted and acquired by any student wishing to learn a craft skill. Nostalgia, although this might not be the exact term, may also play a part in recruiting potential craft students, especially with pot throwing students, as some may have seen the pot throwing interlude on television (see 3.3.7 p63).Psychological wellness and anti-stress needs of society today have renewed interest in crafts Therefore, interested people may wish to experiment and try their hand at such a craft skill.

6.14.1 Limitations of the study.

There are many limitations that can impact a research study.

- A small research team, a team of one plus an aide for moving equipment.
- Participants having a limited time opportunity for contributing to the data collection.
- The sample size was diminutive, although data was rich.
- There were no previous studies completed and published in the research area.
- Visiting participants in their place of work, travelling time for the researcher.

Had the study used one site for observing participants visual data would have been more regular. The cost of recruitment would have been larger than funds available.

6.15 Conclusion

Research methods and methodology have been reviewed in this chapter. The tools were for the most part well chosen, except for the self-reporting strategy. The main adverse effect for the study was that potters rarely if ever capture themselves working. Therefore, the participants were caught up in the novelty of watching themselves throw. They did express an interest in seeing other potters throw. The aim for this section of data collection was to garner some thoughts of self-reflection. Results were not as rich as anticipated. Where the strategy worked was when two participants participated in the same studio. At review time they both watched and discussed performance points together. Thus, an improvement might be to have small groups discussing performances.

7 Pot throwing: An investigation.

This chapter addresses the research aim, the objectives and the questions posed in chapter 1. Firstly, providing an amplified understanding of a pot throwing performance for both novice and experienced pot throwers and the question 'What exactly happens when a potter throws a pot'.

This has been explored through observation of throwing performances (see chapters 4 and 5). Observations made and digitally recorded were analysed for performance events, key sections, use of water, for body posture wheel speed and length of performance. These critical and systematic analyses have offered evidence for what happens as a potter throws a pot on the potter's wheel.

7.1 A described throwing performance.

To enhance and further demonstrate, a scenario is offered, a description based on evidence from analysis.

An expert potter goes to a potter's wheel with the design intention of throwing a cylinder pot. The clay has been wedged previously in preparation. The clay material has been sectioned off into 1kg portions. The expert potter will shape the clay, into a rough sphere (P1, P2, P4, P7, P8, P9 and P10) or into a cone shape (P3, P5, P6). In either case these expert potters know that the material will centre more easily if clay is 'streamlined'.

The potter then has a short period of pre performance preparation. They have a choice of pre-performance preparations. Some potters touch the clay, by patting (P2, P7, P10) or by grasping (P4, P5) or by holding (P6).

Pre-performance routines are known in sport psychology and training of enhancing physical performance. They get athletes focussed on task relevant information, preventing the athlete from 'devoting too much attention to the mechanics of the skill which can affect automaticity' (Moran, 1996). Pre-performance routines should be short and simple, easy to do and under the individuals' control (Cohn, 1990).A pre-performance routine, is learned behaviour and cognitive strategies to facilitate a physical performance This provides time to gather focus on the task to be undertaken, in this example a 1kg cylinder pot. Pre-performance routines are personal and tacit in their influence.

From patting, grasping, or holding the clay material, tacit mental preparations occur. Sensory messages are already assessing what may be needed, the state of the clay, moisture, malleability the temperature. Participant P8 performed a different ritual. This was to rinse her fingers immediately before starting her throwing performance. There were two potters who appeared not to perform any rituals, preferring to go straight into a throwing performance, participants P1 and P9.

The next action is to get the clay to the wheel. Some participants used the method of placing the clay on the wheel head,(Clark, 1970; Bates, 1981). Participants P1, P2, P3 P6, P8, P9 and P10 demonstrated this method in each of their throwing performances. A slam down method (Mattison, 2003) was performed by participants, P4 and P5. A method advocated by Leach (1976) and McErlain (2002), a throw down approach was used by participant P7 where the clay ball is thrown down onto the wheel head.

The wheel motor mechanism is engaged in this particular example the motor, but it could be a self-propelled kick wheel.

The clay arrives on the wheel head and the first activity for all participants was the addition of water, by hand, a splash, before engaging with the clay material. The water acts as lubrication between the surface of the palm of the hand, the thenar and hypothenar eminences of the hand (see Figure 2-18). The interaction between clay material and machine begins with a rapid acceleration of rotational velocity (section 4.9 and Figure 4-46) For the centring routine,(section 4.6.2 and Figures 4-28, 4-29 and 4-30) hands start to manipulate the clay ball or cone shape in an upwards and downwards motion in order to align the clay particles (Section 2.27 and Figure 2-13). All participants demonstrated this motion. Water was then added at during or at the end of this sub-routine, before opening up of the clay mass (Figures 4-65, P1 and 4-66, P6). Opening up then commences

(Section 4.6.3 and Figures 4-31, 4-32, 4-33), where a hole is made in the rotating streamlined, centred mass of clay, by thumbs (Leach, 1976; McErlain, 2002; Phethean, 2012) or by the use of fingers (Colbeck, 1969; Casson, 1985; Mattison, 2003). The hole is then enlarged water may then be added, dependent on the plasticity of the clay, to the desired width of the base of the pot. The base of the cavity, the hole is then pressed (Phethean, 2012). The base is consolidated, this action was used by all participants with the exception of P2 who continued into the Pulling up of the walls sub-section. Those who consolidated the base of the pot continued with making a cone shape (Section 4.6.4. and Figures 4-34, 4-35, and 4-36) as the initial start to raising the walls of the pot (Figure 2-12). The cone shape (Phethean, 2012) is used as a tool to prevent the walls from extending laterally and widening too far to make a cylinder shaped pot.

The performance continues into the pulling up of the walls (Section 4.6.5 and Figures 4-37, 4-38 and 4-39) the walls of the pot are pulled a multiple of times (Bates, 1981; Casson, 1985; Mattison, 2003) by working the fingertips of Digits 1 and 2 of the left hand and either the knuckle of Digit 1 or the fingertips of Digits 1 and 2 against each other either side of the wall of clay. Exerting the correct amount of pressure to achieve the refinement and height of the pot walls according to design intent. The wheel speed is slower at this point (Figure 4-48). Part of the pulling up sub routine is the collaring of the pot, performed by participants P1, P4, P5, P7, and P9. Participants P2, P8 and P10 performed the collaring routine inconsistently only when necessary. The other routine which frequently occurred was consolidating the rim of the pot. This routine would provide strength to the edge, the lip of the pot as clay particles would be compressed and smoothed so as to have no sharp irregular edges. All Participants performed this action. An extra routine providing punctuation to the performance, was the action of tidying the foot of the pot, this involved the removal of extraneous clay. Participants P1, P2, P4, P7, P8 and P9 used this strategy regularly, during the pulling up part of the performance. Participants P3, P5, and P6 performed this action during the checking section of the pot throwing performance. Participant P10 did not tidy the foot of each of his performance pots. Tidying the foot provides a practical purpose of removing extraneous unwanted clay away from the pot which would prevent even drying out and potentially cause cracking thus, spoiling the pot. It also shortens 'turning' time of the pot where in a hardened state the foot of a pot can be refined to present a good finish.

The checking of the thrown pots (Section 4.6.6 and Figures 4-40, 4-41 and 4-42) while still on the wheel was performed as part of the throwing performance by participants P3, P4, P5, P6 and P8, all female participants.

Once satisfied the pot was then removed from the wheel (Section 4.6.7 and Figures 4-43, 4-44, and 4-45) by wiring the base sometimes lifted away and sometimes floated away from the wheel on a film of water to an awaiting board. And performance complete.

This description has used evidence and literature to justify points in a pot throwing performance. Understanding of the throwing process through the throwing performance has been enhanced with the capturing of the throwing performances of the participants from two angles. The collection tool of having two data collection camcorders capturing the throwing performance was profitable. Even data collected despite some of the camcorder positional angles were cramped and close (P2).

Task analysis of the visual data through event logging has proved to be insightful. The process was to take an original event list from a Microsoft Excel spreadsheet, where the elements of the list were itemised. The second part of the analysis process was to code, by colour, the key points within the performance. This enabled a viewing of the coding across all the performances (See Appendices Fa, Fb, Fc and Fd).

Analysis and comparisons were made between participants where one had few of events and one had more events during a key period of the throwing performance. This enhanced the ability to detect what exactly was happening during the performances.

However, this analysis misses explaining the differences in duration of the pot throwing performances.

In this purposively sampled group of participants there are physical differences between each participant (Section 4.4), gender and age differences. Identical physical apparatus, the same wheel used for each throwing performance the same stool for each performance, mostly personal choice of clay if not a well-known generic throwing clay and an expert group of potters. Chapter 5 discusses anthropometrical physical measurements on the throwing performances, stature (Section 5.1.1), shoulder breadth (Section 5.1.2), upper limb length (Section 5.1.3) and wrist breadth (Section 5.1.4). Nothing suggested that any measurement was optimum for a throwing performance. Anthropometrical hand measurements were equally discussed in Chapter 5, hand length, hand breadth and the measurement of the thumb saddle to the tip of Digit 2 (Section 5.1.5). Broader hand breadths can make narrow cylinder pots, P9.

Hand preference was of interest, there was a societal spread of right- and left-hand preference within the group of participants, 90% right hand and 10% left hand. (Coren, 1992). Participant P7 was the left-handed participant. His performance times were lengthier than other male participants. He chose to throw on a right-handed setting of the wheel. The wheel rotates in an anti-clockwise direction where the clay passes through hands from left to right. Anatomically, the clay passes through the most receptive part of the hands, the fingertip pads, providing dense sensory information and an individual can adjust finger positions in nano amounts of time. P7 has a complex line of communication to decode and transfer from left hand to right hand. For a right-handed potter, the dominant hand is operating on the outside of the pot adjusting pressure on the left-hand digits to manipulate the clay material into the desired design. P7 operates with his dominant hand inside the pot and his non-dominant hand on the exterior. Movement and pressure messages would then need to be translated from a left-handed direction to a non-dominant hand direction to a right-handed direction, which may cause the delay in performance duration. P7 was working far harder cognitively than the rest of the participants. A possible future research investigation could be to inquire as to whether right-handed expert throwers would be similarly disadvantaged if they performed on a clockwise rotating wheel, and left-handed throwers more time efficient. A further future enquiry could be to investigate cognitive loading between right and left-handed throwers and a familiar and unfamiliar rotational direction.

Maximum wheel velocity and average performance speed (Section 5.2.3) were investigated for anomalies. Some participants (P9) threw at a lower rotational speed than others and completed the design intent of a cylinder pot.

Body posture provided interest in physical terms the legs provided stability and support for the upper body. With a number of participants, one leg, usually the left leg, remained static where-as the right leg flexed to allow for change in upper body posture. The upper limbs were stabilised by the legs with the right arm being tucked into the right groin during the centring stage to give the added stability to centre the clay, the more support given is dependent upon the weight of the clay. Four participants were selected as examples of lower limb movement, P2, P3, P7 and P10. All participants performed their throws on the same potter's wheel, yet leg movements vary. Participants P2 and P3, made minimal posture changes (see Figures 4-70 and 4-71). Their statures were 170cm for P2 and 178.5cm for P3. This should have indicated different posture changes. The lower limbs were not measured for this study. Both used their lower limbs for balance and support. Participant P10 changed right lower limb posture more than his left (See Figure 4-72). His left lower limb was confined by other equipment. Participant P7, (see Figure 4-73), changed both lower limb postures frequently. A reason for this would be balance. The positioning of the lower leg was behind the knee as if in a slight crouch position. Participants P2 and P3 had their lower legs positioned in slightly front of their knees. This posture offers more strength and stability. A differently sized potter's wheel may have offered more visible comfort to participant P7.

Body posture was considered for upper limbs (Section 4.11.1) and lower limbs (Section 4.11.2). For upper limb positioning two participants were selected, both throw similar length performances, P2, 119 sec, 68 sec and

90 sec, and P9, 149 sec, 120 sec and 154 sec but amount of arm movements were different. Figure 4-68 illustrates the movements of participant P2, compared with Figure 4-67 which exhibits the upper limb movements of participant P9. Participant P2 was measured with the shortest male stature (170 cm), P9 was taller 185cm. Based on stature and the same potter's wheel, throwing performances were no dissimilar. When other physical factors are involved e.g. the breadth of shoulders and the length of arm, reasons become apparent for the extra arm movements from P9. Participant P2 recorded a shoulder breadth of 49cm over P9 measuring 43.05cm. P2 measured 76.25cm for upper limb length whereas, P9 measured a longer 81cm.These facts would enable P2 to have a wider shorter wide-based 'triangle' of upper limb movement, as there was less need to position elbows and limb length. Participant P9 had a narrower based 'triangle' of upper limb movement with more length to control. Should the potter's wheel been differently sized the arm movement patterns would have been different for both participants.

7.2 Key elements within a pot throwing performance.

Basic Key elements are the physical processes involved in throwing a pot such as:

- Centring,
- Opening up,
- Pulling up walls,
- Checking pots and,
- Removing pots from the wheel.

Explanations for the physical parts of the performance can be accessed thought paper and digital means and are easily available. Key pointers for educators, novices and experienced potters may include the areas of understanding:

- Preparation both physically and mentally. Being prepared for the throwing performance with equipment ready. Being mentally prepared, through using pre-performance preparation activities.

- Material properties of clay. Different recipes and formulas for refined clay are used for differing purposes. The physical tactile properties of clay will offer information about the readiness for clay activities, too cold, too dry, too plastic will inform decisions about making.
- An understanding of the impact of water on clay material. Too much or too little will make an impact on a physical throwing performance.
- Forces, velocity, and centrifugal force, to understand moments of too little or too much of potential impact, at certain key moments of a throwing performance.
- Good body posture to provide stability and balance.

Timing and body posture, in ergonomic and safe way, that throwing for a long duration in a similar position will cause muscular and joint body strain and will shorten the economic life of an individual. Speed of performance has implications, economically and physically. Economically, the faster the throw the greater the output for a potter and greater the income. Physically, the faster the throw could limit economic viability with a shortened career. damage to the potter’s throwing tool, the body, but this could be marred, and output reduced by increased bodily injury from repeated, damaging repetitive movements. With these implications in mind, the learning and acquiring of safe throwing performance skills and behaviours have economic significance. This would be in terms of the day-to-day operations to be injury free and for production career

7.3 Decision making.

Increased understanding of decision-making Part of the design decision-making was exemplified within the throwing performance, at the water adding points at the end of key throwing performance sections. It appeared that participants used the end of section water adding events, not only to add lubrication, the amount needed resulting from sensory input, but also to perform a review and change event. The end-of-section watering moments were seen at the end of a centring section, a cone making section and at the end of the opening-up section. Water usage proved an interesting series of events within a throwing performance. There are two possible foci for these events.

- The purely physical aspect of the sensory detection and feedback.
- A decision-making point between phases of the throwing performance.

7.4 Contribution to knowledge

The researcher considers that the key contribution to knowledge is through the method by which the pot throwing performance was captured. The structure of performance capture and digitally recording throwing performances from two angles provided rich data for analysis. This is completed by a selected suite of analysis tools imposed on the visual data. Tools which allowed the viewing of the data frame by frame.

- Capturing images from prior performance, which ordinarily would have been dismissed as inconsequential, these pre-performance actions are viewed as pre-performance routines, recognised as important in sports psychology (Cohn, 1990; Jowett and Lavallee, 2007) . The pre-performance routines indicate tacit, implicit actions preparing for the physical and mental performance of pot throwing. These actions are not necessarily noticed by those involved outside sport but when scrutinised and analysed they are recognised as important. They also serve as a time for sensory data gathering as the clay is patted or held.
- Micro reflection, water application serves a double aim firstly one of lubrication between the interface of potter and material but also the application serves as a punctuation mark, a micro time of reflection before the next main activity. This event usually occurs opening up or pulling up of the walls.
- Micro reflection, tidying the foot, times of tacit and heuristic decision making viewed in pulling up routines. This event is repeated suggesting that the function is more than just practical. Participant P5

used this action as purely practical, suggested by the placement in the throwing performance, within the last five actions/events of the performance. Participants P7 and P10 used the 'tidy foot' event in two performances (P7) and one performance (P10). The remaining participants used the tidying foot action as a micro-moment of reflection.

The structure and style of data collection could be transferable to other scenarios where material and individual and equipment combine to form an object e.g. weaving, glassblowing, textiles, woodcraft, papercraft.

The audience for this research would be those who are actively engaged in pot throwing whether novice or expert and educators. Researchers studying methods of data capture, and those who are interested in crafts.

7.5 Future work

This study could be developed and extended into future research projects. Extension possibilities include:

- An investigation into pressures exerted on the clay material to form it into a cylinder pot. This would inform industry about further developing an increased handmade sensation to their wares.
- Further biomechanical studies observing the twisting, stretching, and turning of the torso, for prevention of injuries.
- An investigation into a development of a truly ergonomic potter's wheel which can be adjustable for all physical dimensions of users.
- Development of a 'dashboard'/speedometer to indicate speed of rotation, and possibly including indications for optimum speeds for throwing a pot. A tool for learning with novices and enhancing skills for expert potters.
- Developing a 'good practice' bank of throwing styles for reference. The participants in this study expressed an interest in this project.

This study could aid craft skills in developing countries, using the visual digital capturing of performance, and by utilising the list of key elements in a craft performance.

Figure 7-1 shows ten samples of 1kg cylinder pots of the 30 pots created by the expert participant potters.

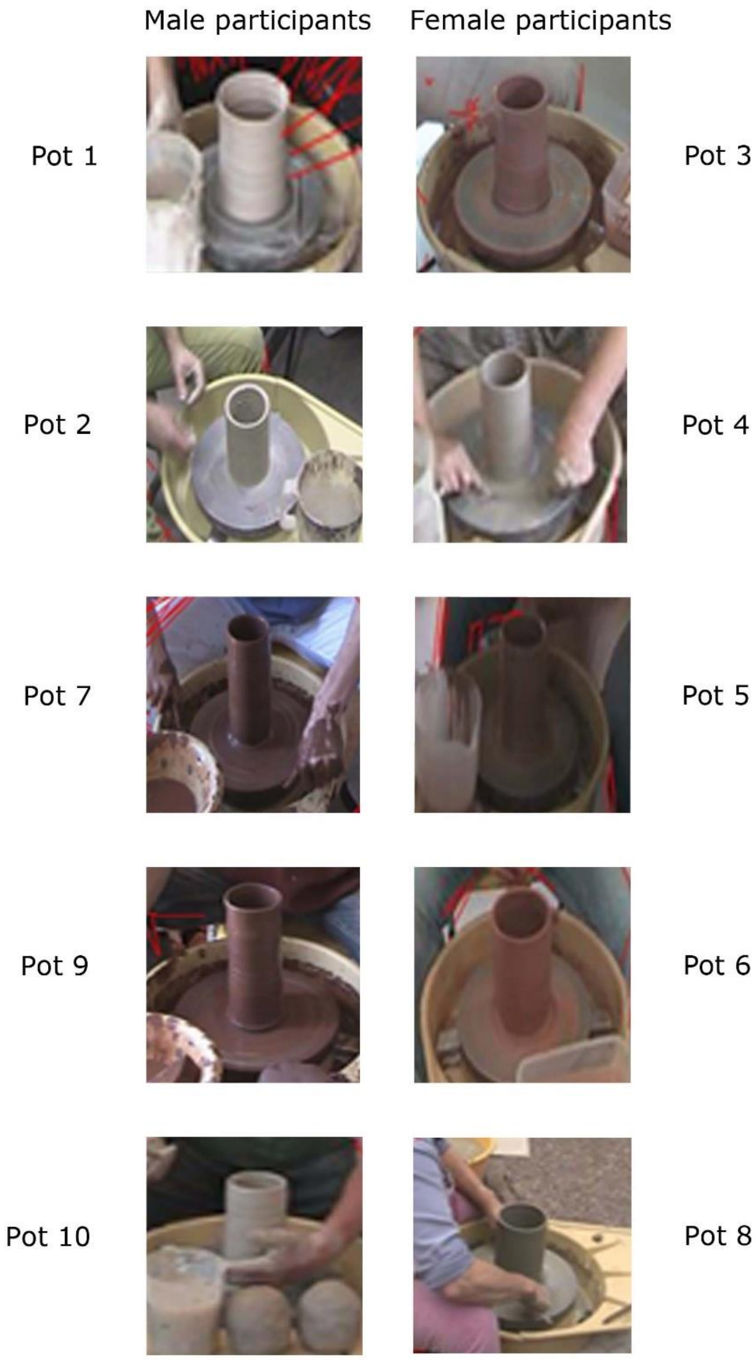


Figure 7-1:Ten 1kg cylinder pots.

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Appendix A: Ethics Clearance Checklist.

Ethical Clearance Checklist

(TO BE COMPLETED FOR ***ALL*** INVESTIGATIONS INVOLVING HUMAN PARTICIPANTS)

If your research is being conducted off-campus and ethical approval has been granted by an external ethics committee, you may not need to seek full approval from the University Ethical Advisory Committee. However you will be expected to provide evidence of approval and the terms on which this approval has been granted.

If you believe this statement applies to your research, please contact the Secretary of the Ethical Advisory Committee for confirmation.

If your research is transferring into Loughborough University and approval was obtained from your originating institution, there is a requirement on the University to ensure that appropriate approvals are in place.

If you believe this statement applies to your research, please contact the Secretary of the Ethical Advisory Committee with evidence of former approval and the terms on which this approval has been granted.

It is the responsibility of the individual investigators to ensure that there is appropriate insurance cover for their investigation.

If you are at all unsure about whether or not your study is covered, please contact the Finance Office to check.

Section A: Investigators

Title of Investigation Craft skills: A study investigating the explicit and tacit skills and knowledge involved in a craft process, focussing on the pot throwing process in order to inform an inclusive approach to teaching and learning a craft skill.

Name, Status and Email Address of Senior Investigators (University Staff Research Grade II and above):

George Torrens, Lecturer, g.e.torrens@lboro.ac.uk Loughborough Design School David Scott, Lecturer, d.scott1@lboro.ac.uk School of the Arts, Loughborough **Department:** Loughborough Design School

Name, Status and Email Address of Other Investigators (other University Staff and Students):

Georgina Palmer, Postgraduate Research Student(Y3), g.r.palmer@lboro.ac.uk

Department: Loughborough Design School

A1. Do investigators have previous experience of, and/or adequate training in, the methods employed?

Yes X ☐ **No**† †If **No**, Please provide details below

A2. Will junior researchers/students be under the direct supervision of an experienced member of staff? YesX ☐ **No**† †**If No**, Please provide details below

A3. Will junior researchers/students be expected to undertake physically invasive procedures (not covered by a generic protocol) during the course of the research?

Yes† ☐ No X †If **Yes**, Please provide details below A4. Are researchers in a position of direct authority with regard to participants (eg academic staff using student participants, sports coaches using his/her athletes intraining)?

Yes† ☐ No X †If **Yes**, Please provide details below **If you have selected one of the answers above marked with an † please provide additional information on how you intend to manage the issues (please continue onto a separate sheetif**

required), then submit this checklist to the Secretary to the EAC:

Section B: Participants

Vulnerable Groups

Will participants be knowingly recruited from one or more of the following vulnerable groups?

B1. Children under 18 years of age	**Yes**# ☐	No X(pl
B2. People over 65 years of age	**Yes**#	No X
B3. Pregnant women	**Yes**# ☐	No X
B4. People with mental illness	**Yes**# ☐	No X
B5. Prisoners/Detained persons	**Yes**# ☐	No X
B6. Other vulnerable group (please specify)	**Yes**# ☐	No X

If you have answered 'No' to questions B1-B6, please now go to Section C

 # If the procedure is covered by an existing generic protocol which

Chaperoning Participants

If appropriate, e.g. studies which involve vulnerable participants, taking physical measures or intrusion of participants' privacy:

B7. Will participants be chaperoned by more than one investigator at all times?

Yes X **No*** **N/A**† †**If N/A,** please provide details below B8. Will at least one investigator of the same sex as the participant(s) be present throughout the investigation? Yes X **No*** **N/A**† †**If N/A,** please provide details below

B9. Will participants be visited at home?

Yes* No X **N/A**† †**If N/A,** please provide details below

*** Please submit a full application to the Ethical Advisory Committee.**

If you have selected one of the answers above marked with an † please provide additional information on how you intend to manage the issues (please continue onto a separate sheet if required), then submit this checklist to the Secretary to the EAC:

Section C: Methodology/Procedures

To the best of your knowledge, please indicate whether the proposed study:

C1. Involves taking bodily samples **Yes**# No X(please refer to pub

C2. Involves procedures which are likely to cause physical, psychological, social or emotional distress to participants **Yes**# No X

C3. Is designed to be challenging physically or psychologically in any way (includes any study involving physical exercise) **Yes**# No X

 # If the procedure is covered by an existing generic protocol, please insert reference number here

If the procedure is not covered by an existing generic protocol, please submit a full application to the Ethical Advisory Committee

C4. Exposes participants to risks or distress greater than those encountered in their normal lifestyle

Yes* No X

C5. Involves collection of body secretions by invasive methods **Yes*** No XC6. Prescribes inta

manipulation/supplementation **Yes*** No X

C7. Involves testing new equipment **Yes*** No X

C8. Involves pharmaceutical drugs

Chaperoning Participants

If appropriate, e.g. studies which involve vulnerable participants, taking physical measures or intrusion of participants' privacy:

B7. Will participants be chaperoned by more than one investigator at all times?

Yes X **No*** **N/A**† †**If N/A,** please provide details below B8. Will at least one investigator of the same sex as the participant(s) be present throughout the investigation? Yes X **No*** **N/A**† †**If N/A,** please provide details below

B9. Will participants be visited at home?

Yes* No X **N/A**† †**If N/A,** please provide details below

*** Please submit a full application to the Ethical Advisory Committee.**

If you have selected one of the answers above marked with an † please provide additional information on how you intend to manage the issues (please continue onto a separate sheet if required), then submit this checklist to the Secretary to the EAC:

Section C: Methodology/Procedures

To the best of your knowledge, please indicate whether the proposed study:

C1. Involves taking bodily samples **Yes**# No X(please refer to pub

C2. Involves procedures which are likely to cause physical, psychological, social or emotional distress to participants **Yes**# No X

C3. Is designed to be challenging physically or psychologically in any way (includes any study involving physical exercise) **Yes**# No X

 # If the procedure is covered by an existing generic protocol, please insert reference number here

If the procedure is not covered by an existing generic protocol, please submit a full application to the Ethical Advisory Committee

C4. Exposes participants to risks or distress greater than those encountered in their normal lifestyle

Yes* No X

C5. Involves collection of body secretions by invasive methods **Yes*** No XC6. Prescribes inta

manipulation/supplementation **Yes*** No X

C7. Involves testing new equipment **Yes*** No X

C8. Involves pharmaceutical drugs **Yes*** No X(please refer to published guidelines)

E4. For children under the age of 18 or participants who have impairment of understanding or communication:

- will consent be obtained (either in writing or by some other means)?

Yes **No*** N/A X

- will consent be obtained from parents or other suitable person?

Yes **No*** N/A X

- will they be informed that they have the right to withdraw regardless of parental/ guardian consent? Yes **No*** N/A X

E5. For investigations conducted in schools, will approval be gained in advance from the Head- teacher and/or the Director of Education of the appropriate Local Education Authority

Yes **No*** N/A X

E6. For detained persons, members of the armed forces, employees, students and other persons judged to be under duress, will care be taken over gaining freely informed consent?

Yes **No*** N/A X

*** Please submit a full application to the Ethical Advisory Committee**

Deception

E7. Does the study involve deception of participants (ie withholding of information or the misleading of participants) which could potentially harm or exploit participants?

Yes No X If **No**, please go to Section F

If yes,

E8. Is deception an unavoidable part of the study? Yes **No***

E9. Will participants be de-briefed and the true object of the research revealed at the earliest stage upon completion of the study? Yes **No***

E10. Has consideration been given on the way that participants will react to the withholding of information or deliberate deception? Yes **No***

*** Please submit a full application to the Ethical Advisory Committee**

Section F: Withdrawal

F1. Will participants be informed of their right to withdraw from the investigation at any time and to require their own data to be destroyed?

Yes X **No***

*** Please submit a full application to the Ethical Advisory Committee**

Section G: Storage of Data and Confidentiality

Please see University guidance on Data Collection and Storage

G1. Will all information on participants be treated as confidential and not identifiable unless agreed otherwise in advance, and subject to the requirements of law?

Yes X **No***

G2. Will storage of data comply with the Data Protection Act 1998?

(Please refer to published guidelines) Yes X **No***

G3. Will any video/audio recording of participants be kept in a secure place and not released for use by third parties? Yes X **No***

G4. Will video/audio recordings be destroyed within six years of the completion of the investigation?

Yes X **No***

G5. Will full details regarding the storage and disposal of any human tissue samples be communicated to the participants?

Yes X **No***

*** Please submit a full application to the Ethical Advisory Committee**

Section H: Incentives

H1. Have incentives (other than those contractually agreed, salaries or basic expenses) been offered to the investigator to conduct the investigation?

Yes† No X †If **Yes**, Please provide details below

H2. Will incentives (other than basic expenses) be offered to potential participants as an inducement to participate in the investigation?

Yes† No X †If **Yes**, Please provide details below

If you have selected one of the answers above marked with an † please provide additional information on how you intend to manage the issues (please continue onto a separate sheet if required), then submit this checklist to the Secretary to the EAC:

Section I: Work Outside of the United Kingdom

G1. Is your research being conducted outside of the United Kingdom?

Yes No X

If **Yes**, you may need additional insurance cover/clearance for your research.

Appendix A: Ethics Clearance Checklist.

Section I: Declarations

Checklist Application only:

If you have completed the checklist to the best of your knowledge without selecting an answer marked with an * or †, your investigation is deemed to conform with the ethical checkpoints and you do not need to seek formal approval from the University's Ethical Advisory Committee.

Please sign the declaration below, and lodge the completed checklist with your Head of Department or his/her nominee.

Declaration

I have read the University's Code of Practice on Investigations on Human Participants. I confirm that the above named investigation complies with published codes of conduct, ethical principles and guidelines of professional bodies associated with my research discipline.

Checklist with additional information to the Committee:

If, upon completion of the checklist you have **ONLY** selected answers which require additional information to be submitted with this checklist (indicated by a †), please ensure that all the information is provided in detail and send this checklist to the Secretary to the EAC.

Full Application Needed:

If on completion of the checklist you have selected one or more answers which require the submission of a full proposal please download the relevant form from the Committee's web page.

A copy of this checklist, signed by your Head of Department should accompany the full submission to the Ethical Advisory Committee.

Signature of Responsible Investigator G.R. Palmer

Signature of Head of Department or his/her nominee ………………………… Date 14/5/12

………………………………………

Appendix B: Loughborough University Health Screen.

Appendix B Loughborough University Health Screen

As a volunteer participating in a research study, it is important that you are currently in good health and have had no significant medical problems in the past. This is (i) to ensure your own continuing well-being and (ii) to avoid the possibility of individual health issues confounding study outcomes.

Please complete this brief questionnaire to confirm your fitness to participate:

1. **At present,** do you have any health problem for which you are:
   - (a) on medication, prescribed or otherwise .... Yes ☐ No ☐
   - (b) attending your general practitioner .... Yes ☐ No ☐
   - (c) on a hospital waiting list .... Yes ☐ No ☐
2. **In the past two years,** have you had any illness which required you to:
   - (a) consult your GP .... Yes ☐ No ☐
   - (b) attend a hospital outpatient department .... Yes ☐ No ☐
   - (c) be admitted to hospital .... Yes ☐ No ☐
3. **Have you ever** had any of the following:
   - (a) Convulsions/epilepsy .... Yes ☐ No ☐
   - (b) Asthma .... Yes ☐ No ☐
   - (c) Eczema .... Yes ☐ No ☐
   - (d) Diabetes .... Yes ☐ No ☐
   - (e) A blood disorder .... Yes ☐ No ☐
   - (f) Head injury .... Yes ☐ No ☐
   - (g) Digestive problems .... Yes ☐ No ☐
   - (h) Heart problems .... Yes ☐ No ☐
   - (i) Problems with bones or joints .... Yes ☐ No ☐
   - (j) Disturbance of balance/coordination .... Yes ☐ No ☐
   - (k) Numbness in hands or feet .... Yes ☐ No ☐
   - (l) Disturbance of vision .... Yes ☐ No ☐
   - (m) Ear / hearing problems .... Yes ☐ No ☐
   - (n) Thyroid problems .... Yes ☐ No ☐
   - (o) Kidney or liver problems .... Yes ☐ No ☐
   - (p) Allergy to nuts .... Yes ☐ No ☐
4. **Has any,** otherwise healthy, member of your family under the

age of 35 died suddenly during or soon after exercise? .... Yes ☐ No ☐

If YES to any question, please describe briefly if you wish (eg to confirm problem was/is short-lived, insignificant or well controlled.)

....

....

1. **Allergy Information**

(a) are you allergic to any food products? Yes ☐ No ☐

(b) are you allergic to any medicines? Yes ☐ No ☐

(c) are you allergic to plasters? Yes ☐ No ☐

If YES to any of the above, please provide additional information on the allergy

....6.

Additional questions for female participants

(a) are your periods normal/regular? .... Yes ☐ No ☐

(b) are you on "the pill"? .... Yes ☐ No ☐

(c) could you be pregnant? .... Yes ☐ No ☐

(d) are you taking hormone replacement therapy (HRT)? Yes ☐ No ☐

7. Please provide contact details of a suitable person for us to contact in the event of any incident or emergency.

For Loughborough school of the Arts participants only

Name: ....

Telephone Number:...

Work ☐ Home Mobile

Appendix C: Participant information sheet.

Appendix C Partipant information sheet

Craft skills: A study investigating the explicit and tacit skills and knowledge involved in a craft process, focussing on the pot throwing process in order to inform an inclusive approach to teaching and learning a craft skill.

Participant Information Sheet Name, Georgina Palmer, Postgraduate Research Student Email: g.r.palmer@lboro.ac.uk Tel. no. 01509 226978

Name, George Torrens, Lecturer, Loughborough Design School Email: g.e.torrens@lboro.ac.uk Tel. no. 01509 222664
David Scott, Lecturer, School of the Arts, Loughborough Email: d.scott1@lboro.ac.uk, Tel. no. 01509 228955

What is the purpose of the study?

The purpose of this study is to study investigate the explicit and tacit skills and knowledge involved in a craft process, focussing on the pot throwing process in order to inform an inclusive approach to teaching and learning a craft. This will be through background questionnaires, video movement analysis of the process, audio analysis of commentary looking for pertinent key points about the process. This will inform teaching and learning approaches to craftwork, which can then make the process universal to all who might wish to throw a clay pot.

Who is doing this research and why?

Georgina Palmer, a doctoral researcher with Loughborough Design School will be undertaking the study under the supervision of George Torrens and Dave Scott.

This is a department funded study, one of a developing series of investigations into craft processes. This study is part of a Student research project supported by Loughborough University,

Are there any exclusion criteria?

The project is bounded by, age limits, potters aged between 18 years and 65 years.

The other limitations are on frequency of throwing. Potters are required to throw frequently.

Once I take part, can I change my mind?

Yes! After you have read this information and asked any questions you may have we will ask you to complete an Informed Consent Form, however if at any time, before, during or after the sessions you wish to withdraw from the study please just contact the main investigator.

Will I be required to attend any sessions and where will these be?

There is a choice in place of participation, either *Loughborough School of the Arts* or your *own studio/workplace.*

How long will it take?

It is anticipated that the actual practical session will take no longer than 2 hours duration. The background questionnaire, should take less than 15 minutes.

Is there anything I need to do before the sessions?

It is anticipated that participants complete an online background questionnaire prior to participating in the practical session. Is there anything I need to bring with me?

You might like to bring your completed questionnaire if you have not returned it online. What type of clothing should I wear?

If you have selected to participate in Loughborough, you will need your clothing worn when throwing Who should I send the questionnaire back to?

The questionnaire can be returned 3 ways

In person

By email to g.r.palmer@lboro.ac.uk

By post to Georgina Palmer

Loughborough Design School Loughborough University Loughborough Leicestershire LE11 3TU

What will I be asked to do?

Whether, the participation in the project; is in the workplace or at Loughborough School of the Arts. Your hands will be measured for anthropometric data e.g. width of palm, length of fingers etc.

The temperature of your hands will be taken with a thermistor.

Participant potters will be asked to throw a maximum of three cylindrical pots using a 1kg ball of clay for each pot, using a provided wheel, so that speed while throwing can be measured.

There will be a familiarisation time for those potters choosing to participate in Loughborough School of the Arts.

- The participant potter will need to prepare the clay for these pots.
- First throwing will be an initial practice throw so as to fine tune recording equipment.
- Second and third throwing will be without tools, with or without a commentary, from the potter, of what is happening within the process.

The throwing process will be video recorded along with any commentary made on the events, by 2 positioned cameras e.g. a front view and a side view. There may be some still photography taken during the event.

The throwing performances will be reviewed. The participation will then be finished.

What personal information will be required from me?

The information requested in the background questionnaire will ask general personal data.

Are there any risks in participating?

There are no anticipated risks when participating in this study.

Will my taking part in this study be kept confidential?

Confidentiality will be observed through a coded format procedure. All participants will not be identified by name either within the study or in any publications resulting from this study.

What will happen to the results of the study?

The data collected from this study will be stored securely for a maximum of 10 years as stated in Loughborough University Data Collection and Storage guidelines.

What do I get for participating?

It is possible that there might be a copy available of your throwing practice available for you, should you request.

I have some more questions who should I contact?

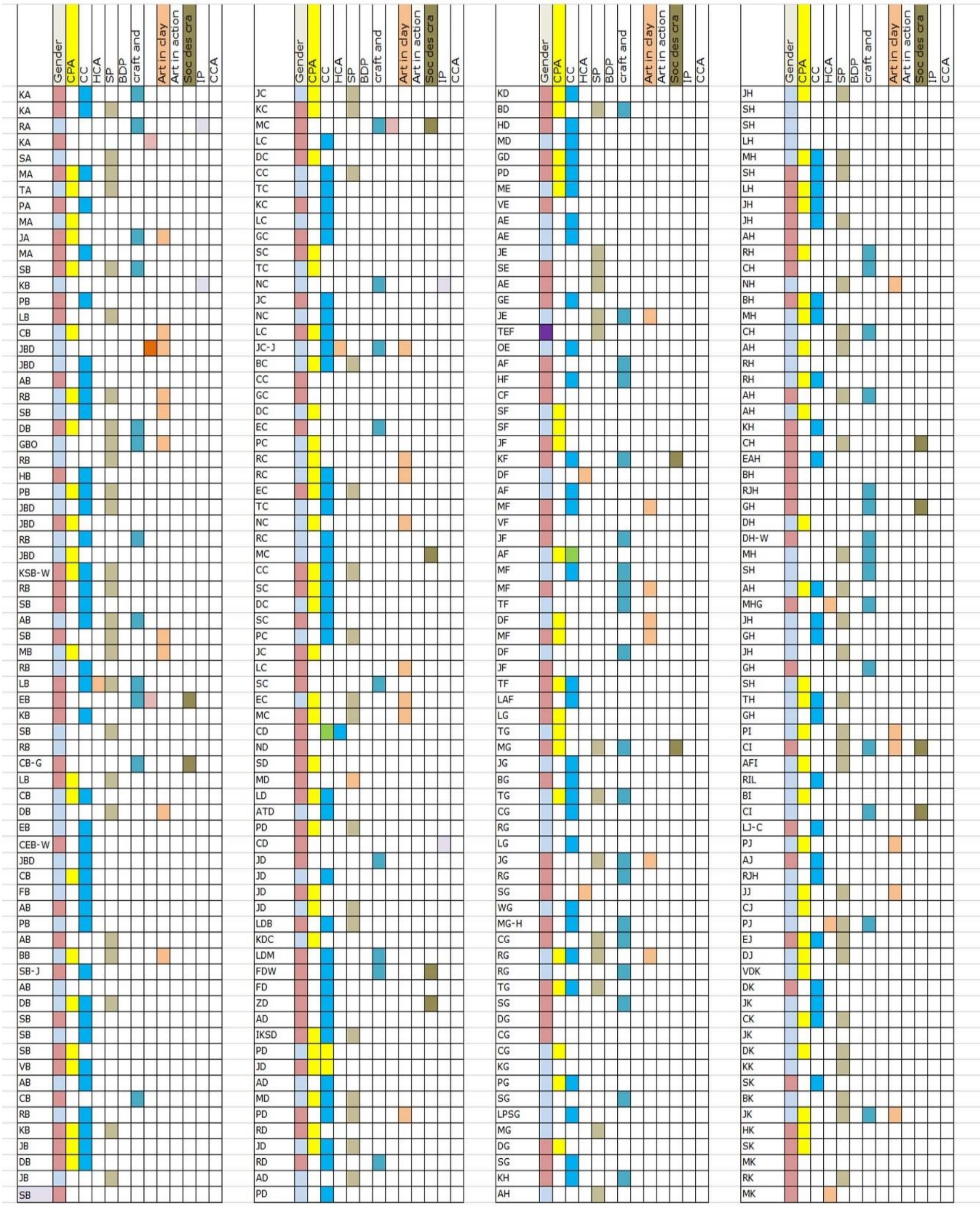
Please contact either:

Georgina Palmer by email: g.r.palmer@lboro.ac.uk or tel: 01509 222783
George Torrens by email: g.e.torrens@lboro.ac.uk or tel: 01509 222664
Dave Scott by email: d.scott1@lboro.ac.uk or tel: 01509 228955

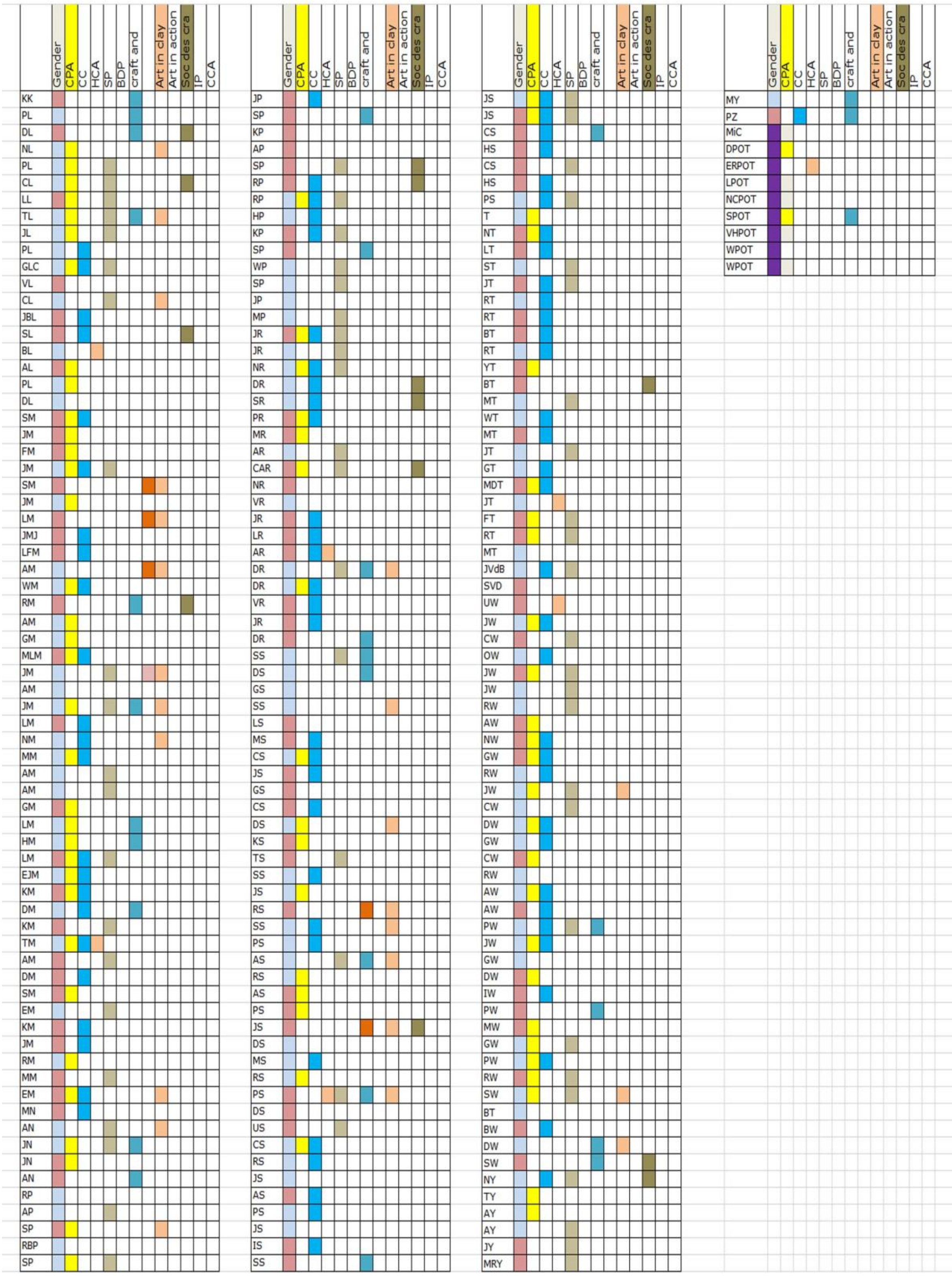
What if I am not happy with how the research was conducted?

The University has a policy relating to Research Misconduct and Whistle Blowing which is available online at http://www.lboro.ac.uk/admin/committees/ethical/Whistleblowing(2).htm.

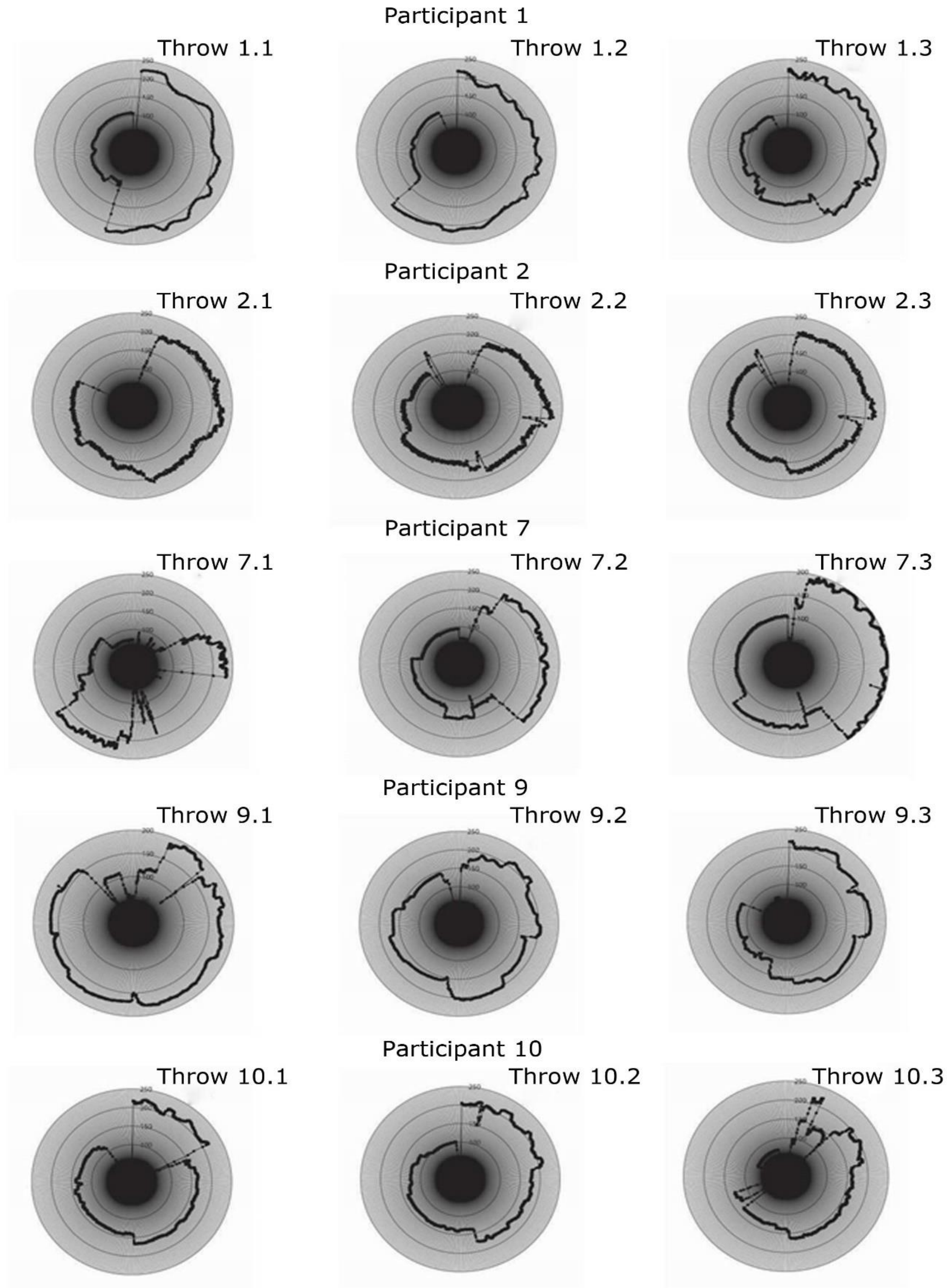
Appendix D: Potter data.



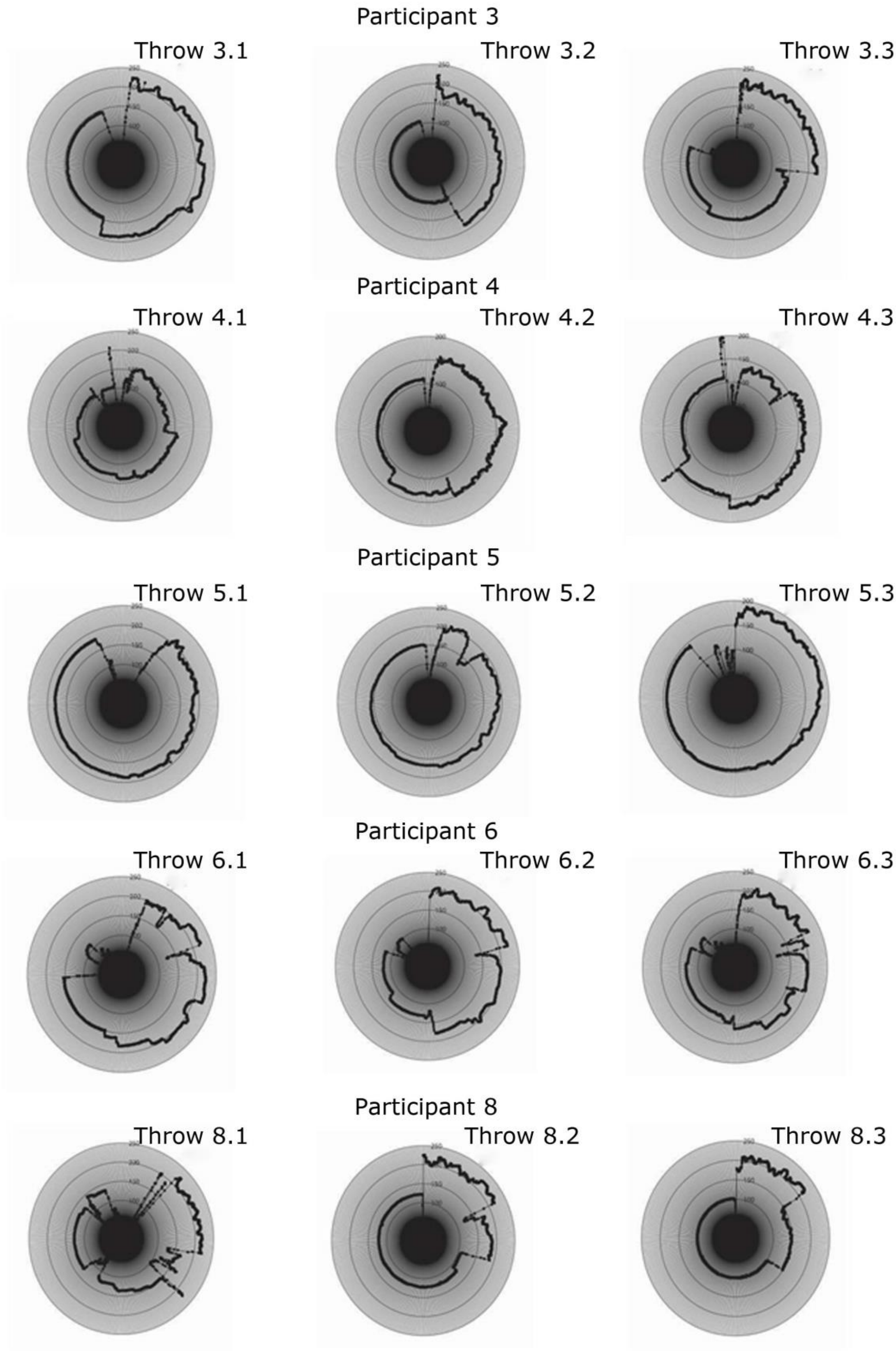
Appendix D: Potter data.



Appendix E: Male and Female Radar charts of throws.



Appendix E: Male and Female Radar charts of throws.



Appendix Fa: Event detail, P1, P2, P7.

Participant 1			Participant 2			Participant 7		
Ball of clay onto wheel	Ball of clay onto wheel	Wheel moving	Clay on wheel	Clay on wheel	Clay on wheel	Clay in hand	Clay in hand	Throw clay
Start wheel	Start wheel	Ball of clay onto wheel	Pat clay side	Push clay forward	Start wheel	Pat Clay	Clean wheel	Decrease speed
Water	Water	Water	Pat clay top	Fingertip push clay	Add water	Stop patting clay	End clean wheel	Pat Clay on wheel
Manipulate clay up	Manipulate clay up	Manipulate clay up	2 hand pat	Start wheel	Smooth ball	Hold clay	Throw clay	Stop patting clay
Manipulate clay down	Water	Water	Pat clay top	Add water	Manipulate down	Throw clay	Start wheel	Add water
Water	Manipulate clay down	Manipulate clay up	Start wheel	Smooth ball	Manipulate up	Start wheel	Decrease speed	Centring
Making hole	Manipulate up	Manipulate down	Add water	Manipulate up	Manipulate down	Stop wheel	Pat Clay on wheel	Speed increase
Opening up	Manipulate down	Water	Centring	Manipulate down	Add water	Start wheel	Stop patting clay	Add water
Compressing base	Water	Water	Smooth ball	Add water	Manipulate up	Pat Clay on wheel	Add water	Manipulate clay up
Finish compressing base	Making hole	Manipulate down	Manipulate down	Manipulate up	Manipulate down	Stop patting clay	Add water	Add water
Add water	Opening up	Making hole	Manipulate up	Manipulate down	Manipulate up	Water hand	Centring	Manipulate clay down
Make cone	Compressing base	Add water	Manipulate down	Manipulate up	Manipulate down	Add water	Speed increase	Add water
Add water	Finish compressing base	Opening up	Add water	Manipulate down	Manipulate up	Centring	Add water	Manipulate down
Collar pot	Add water	Compressing base	Manipulate up	Manipulate up	Add water	Add water	Manipulate clay up	End down
Add water	Start cone	Finish compressing base	Manipulate down	Add water	Manipulate up	Manipulate clay up	Change hand positions	Add water
1st pull	Make cone	Add water	Manipulate up	Manipulate down	Tidy foot	Hands off	Add water	Add water
Collar pot	Compress rim	Start cone	Manipulate down	Manipulate up	End tidy foot	Add water	Manipulate clay down	Manipulate down
Add water	Add water	Make cone	Manipulate up	Manipulate down	Add water	Manipulate clay up	Add water	Stop manipulation down
2nd pull	Tidy foot	Compress rim	Tidy foot	Manipulate up	Make hole	Hands off	Add water	Add water
Change speed	1st pull	Add water	End tidy foot	Tidy foot	End hole	Add water	Manipulate down	Manipulate down
2nd pull	Add water	Tidy foot	Add water	End tidy foot	Check pot	Manipulate down	Add water	Stop manipulation down
Collar pot	Collar pot	1st pull	Make hole	Add water	End check pot	Stop manipulation	Manipulate up	Tidy base
Tidy foot	Compress rim	Collar pot	End hole	Make hole	Add water	Add water	Manipulate down	Stop tidy base
3rd pull	Add water	Add water	Check pot	End hole	Pull 1	Manipulate down	Stop manipulation down	Add water
Compress rim	Tidy foot	Compress rim	End check pot	Check pot	End pull	Palm press down	Add water	Manipulate down stance
Grab sponge	2nd pull	Collar pot	Add water	End check pot	Add water	Stop palm press	Manipulate down	Add water
Dry out pot	Collar pot	Tidy foot	Pull 1	Add water	Pull 2	Add water	Tidy base	Manipulate down stance
Tidy wheelhead	Get rib	2nd pull	End pull	Pull 1	End pull	Manipulate down	Stop tidy base	End
Dry out pot	Tidy foot	Collar pot	Add water	End pull	Add water	Stop	Add water	Make hole
Grab Wire	3rd pull	Add water	Pull 2	Add water	Pull 3	Wheel stop	Make hole	Stop hole
Slide near to far under po	Pot collapses	Tidy foot rib	End pull	Pull 2	Change hand position	Wheel start	Stop hole	Add water
Pot lifted away	Pot lifted away	open rim	Add water	End pull	End pull	Add water	Open up	Make hole cont
Wheel moving	Wheel moving	2nd pull rib	Add water	Add water	Pull 4	Manipulate down	end open up	End
		Add water	Pull 3	Pull 3	End pull	Stop manipulation down	Fingertip water	Open up
		Collar pot	End pull	Change hand position	Consolidate rim	Add water	Open up	Add water
		Get rib	Check wall	End pull	End consolidation	Change hand positions	Decrease speed	end open up
		3rd pull	Pull 4	Pull 4	Tidy foot	Add water	Open up	Add water
		Consolidate rime	End pull	Change hand position	End tidy foot	Manipulate up	Add water	Dry inside pot
		Wheel stop	Consolidate rim	End pull	Wheel stop	Change speed up	Base work	End dry inside pot
		Get wire	End consolidation	Collar	Cheesewire	Add water	Stop base work	Decrease speed
		Lift pot from wheel	Tidy foot	Consolidate rim		Manipulate up	Decrease speed	Base work
			End tidy foot	End consolidation		Change shape of top	Add water	Stop base work
			Wheel stop	Tidy foot		End top shape	Make cone	Decrease speed
			Cheesewire	End tidy foot		Add water	End cone	Add water
				Wheel stop		Manipulate down	Add water	Add water
				Cheesewire		Add water	Pull 1	Make cone
						Manipulate up	Stop	Add water
						Manipulate down	Speed decrease	Pull 1
						Change hand positions	Base add water	Stop
						Add water	Pull 2	Add water
						Flatten	Base add water	Manipulate rim
						End flatten	End pull	End manipulation
						Make hole	Add water	Base add water
						Add water	Consolidate rim	Collar pot
						Open up	End consolidation	End collar
						end open up	Dry inside pot	Pull 2
						Add water	End dry inside pot	End pull
						Decrease speed	Wall add water	Rinse fingers
						Add water	Check base	Decrease speed
						Open up	End check base	Add water walls
						Decrease speed	Pull 3	Hand to wall
						Add water	End pull	Pull 3
						Make cone	Decrease speed	End pull
						End cone	Add water	Consolidate rim
						Add water	Check rim	End consolidation
						Add water	Add water	Add water
						Decrease speed	Consolidate rim	Add water
						Dip fingers	End consolidation	Pull 4
						Pull	Check wall	Change hand positions
						Stop	End check wall	End pull
						Add water	Check wall	Add water
						Pull	End check wall	Add water
						End pull	Consolidate rim	Pull 5
						Consolidate rim	End consolidation	Change hand positions
						End consolidation	Pull 4	End pull
						Base add water	End pull	Consolidate rim
						Tidy base	Cheesewire pot	End consolidation
						End tidy base	Dry inside pot	Add water walls
						Base add water	End dry inside pot	Pull 6
						Add water		Change hand positions
						Pull 2		End pull
						End pull		Consolidate rim
						Consolidate rim		End consolidation
						End consolidation		Tidy foot
						Decrease speed		End tidy foot
						Add water		Dry inside pot
						Pull 3		End dry inside pot
						End Pull		Cheesewire pot
						Check rim		Stop wheel
						Consolidate rim		Lift pot
						End consolidation		
						Tidy base		
						End tidy base		
						Check base		
						End check base		
						Dip fingers		
						Cheesewire pot		
						Stop wheel		
						Lift pot		

1.

Appendix Fb: Event detail, P9, P10.

Participant 9			Participant 10		
Start wheel	Start wheel	Start wheel	Clay placed	Clay placed	Clay placed
Clean wheel	Place clay on wheel	Place clay on wheel	Start wheel	Start wheel	Pat clay
Tidy loose clay	Water hand	Manipulate clay up	Add water	Stop wheel	End pat clay
Place clay on wheel	Manipulate clay up	Manipulate clay down	Smooth ball	Start wheel	Start wheel
Water	Manipulate clay down	Make a dip	Manipulate clay up	Add water	Stop wheel
Manipulate clay up	Make a dip	Water	Add water	Increase speed	Add water
Manipulate clay down	Water	Making hole	Manipulate clay up	Smooth ball	Wet clay
Manipulate clay up		opening up	Add water	Manipulate clay up	Start wheel
Manipulate clay down	Making hole	Compressing base	Manipulate clay down	Add water	Add water
Make a dip	opening up	Start cone	Add water	Manipulate clay down	Increase speed
Water	Compressing base	Make cone	Manipulate clay up	Add water	Add water
Making hole	Finish compressing base	Something	Add water	Add water	Smooth ball
Opening up	Begin cone	Add water	Manipulate down	Manipulate clay up	Manipulate clay up
Compressing base	Make cone	Add water	Add water	Add water	Add water
Finish compressing base	Something	First pull	Making hole	Manipulate clay down	Manipulate clay up
Add water	Add water	Compress rim	Add water	End manipulation	End manipulation
Start cone	First pull	Collar pot	Continue making hole	Add water	Manipulate clay down
Make cone	Compress rim	Compress rim	add water	Making hole	End manipulation
Something	Collar pot	Add water	Open up	Add water	Add water
Add water	Compress rim	Add water	Add water	Continue making hole	Manipulate clay up
Add water	Collar pot	Touch wall	Consolidate base	Check pot	Dipped fingers
1st pull	Compress rim	2nd pull	Add water	Open up	Manipulate clay down
Compress rim	water	Compress rim	1st pull	Add water	End manipulation
Water fr wheel to bowl	Touch sponge on pot	Collar pot	Add water	Check pot	Add water
Water fr wheel to bowl	2nd pull	Compress rim	Touch outside of pot	Continue opening	Making hole
Add water	Compress rim	Collar pot	Add water	End opening	Add water
add water	Grab sponge	Grab sponge	2nd pull	Add water	Continue making hole
2nd pull	Dry out centre	Dry inside	3rd pull	Consolidate base	Check pot
Compress rim	Collar pot	Tidy foot	Compress rim	End consolidation	Continue making hole
Collar pot	Tidy foot	Collar pot	Fingers down cone	Add water	Check pot
Compress rim	Rid of loose clay	3rd pull	Fingers down cone fr top	Making cone	Open up
Grab sponge water	3rd pull	Compress rim	4th pull	End cone	Dipped fingers
Tidy foot	Compress rim	Tidy foot	Compress rim	Add water	Consolidate base
Add water	Tidy base	Wheel stop	Rinse hands	1st pull	End consolidation
Grab sponge water	Wheel stop	Insert shape R	Grab tri tool	Add water	Dipped fingers
Splash	Wire	Manually move wheel	Tidy foot	End pull	1st pull
Splash	Wheel spin	Insert shape L	Grab sponge	Add water	End pull
Water	Wheel stop	Start wheel	Sponge inside pot	Collar	Dipped fingers
3rd pull	Pot lifted away	Compress rim	Sponge removed	End collar	Collar
Compress rim		Wheel stop	5th pull	Consolidate rim	End collar
Touch pot		Wire	Fingers down pot	End consolidation	Dipped fingers
Collar pot		Wheel spin	6th pull	Add water	Check pot
Compress rim		Wheel stop	Fingers down pot	Rub down cone	Pull 2
Tidy foot		Pot lifted away	Fingers up pot	Rub up cone	Add water
Grab sponge			Fingers down pot	Rub down cone	End pull
Squeeze sponge			Check rim	Rub up cone	Cosolidate rim
Dry out pot			Dry out pot	Add water	End consolidation
Wire			Check walls up	Check pot	Dipped fingers
Wheel stop			Check walls up	End check	Collar
Poke pot			Check walls down	Pull 2	End collar
Pot lifted away			Consolidate rim	End pull	Dipped fingers
			Grasp tri tool	Dipped fingers	Check pot
			Tidy foot	Collar	Dipped fingers
			Wire	End collar	Pull 3
			Wheel stop	End collar	Add water
			Pot lifted away	Rub walls	End pull
				End rub walls	Collar
				Collar	End collar
				End collar	Add water
				Cosolidate rim	Pull 4
				End consolidation	End pull
				Dipped fingers	Wheel stop
				Rub walls	Add water
				End rub walls	Wheel start
				Check pot	Collar
				End check pot	End collaring
				Collar	Check pot
				End collar	End check pot
				Dipped fingers	Consolidate rim
				Grab tri tool	End consolidation
				Add water	Wheel stop
				Pull 3	Wheel start
				End pull	Check pot
				Pull 4 top	End check pot
				End pull	Pull 5
				Consolidate rim	End pull
				End consolidation	Collar
				Wheel stop	End collar
					Check walls
					End check walls
					Collar
					End collaring
					Half pull
					End half pull
					wheel stop

Appendix Fc: Event detail, P3, P4, P5.

Participant 3			Participant 4			Participant 5		
Clay on wheel	Clay on wheel	Pat ball of clay	Dampen wheel	Clay held	Clay held	Grasp clay	Grasp clay	Slap clay
Wheel start	Wheel start	Clay on wheel	End dampen wheel	Clay slammed down	Clay slammed down	Pat clay	Hold clay	Slap clay
Add water	Add water	Wheel start	Grasp clay	Clay grasped	Clay grasped	Hold Clay	Slam clay onto wheel	Start wheel
Smoothing ball	Check speed	Check speed	Clay slammed down	clay pushed down	Add water	Raise clay in hands	Slap clay	Add water
Manipulate up	Add water	Add water	clay pushed down	Add water	Wheel started	Pat clay	Slap clay	Smooth ball
Add water	Smoothing ball	Smoothing ball	Wheel started	Wheel started	Smooth ball	Slam clay onto wheel	Start wheel	Manipulate clay up
Manipulate down	Manipulate up	Manipulate up	Add water	Smooth ball	Add water	Slap clay	Add water	Manipulate top of clay
Manipulate up	Top	Top	Smooth ball	Add water	Raise clay	Start wheel	Smooth ball	Manipulate clay up
Manipulate down	Add water	Add water	Raise clay	Raise clay	Add water	Add water	Manipulate clay up	Manipulate down
Add water	Manipulate down	Manipulate down	Add water to walls	End Raise clay	End Raise clay	Smooth ball	Manipulate top of clay	Manipulate clay down
Flatten	Add water	Add water	Raise clay	Add water to walls	Add water to walls	Manipulate clay up	Manipulate clay down	Manipulate clay down
Cup clay	Manipulate up	Manipulate down	Add water to walls	Raise clay	Manipulate down	Manipulate top of clay	Manipulate top of clay	Add water
Add water	Manipulate down	Manipulate up	Raise clay	Add water	Add water	Add water	Add water	Manipulate clay down
Make hole	Add water	Manipulate down	Tidy foot	Manipulate down	Change hand position	Manipulate clay down	Manipulate clay up	Manipulate clay up
Add water	Flatten	Tidy foot	End tidy foot	Change hand position	Change hand position	Manipulate clay up	Manipulate clay down	Manipulate clay down
Open up	Tidy foot	End tidy foot	Add water	End manipulation	End manipulation	Manipulate clay down	Manipulate clay end	Manipulate clay down
End opening up	Make hole	Add water	Manipulate down	Add water	Add water	Manipulate clay down	Add water	Manipulate clay down
Consolidate base	Add water	Flatten	Add water	Manipulate up	Manipulate up	Manipulate clay down	Manipulate clay down	Flatten clay
End consolidation	Make hole	Add water	Change hand position	Manipulate down	Flatten	Flatten clay	Flatten clay	Add water
Add water	Open up	Smooth top	Change hand position	Change hand position	Change hand position	Add water	Add water	Cup clay
Cone	End opening up	Make hole	Add water	End hand position	End hand position	Flatten clay	Making hole	Flatten clay
Reduce speed	Consolidate base	Add water	Manipulate up	Add water	Add water	Add water	Opening up	Add water
Add water	Add water	Make hole	Add water	Manipulate up	Flatten	Flatten clay	Consolidate base	Making hole
1st pull	Continue consolidation	Add water	Manipulate down	Stop manipulation	Change hand position	Add water	Add water	Opening up
End pull	End consolidation	Open up	Change hand position	Add water	End manipulation	Making hole	Consolidate base	Finish opening up
Consolidate rim	Add water	End opening up	Add water	Manipulate up	Add water	Opening up	Consolidate base	Consolidate base
End consolidation	Cone	Consolidate base	Manipulate up	End manipulation	Cup clay	Finish opening up	Consolidate base	Consolidate base
Add water	End cone	Add water	Manipulate down	Add water	End cup clay	Add water	Finish consolidating base	Consolidate base
Wet walls	Consolidate rim	Cone	Change hand position	Tidy foot	Flatten	Consolidate base	Begin cone	Add water
2nd pull	End consolidation	End cone	Add water	End tidy foot	End flatten	Add water	End 1st shape	Consolidate base
End pull	Add water	Consolidate rim	Manipulate up	Add water	Add water	Consolidate base	Consolidate top	Finish consolidating base
Slowed speed	Wet walls	End consolidation	Tidy foot	Manipulate up	Make hole	Consolidate base	Add water	Begin cone
Add water	Tidy foot	Change speed slower	End tidy foot	End manipulation	End hole	Consolidate base	1st pull	End 1st shape
Wet walls	Add water	Change speed faster	Add water	Add water	Open up	Finish consolidating base	Finish pull	Consolidate top
Check rim	1st pull	Add water	Manipulate down	Manipulate down	End open up	Add water	Consolidate rim	Add water
3rd pull	End pull	Wet walls	End manipulation	End manipulation	Add water	Begin cone	Finish consolidating rim	1st pull
End pull	Consolidate rim	Adjust speed faster	Add water	Add water	Open up	End 1st shape	Add water	Finish pull
Consolidate rim	End consolidation	Add water	Flatten	Manipulate down	End open up	Consolidate top	Collaring	Consolidate rim
End consolidation	Slowed speed	Check inside pot	Change hand position	Change hand position	Consolidate base	Add water	Rim work	Finish consolidating rim
Add water	Added speed	Tidy foot	Add water	Add water	End consolidation	1st pull	Add water	Add water
Wet walls	Add water	End tidy foot	Make hole	Manipulate up	Add water	Finish pull	2nd pull	Collaring
Check rim	Wet walls	Add water	End hole	Change hand position	Hands on both sides	Consolidate rim	Finish pull	Rim work
4th pull	Add water	Wet walls	Open up	Flatten	Pull 1	Finish consolidating rim	Consolidate rim	Add water
End pull	Check inside pot	1st pull	Add water	Change hand position	End pull	Collaring	Finish consolidating rim	2nd pull
Consolidate rim	Tidy foot	End pull	End open up	Add water	Dry inside	Rim work	Add water	Finish pull
End consolidation	Add water	Consolidate rim	Consolidate base	Cup clay	End dry inside	Add water	Collaring	Consolidate rim
Check wall	Wet walls	End consolidation	End consolidation	Add water	Pull 2	2nd pull	Rim work	Finish consolidating rim
Tidy foot	2nd pull	Wet walls	Add water	Flatten	End	Finish pull	Stop rim work	Add water
End tidy foot	End pull	Add water	Pull 1	Change hand position	Consolidate rim	Consolidate rim	Add water	Collaring
Dry inside sponge	Consolidate rim	Check inside pot	End pull	Make hole	End consolidation	Finish consolidating rim	3rd pull	Rim work
End dry	End consolidation	Tidy foot	Consolidate rim	End hole	Add water	Add water	End of pull	Stop rim work
Wheel stop	Add water	End tidy foot	End consolidation	Add water	Check walls	Add water	Consolidate rim	Add water
	Wet walls	2nd pull	Add water	Open up	End check walls	Collaring	End consolidation	3rd pull
	Add water	End pull	Consolidate rim	End open up	Pull 2	Rim work	4th pull	End of pull
	Add water	Consolidate rim	End consolidation	Consolidate base	End pull	Stop rim work	End of pull	Consolidate rim
	Wet walls	End consolidation	Pull 2	End consolidation	Consolidate rim	Add water	Consolidate rim	End consolidation
	Tidy foot	Wet walls	End	Dry inside	End consolidation	3rd pull	End Consolidation	4th pull
	3rd pull	Wet walls	Dry inside	End dry inside	Dry inside	End of pull	Add water	End of pull
	End pull	Add water	End dry inside	Pull 1	End dry inside	Consolidate rim	Collar	Consolidate rim
	Consolidate rim	Wet walls	Dry inside	End pull	Dry inside	End consolidation	Rim work	End Consolidation
	End consolidation	Tidy foot	End dry inside	Consolidate rim	End dry inside	Collaring	End collar	Check wall 6th pull
	Add water	End tidy foot	Add water	End consolidation	Tidy foot	Rim work	Check wall 6th pull	End of pull
	Check inside pot	3rd pull	Collar	Add water	End tidy foot	4th pull	End of pull	Check
	Add water	End pull	End Collaring	Consolidate rim	Smooth foot	End of pull	Check	Consolidate rim
	Wet walls	Consolidate rim	Add water	End consolidation	End smooth foot	5th pull	Cylinder made	End consolidation
	4th pull	End consolidation	Pull 3	Pull 1	Add water to walls	End of pull	Tidy foot	Check
	End pull	Adjust speed slower	End pull	End	Add water to walls	Collar	Wheel stop	Tidy foot
	Check wall	Add water	Consolidate rim	Add water	Collar	End collar	Wheel start	Wheel stop
	Consolidate rim	Check inside pot	End consolidation	Consolidate rim	End Collaring	Check wall 6th pull	Dry inside	Cylinder made
	End consolidation	4th pull	Dry inside	Pull 2	Add water	End of check	Sponge out	
	Tidy foot	End pull	End dry inside	End pull	Add water	Consolidate rim	Wheel stop	
	End tidy foot	Consolidate rim	Sponge foot	Consolidate rim	Pull 3	Cylinder made		
	Tidy wheel	End consolidation	End smooth foot	End consolidation	End pull	Tidy foot		
	End tidy wheel	Check upper wall	Tidy foot	Dry inside	Dry inside	Finish foot		
	Dry inside sponge	Pull	End tidy foot	End dry inside	End dry inside	Wheel stop		
	End dry	End pull	Add water	Add water	Tidy foot			
	Wheel stop	Tidy foot	Add water	Pull 3	End tidy foot			
		End tidy foot	Pull 4	End pull	Smooth foot			
		Dry inside sponge	End pull	Add water	End smooth foot			
		End dry inside	Consolidate rim	Add water to walls	Tidy foot			
		Touch rim	End consolidation	Collar	End tidy smooth foot			
		Tidy wheel	Check wall	End Collaring	Decrease speed			
		End tidy wheel	End check	Dry inside	Tidy foot			
		Dry inside sponge	Tidy foot	End dry inside	End tidy foot			
		Consolidate rim	End tidy foot	Add water	Smooth foot			
		End consolidation	Smooth foot	Tidy foot	End smooth foot			
		Wheel stop	End smooth foot	End tidy foot	Stop wheel			
			Dry inside	Smooth foot	Water wheel			
			End dry inside	End smooth foot	Cheesewire			
			Add water	Pull 4	Cheesewire			
			Pull 5	End pull	Pot off			
			End pull	Consolidate rim				
			Consolidate rim	End consolidation				
			End consolidation	Check wall				
			Smooth foot	End check				
			End smooth foot	Tidy foot				
			Stop wheel	End tidy foot				
			Cheesewire	Smooth foot				
			Add water	Check rim				
			Cheesewire	End check rim				
			Pot off	Check inside				
				End check inside				
				Add water				
				Pull 5				
				End pull				
				Pull 6				
				End pull				
				Dry inside				
				End dry inside				
				Consolidate rim				
				End consolidation				
				Check wall				
				End check wall				
				Smooth foot				
				End smooth foot				
				Tidy foot				
				End tidy foot				
				Smooth foot				
				End smooth foot				
				Stop wheel				
				Cheesewire				
				Cheesewire				
				Pot off				

Appendix Fd: Event detail P6, P8.

Participant 9			Participant 10		
Start wheel	Start wheel	Start wheel	Clay placed	Clay placed	Clay placed
Clean wheel	Place clay on wheel	Place clay on wheel	Start wheel	Start wheel	Pat clay
Tidy loose clay	Water hand	Manipulate clay up	Add water	Stop wheel	End pat clay
Place clay on wheel	Manipulate clay up	Manipulate clay down	Smooth ball	Start wheel	Start wheel
Water	Manipulate clay down	Make a dip	Manipulate clay up	Add water	Stop wheel
Manipulate clay up	Make a dip	Water	Add water	Increase speed	Add water
Manipulate clay down	Water	Making hole	Manipulate clay up	Smooth ball	Wet clay
Manipulate clay up		opening up	Add water	Manipulate clay up	Start wheel
Manipulate clay down	Making hole	Compressing base	Manipulate clay down	Add water	Add water
Make a dip	opening up	Start cone	Add water	Manipulate clay down	Increase speed
Water	Compressing base	Make cone	Manipulate clay up	Add water	Add water
Making hole	Finish compressing base	Something	Add water	Add water	Smooth ball
Opening up	Begin cone	Add water	Manipulate down	Manipulate clay up	Manipulate clay up
Compressing base	Make cone	Add water	Add water	Add water	Add water
Finish compressing base	Something	First pull	Making hole	Manipulate clay down	Manipulate clay up
Add water	Add water	Compress rim	Add water	End manipulation	End manipulation
Start cone	First pull	Collar pot	Continue making hole	Add water	Manipulate clay down
Make cone	Compress rim	Compress rim	add water	Making hole	End manipulation
Something	Collar pot	Add water	Open up	Add water	Add water
Add water	Compress rim	Add water	Add water	Continue making hole	Manipulate clay up
Add water	Collar pot	Touch wall	Consolidate base	Check pot	Dipped fingers
1st pull	Compress rim	2nd pull	Add water	Open up	Manipulate clay down
Compress rim	water	Compress rim	1st pull	Add water	End manipulation
Water fr wheel to bowl	Touch sponge on pot	Collar pot	Add water	Check pot	Add water
Water fr wheel to bowl	2nd pull	Compress rim	Touch outside of pot	Continue opening	Making hole
Add water	Compress rim	Collar pot	Add water	End opening	Add water
add water	Grab sponge	Grab sponge	2nd pull	Add water	Continue making hole
2nd pull	Dry out centre	Dry inside	3rd pull	Consolidate base	Check pot
Compress rim	Collar pot	Tidy foot	Compress rim	End consolidation	Continue making hole
Collar pot	Tidy foot	Collar pot	Fingers down cone	Add water	Check pot
Compress rim	Rid of loose clay	3rd pull	Fingers down cone fr top	Making cone	Open up
Grab sponge water	3rd pull	Compress rim	4th pull	End cone	Dipped fingers
Tidy foot	Compress rim	Tidy foot	Compress rim	Add water	Consolidate base
Add water	Tidy base	Wheel stop	Rinse hands	1st pull	End consolidation
Grab sponge water	Wheel stop	Insert shape R	Grab tri tool	Add water	Dipped fingers
Splash	Wire	Manually move wheel	Tidy foot	End pull	1st pull
Splash	Wheel spin	Insert shape L	Grab sponge	Add water	End pull
Water	Wheel stop	Start wheel	Sponge inside pot	Collar	Dipped fingers
3rd pull	Pot lifted away	Compress rim	Sponge removed	End collar	Collar
Compress rim		Wheel stop	5th pull	Consolidate rim	End collar
Touch pot		Wire	Fingers down pot	End consolidation	Dipped fingers
Collar pot		Wheel spin	6th pull	Add water	Check pot
Compress rim		Wheel stop	Fingers down pot	Rub down cone	Pull 2
Tidy foot		Pot lifted away	Fingers up pot	Rub up cone	Add water
Grab sponge			Fingers down pot	Rub down cone	End pull
Squeeze sponge			Check rim	Rub up cone	Cosolidate rim
Dry out pot			Dry out pot	Add water	End consolidation
Wire			Check walls up	Check pot	Dipped fingers
Wheel stop			Check walls up	End check	Collar
Poke pot			Check walls down	Pull 2	End collar
Pot lifted away			Consolidate rim	End pull	Dipped fingers
			Grasp tri tool	Dipped fingers	Check pot
			Tidy foot	Collar	Dipped fingers
			Wire	End collar	Pull 3
			Wheel stop	End collar	Add water
			Pot lifted away	Rub walls	End pull
				End rub walls	Collar
				Collar	End collar
				End collar	Add water
				Cosolidate rim	Pull 4
				End consolidation	End pull
				Dipped fingers	Wheel stop
				Rub walls	Add water
				End rub walls	Wheel start
				Check pot	Collar
				End check pot	End collaring
				Collar	Check pot
				End collar	End check pot
				Dipped fingers	Consolidate rim
				Grab tri tool	End consolidation
				Add water	Wheel stop
				Pull 3	Wheel start
				End pull	Check pot
				Pull 4 top	End check pot
				End pull	Pull 5
				Consolidate rim	End pull
				End consolidation	Collar
				Wheel stop	End collar
					Check walls
					End check walls
					Collar
					End collaring
					Half pull
					End half pull
					wheel stop