REFERENCES

FIGURE CAPTIONS AND CREDITS
Figure 1: Design Thinking Process – adapted from d.school Stanford University Institute for Design.
Figure 2: Storytell.
Figure 3: Brainstorm.
Figure 4: Voting.
Figure 5: Feedback & Capture.
Figure 6: Feedback & Capture.
Figure 7: Number of respondents who found the techniques helpful or very helpful by assignment.

ABSTRACT
THIS PAPER PORTRAYS THE JOURNEY OF A COLLABORATIVE RESEARCH PROJECT BETWEEN THE AUTHORS: REBECCA HOYES AND ANNE MARR, BOTH EDUCATORS AND RESEARCHERS ON THE BA (HONS) TEXTILE DESIGN AT CENTRAL SAINT MARTINS (CSM).

The project started as an open-ended research investigation exploring existing material boundaries in the hope to develop new hybrid ceramic – textile materials. The Material Boundaries project was designed to explore first steps into these new territories, to consciously experiment beyond the unknown, generate a deeper understanding of future craft processes and open up further opportunities for co-design with other disciplines. The paper outlines an investigation into where ceramic begins and textiles end and the transitional space in between them. The findings of this paper identify risk-taking and co-design as essential strategies to invite valuable setbacks and disasters, as well as happy accidents. The key stages of an open-ended research process are outlined: Mapping New Terrain, Material Investigation, Trans-disciplinary Feedback and Systematic Reflection. The project took risk-taking to the extreme by fusing material hybrids in a kit, often ‘producing’ not even a trace of dust. This paper presents a visual journey of the reflective mapping process, illustrating the key stages of the research. Transdisciplinary feedback from colleagues supported the progression of the project applying ceramic and textile thinking to the journey.
INTRODUCTION
This paper portrays the journey of a collaborative research project between the authors. At the core of this exploration is engaging with process rather than set end results and in fact the process of the project is its outcome. Therefore, this paper focuses on the process of learning through investigation and on the nature of collaboration. The project started in Summer 2014 through a mutual interest in process-led research as well as ceramics and is on-going until Spring 2016. The aim of Material Boundaries is to develop new textile/ceramic hybrid materials (figure 1) and to explore the possibilities of co-design as well as to record process-led textile design methods in order to inform research and teaching practice.

CONTEXT: WHERE DO TEXTILES END AND WHEN DO CERAMICS BEGIN?

HYBRID MATERIALS
In 2014 CSM organised a graduate exhibition Restless Futures, which raised debate and posed questions around emerging issues in design. Expanded Boundaries was one of the four themes of the exhibition and the Material Boundaries project was partly born from reflection on the exhibition manifesto which predicts, that methods and concepts of design will be ‘taken into other areas as catalysts and vehicles for new collaborative ways of thinking and acting’ (Restless Futures 2014).

Over the past few years, textiles have rapidly expanded into an interdisciplinary practice. Here the broadening of disciplines allows for textile design and textile thinking to be used for new collaborative ways of making. These merging and uncertain boundaries create a space for innovative opportunities: ‘More notably it is in the cross fertilisation of materials where a new breed of designers are evolving. Materiologists are those designers who are happy to cross boundaries, explore the unexplored and are driven by materiality’ (Wagner 2014: unknown).

New materials are getting increasingly ‘smarter’ and adaptable with great potential to inform future lives. At the same time it is no coincidence that the interest in raw haptic materiality has surged in a world increasingly shaped by enhanced digital technologies. Re-establishing an intrinsic relationship between material, maker and user has seen a desire for connectedness emerging which has ‘…driven the way for new interpretations of Materiality, as opposed to merely applying materials as an afterthought’ (Lefteri 2014: unknown). Textiles and ceramics both have, as part of their cultural DNA, some of the most raw, low tech physical origins for example, silted earth dug up from riverbeds or sheared sheep skin (Miodownik 2013). Through chemical processes they can evolve respectively into the most sophisticated porcelain or high tech worn tweed fabric.

‘Disseminating information extensively and beyond the scope of the obvious applications is a precondition for discovering new applications. Such dissemination requires a new approach on the part of manufacturers and designers’ (Material World 2 2006: 23). Whilst manufacturers take on this new approach and experiment with yarns and clay to solve specific design and production problems, the authors began from a position of curiosity: using the making process as a way of thinking through material to create new material hybrids. It is this liminal space between textiles and ceramics and where these two disciplines come together that is the focus of this project.

CO-DESIGNING UNCERTAINTY
At the same time the project also takes on a further dimension as a collaborative investigation between the authors in their roles as a BA Course Leader and academic researcher and as an Associate Lecturer and professional design practitioner. Although they share a mutual openness to experiment and have taught students together for a number of years, they have not previously co-researched or collaborated on a project. Sanders and Stappers (2008) comment on the value of the co-design process as an opportunity to engage in moments of decision and idea generation. The significant value of using co-design at the start of the design process, as a method to break down traditional roles of subject and research has been described by Shumack (2015).

Learning from mistakes is defined as a key factor in the design journey (Petroski 2006). The opportunity offered by a project, which inserts notions of ‘risk’, ‘uncertainty’ and ‘failure’ into the outcomes is an interesting one. At the outset of the project the authors were not so concerned with the design application as they were to initiate playful experiments into where textiles end and ceramics begin, whilst using textile thinking as a cross-disciplinary lens on the utilisation of ceramic qualities and processes. Therefore, the initial research question: ‘Where do textiles end and when do ceramics begin?’ was left deliberately open to develop a deeper material understanding through process-led research. Noting that a design project that is ‘too planned’ (Osmond et al. 2008: 250) does not challenge existing design clichés, while a research enquiry without any inherent systematic reflection lacks rigour and direction (Botlon 2015: 279). Although experts in their fields of textile design, neither author had previous experience of ceramic design. Using their lack of predetermined ceramic knowledge to their advantage this exploration started as a playful challenge to see how textile materials would endure extreme temperatures required in the firing of ceramics.

Textile design is constantly expanding into a more interdisciplinary practice and educators need to keep abreast if they want to teach their students emerging skills. For full-time art and design educators, time to develop new research is often limited, which makes it challenging to maintain and develop deeper subject knowledge in order to evolve an optimal curriculum. The most useful learning in the modern world is learning about the process of learning, an internalisation of the experience of change (Brockbank & McGill 2007: 209). The authors set themselves the task of doing what they expect their students to do during their studies: to go into unfamiliar territory with a curious mind, understanding risk-taking and collaborative working.

PROJECT DESCRIPTION AND TIME LINE

PHASE 1 – INTRODUCTION TO MATERIALS AND PROCESSES
The starting point was the enthusiasm to experiment and explore an open-ended research outcome together. With minimal knowledge of ceramic processes the main aim was to see how textile materials would transform under high temperature and fuse to create unexpected outcomes, compared with the relatively immediate and controllable process of textile making. This led to research into fire-resistant textile materials and a cautious start testing silica material strips and their bonding qualities with porcelain slip (figure 2).
Clay becomes a ceramic when it has been fired above 573°C, a process known as Alpha Beta Quartz Inversion. However, most textiles cease to exist at 100°C and even ‘frameproof’ materials seldom withstand the ten hour-long firing in the kiln. Using a number of small test samples and three different temperature settings between 600°C and 1200°C the first round of tests resulted in findings that the porcelain slip did not adhere easily to the textiles and at the same time the silica fabric could hardly tolerate temperatures above 600°C. Often the test firing produced nothing but ‘coptic’ dust fragments (figure 3). During this phase the informal short technical inductions from the ceramic technicians became vital to build up basic knowledge and progress the project.

**PHASE 2 – QUANTITATIVE LATERAL TESTING**

The first review of the surviving test strips identified the need to expand the material selection to include high tech textiles that could withstand temperatures above 600°C and stimulate new fusion recipes. It also revealed that more fibrous clay, such as paper clay, could enhance the cohesion between textiles and ceramics and develop a better amalgamation of the two materials. The open-ended nature of the project made it difficult to set boundaries due to the infinite possibilities of our research direction. Existing textile knowledge helped to structure phase two more systematically according to known textile properties such as material and construction processes, which were systematically combined:

- **Fibre and Material:** basalt, kiln-fusing fleece, Kevlar, silica, resin coated polyester, Kynol, glass fibre, Kerafol
- **Process:** rope making, knotting, weaving, pleating, twisting, stitching, mark making, screen printing, laser etching, laser cutting, gluing, dipping, flocking
- **Ceramic Material:** porcelain slip, paper clay, paper clay slip, Enedeca Once Fired slip

This framework gave scope to explore larger quantities of lateral experiments as opposed to a small number of in depth technical tests, without getting lost in too many possibilities. Over 80 test samples were produced in phase 2 (shown in figures 5, 6, 7, 8), compared with 24 samples in phase 1.

**PHASE 3 – REVIEW**

As the project evolved it became apparent that photography would be a key editing tool to manage the emerging research strands of the project. The fragile nature of the work generated the most natural fusion of clay and textiles after a firing process of 600°C, while preserving the haptic qualities of being simultaneously hard and soft: basalt, silica as well as once fired clay.

DURING THIS PROJECT THE AUTHORS DELIBERATELY DID NOT SET THEMSELVES A USER-CENTRED DESIGN PROBLEM BUT INSTEAD EMBARKED ON A JOURNEY OF ‘MATERIAL FICTION’ – IMAGINING A POTENTIAL CHEMICAL REACTION BETWEEN FABRIC AND CLAY, THROUGH PROCESS-LED DESIGN RESEARCH.
which participants were completely free 

material properties, a crash course 

workshop day included a ‘Show and 

Ten colleagues from two different 

knowledge or existing hierarchies. 

putting all participants 

co-learning how to use slip casting 

using any of the materials provided 

fabric and clay, through process-led 

intelligence when hands, mind, and 

eyes are connected in a creative 

process (Carter 2004) (Figure 12). 

Tacit knowledge expands through direct 

material manipulation, providing a 

deeper hands-on understanding of 

design practice itself. 

Dewey (1925) considered experience 

and action as knowledge, which 

could be summarized, possibly in the 

axiom, doing is knowing. The very act 
of making is both the process and 

the subject. The materialization of 

an object i.e., craft making, can be 

considered the ‘…subject-matter and 
sustainer of conscious activity’ (Dewey 

1925: 393). During this project 

the authors deliberately did not set 

themselves a user-centred design 

problem but instead embarked on a 

journey of ‘Material Fiction’ – imagining 

a potential chemical reaction between 

DISCUSSION 

The nature of this project brought 
together different strands of 

research, which relate to the 

complex educational, academic and 

professional design context in which 

the authors are operating. Therefore, 

the following discussion aims to map 

a holistic overview of key findings and 

their interrelationship with each other: 

- Making Material Knowledge 
- Co-designing through Unlearning 
- Out of Boundary 

MAKING MATERIAL KNOWLEDGE 

The hands-on and open-ended nature 

of this project enabled the discovery 
of new material knowledge through 
a lateral and immediate approach 
to making. Gaining an insight into a 
particular practice from within the 
practice itself followed Heidegger’s 
(1962, 2010) notions of ‘handling’ and 
conception of ‘material thinking’ offers 
a view on active materials in creative 
processes. According to him, materials 
are neither passive nor instruments, 
but interact with the maker’s artistic 

this paper have observed open-ended 

material research very much based on ‘designing through’ and ‘designing 
with’. Here ‘a process scenario’ leads to speculative material qualities before 
user-led design research begins. 

Brassett (2011: 7) states that ‘Design 
is an activity which should always 
seek to create value whilst recognising 
and participating in the socio-cultural 
context in which it operates’…’. This 
paper argues that successful material 
thinking can inform designers prior 
to the formulation of a socio-cultural 
driven design problem, as new 
materials might offer possibilities 
that design thinking without material 
handling might not have brought about. 
It is this ‘…intuition of the unthought 
known’ that Gormley describes (2007: 
118) and where much of the magic of 
innovation lies.

PHASE 4 – PARTICIPATORY 
WORKSHOP 
Six months into the project the authors 
recognised their limited expertise on 
constructed textile techniques and 

brought in other textile experts to 
evolve ideas and skills. The authors 
decided to build in a knowledge 
exchange workshop to enable all 
participants to learn something, while 
at the same time gathering feedback 
on the project. Key to this was the idea 
of co-learning how to use slip casting 
as a method to explore 3D textile 
hybrid forms. Putting all participants 
in the same position, exploring a 
new technique without any prior 
knowledge or existing hierarchies. 
Ten colleagues from two different 
colleges participated in the workshop: 
full-time and fractional academic staff, 
PhD students, technicians, associate 
lecturers and research assistants. 
The workshop day included a ‘Show and 
Tell’ session of existing findings and 
material properties, a crash course 
in the history of ceramics, as well as 
a demonstration of slip casting. After 
which participants were completely free 
to use any of the materials provided 
with any textile technique, as long as 
this was used in combination with clay 
or slip casting. The session ended in 
a mini presentation of all participants’ 
products and direct feedback. Overall, 
each participant produced an average 
of three slip cast pieces as well as 
contributing to a large shared outcome 
(Figure 10). 

The feedback was extremely positive 
with all participants saying they had 
found the workshop useful for their 
own research as well as learning a new 
technique. This led to the development 
of new 3D elements made of yarn 
construction in combination with 
slip casting, which will inform design 
development in phase 6 (Figure 11). 
The project is currently on going with 
phase 5, which involves glazing 
processes and colour application to 
lead to selective design developments 
in phase 6. However, for this paper 
the authors have focused on the 
description and analysis of the 
research process rather than the final 
design outcomes.

ANNE MARR AND REBECCA HOYES
The collaborative nature of the project ensured that multiple reflective viewpoints informed the research and ongoing iterations of experiments. Reid (1993: 305) defines reflection as ‘...a process of reviewing an experience or practice in order to describe, analyse, evaluate and also to inform learning about practice’. Having expertise as textile practitioners the authors were able to use textile thinking to work with selected materials and adopt the role of a ‘reflective practitioner’ (Schön 1983) to scrutinize and reflect on the making processes and resulting work. In addition, ‘reflection-in-action’ suggests a process by which a practitioner encounters an unfamiliar situation that requires a different course of action from that which he or she typically does or has initially planned (Schön 1983).

During this project a number of unfamiliar situations occurred, such as material bonding qualities or unknown firing processes, shrinkage and colour changes which required continuous reflection in action. Additionally, careful planning of experiments and testing ensured that the authors were able to build upon acquired reflective material knowledge and managed to surprise the ceramics team with new techniques, such as glazing directly onto unfired silica fabric. ‘Intentional, methodical creative productions can test a variety of ideas in practice and openly demonstrate the researcher’s way of improving his or her professional practice, i.e. what and why an action takes place in a creative process, and the result of it’ (Scriven & Chapman 2004: 4).

Photographic documentation was used as a systematic reflection tool to record the resulting test pieces throughout the project (figure 13) as well as to establish key outcomes in phase 5. Bolton (2015: 279) describes the systematic reflection approach as ‘...the capacity to reflect on actions as a means of engaging in a continuous process of learning, with systematic approaches to analysis and synthesis’ to achieve deep holistic thinking. Experiments at all phases of the process were photographed and served as an invaluable catalogue of developments, especially as some of the outcomes were fragile ceramic dust. The records underpinned visual editing methods to progress the project and to recognise patterns in material qualities as well as opportunities for development, acknowledging issues and less innovative outcomes.

Formalizing the project journey through photographic documentation and the development of a photographic journal facilitated a more objective distancing from the creative/making process.

**CO-DESIGNING THROUGH UNLEARNING**

Both authors had experience of collaborative projects and were aware of the points at which difficulties can arise. The authors naturally assumed certain practical roles, which allowed for greater productivity in the different stages of the project such as material sourcing, bid writing or liaising across college departments.

Design processes that involve teamwork are social processes (Cross & Cross 1996) and require trust in the integrity of the project partner to embrace uncertainty during an unknown making process and abilities to steer through inevitable failures. Any collaboration is a matter of risk-taking, where one’s approach and position may be reinforced, extended or changed in unexpected ways. Elements of mutuality and equality, indifferently, have to be negotiated constantly. Continuous dialogue was key to the progress of this collaboration: dialogue between ourselves, with colleagues and with materials.

Other factors that contributed to an effective non-hierarchical collaboration were negotiations around the ownership and authorship of the project. In phase 1 equal ownership and encouragement to bring all relevant and differing skills to the project were evident. This ‘lack of ownership’ meant that the authors were able to be less precious and let go of their individual identities as designers and ultimately to take greater risks. Co-designing meant sharing knowledge, skills, time, resources and pushing the project into directions that might not have been conceived alone. This was particularly valuable for the initial generative stages of the co-design process, in phases 1 and 2, as the authors could consciously create an open space to learn from each other and go beyond individually established design methods (Sanders & Stappers 2014).

The idea of co-designing was extended by inviting colleagues from different textile specialist areas to a participatory workshop (figure 14). Part of the motivation behind this was to evoke a focused discussion around the display of phase 2 material samples as ‘...the phenomenon is on the table...’ (Sanders & Stappers 2014: 6). The workshop also offered the opportunity to actively co-learn a new process:
slip casting. This put everybody on the same ‘amateur’ level and created a non-hierarchical environment in which all participants were equal experts. Bergold and Thomas (2012) describe the creation of a ‘safe space’ as key to facilitating openness in participatory design workshops, also described by Morrison and Marr (2013). Each of the participants brought with them prior textile knowledge and they were quickly able to assimilate new information that related to the workshop. The distinctive tacit knowledge brought to the group became more evident once the materials had been combined with the cast. In hindsight, the workshop became a key threshold in this project, as the diverse responses provided a new direction for the next stage. The participants themselves also gave positive feedback and stated that they had gained new research insights and particularly enjoyed meeting colleagues from other programmes.

OUT OF BOUNDARY

There were some immediate results of this cross-disciplinary project, which were linked to the physical space and the building. Working in the ceramics department led organically to a new familiarity with the different approaches technicians and staff there might have. Indeed, working in a college as large as CSM there is a danger that one is identified as ‘belonging to’ a particular area and a colleague noted that the authors ‘looked a bit out of boundary’ in a different workshop context. Even though the authors had a great deal of shared textile knowledge an important outcome of this project was to ‘un-learn’ this knowledge: putting aside existing textile assumptions and preoccupation to go beyond binding parameters. The cross-fertilisation of materials, in combination with a variety of processes and concepts provided numerous opportunities for unlearning. For example, the authors deliberately worked with yarns which displayed unsuitable haptic textile qualities before the firing process, as they discovered that the yarn quality would transform after the exposure to the kiln. The transformation process through firing meant that all material qualities were constantly altered and often at risk of total complete loss. The scale of transformation and the danger inherent in the lack of control of the ceramics process felt daring in comparison to textile processes, where material qualities can gradually be developed, altered and restored. In that sense, the majority of ceramics thinking has the complete transformation of clay particles as its core. Fundamentally, this aims to produce a sense of permanency, while traditional textile thinking takes the physical structure of a material for granted, in addition to which, this can be seasonal. This unlearning was a necessary part of the project, ignoring set rules of textile practice, and directing textile thinking to unfamiliar materials and processes to invite creative risk-taking, happy accidents and often improvisation. Uncertainty, more often than not, led to a shift in direction and the development of a new axis of thought. Embracing ‘uncertainty’ has definitely been a key threshold in progression of the project, McDonnell (2012) states that a designer must be in possession of Kekuto’s Negative Capability (Gittings & Mee 2002) for example, the ability to be at ease with working in a state of partial knowledge, to be at ease with uncertainties and contradictions.

CONCLUSION

HANDLING FLUID COMPLEXITY

This paper has revealed the value of process-led design research with no predetermined outcomes and of learning through non-hierarchical collaborative making (figure 15). Through the above findings the intimacy of inter-disciplinary research has become evident and this new creative complexity brings uncertainties and opportunities to the design process. Cross-collaboration between disciplines offers the opportunity to discover unknown liminal space and new domains of ‘collective creativity’ (Sandberg & Hagens 2006: 18).

Materials frontiers provide insolvable design impulses for researchers, designers, educators and students alike. However, in order to positively navigate future projects without getting lost in the outcomes the authors make the following recommendations:

- Treat materials as an active source of design information and invite the making of tacit knowledge through direct material handling;
- Structure process-led design research through systematic reflective photographic documentation;
- Understand collaboration as a social process and establish non-hierarchical environments to nurture collective creativity;
- Invite unlearning as a deliberate part of process-led design research.

Finally, these findings reveal the value of textile thinking and its particular approach to understanding and developing ideas, processes and qualities, as well as outcomes. The amalgamation of this knowledge with other disciplines is an exciting future prospect.

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FIGURE CAPTIONS

Figure 1: Pleated felt material coated with porcelain. Figure 2: Kester and silica material experiments with porcelain slip. Figure 3: Textile fragments after the firing process. Figure 4: Systematic combination of textile processes and materials. Figure 5: Kynol and basalt samples coated in porcelain before the firing process. Figure 6: Remains of Kynol and basalt samples after the firing process. Figure 8: Screen printing porcelain onto fabrics. Figure 8: Screen printing porcelain on paper clay and silica fabrics. Figure 9: Systematic reflection through photographic documentation. Figure 10: Silkcasting combining textiles and once fired silica. Figure 11: Selected techniques from participatory workshop to be developed in phase 2. Figure 12: Handling of material during the participatory workshop. Figure 13: Photographic documentation as a systematic reflection tool. Figure 14: Silkcasting during the participatory workshop. Figure 15: Variety of hybrid material test samples developed in phase 2 and 4 of this project.