Combining Practices in Craft and Design

NITSCHE Michael[a*] and ZHENG Clement[b]

[a] Georgia Institute of Technology
[b] University of Colorado Boulder
* Corresponding author e-mail: michael.nitsche@gatech.edu
doi: 10.21606/dma.2018.537

Combining practices of craft and interaction design opens up new opportunities for both domains but structuring such cross-domain collaboration poses challenges. How to set up a crafter-designer collaboration to utilize the different fields of expertise and include separate practices? We address this question through a co-design research approach. First, we present an overview over existing approaches. Then, we propose our perspective that builds on an initial distinction between the collaborators, repositions the construction of the brief, and culminates into a collaboration through the shared object. Finally, we describe a successful collaboration between an interaction designer and a ceramic artist to support our model. We present a collaboration model that builds on distinct expertise, evolves through a design-based brief, and realizes through a shared dialectic object. We present this through a case study in pottery but we argue that the model is not tied to a particular craft technique and transferable to other collaborative settings in this field.

craft; physical computing; design collaboration

1   Introduction

Craft theory and craft practices have become important reference points for interaction design. New technologies allow the inclusion of physical making practices in digital prototyping and the socio-technological history of craft offers a rich context for interaction design that emphasizes phenomenological approaches and/ or addresses our changing relationships to materials. Yet, the challenge remains to balance this meeting of craft and design practices in a productive way. As successful as many of the craft-related individual projects are, they largely present unique case studies. They do not offer a model for structuring this domain encounter. An overbearing of new technology that merely utilizes craft is as flawed an approach as setting a new agenda for interaction design on a romanticized perception of craft. How can we structure a collaboration of interaction design and craft in a successful and balanced way?

Here, we apply an action research methodology to suggest a structured collaborative practice that ultimately emphasizes the shared object in a new way. The argument builds first on a review of

background work done in this field, then it describes the approach chosen, followed by a case study that describes the collaboration between an interaction designer and a potter. Finally, it summarizes the resulting model and the lessons learned.

1.1   Craft as Reference in Interaction Design

Craft has always been indispensable for interaction design but its place is shifting as new technologies open design opportunities. Ehn suggested already in 1998 the idea of the "Digital Bauhaus" to fulfil a "third culture in the digital age" by combining science, art, and craft based on "a critical and creative aesthetic-technical production orientation that unites modern information and communication technology with design, art, culture and society" (Ehn, 1998). The promised blended model implies a multi-talented and –educated crafter-designer-maker. It largely remains an ideal, though. Gaining mastery levels in both, craft as well as the interaction design requires extensive dual training and copious amounts of talent.

Individual projects (see e.g. (Buechley & Perner-Wilson, 2012; Goodman & Rosner, 2011; Peppler & Glosson, 2013)) demonstrate the potential in this field. But just as the Digital Bauhaus remains an ideal, the question of how to achieve this combination through a structured design process remain a challenge. The hybrid does not simply emerge. In fact, the notion of hybrid crafts itself has been questioned (Devendorf & Rosner, 2017).

Ratto's concept of "critical making" provides one methodological entry point encouraging a shift away from an object-focused production and toward "shared acts of making rather than the evocative object" (Ratto, 2011). This process-oriented approach emphasizes a reflective encounter with technology through the materials at hand. In that way, it references the "reflective practitioner" suggested by Schön (D. A. Schön, 1987) in a workshop setting. The practice of critical engagement through material can also be traced in craft research, but here is it more based on a "thinking through craft" (Adamson, 2007) approach that heavily relies on the exceptional skills of the craftsperson. Unlike critical making exercises, where the resulting object is seen as a trace of the process, the object in a craft-centered approach has value in itself. That is why the material quality and condition of the object are defining components in an ensuing creative collaboration.

1.2   Related Work: Craft and Design

For the purposes of this argument we can divide existent approaches relating craft to interaction design into three main approaches.

Technological/ artistic approaches target novel combinations of crafting and digital interaction to either produce new technological combinations or individual projects that exemplify certain approaches through their unique expressions. The former is prevalent in the area of prototyping and it often combines craft practices such as fiber arts or paper craft with novel materials such as conductive thread and/or ink and new technologies like the Lilypad (Buechley & Qiu, 2014) or ePaper (Karagozler, Poupyrev, Fedder, & Suzuki, 2013). Craft and prototyping techniques are combined to explore a richer technological vocabulary. They present a blended practice that combines traditional craft methods with novel materials and tools. Initial frameworks are emerging – set within the frame of such a technological perspective (e.g. (Zhu, 2012) for paper circuits, (Berzowska & Bromley, 2007) for soft circuits). But the area is dominated by a plethora of individual projects that combine craft and digital components to explore individual forms of expression.

Ethnographic/ educational approaches build on the social context of craft to explore novel practices. For example, Buechley and Perner-Wilson observed 40 crafters to inform their hybrid designs (Buechley & Perner-Wilson, 2012). Goodman and Rosner build on their ethnographic work with gardeners and knitters (Goodman & Rosner, 2011). Peppler investigates the overlap of crafting and digital media to inform novel educational approaches (Peppler, 2013). These works emphasize learning from existing craft traditions and projectiong these lessons onto the digital. However, at the same time, craft itself had to adjust to new digital production techniques and this complicates such a perspective.

Craft-based approaches consist of modifications to existing crafting practices. They are often transformative but focus less on the development of new technologies and more on the application of existing ones to traditional practices. For example, long-held traditions of craft face changes triggered by personal fabrication and digital tools that often simplify and speed up processes (Gershenfeld, 2005). This can lead to a collision "and through this collision a new value for craft thinking, processes, and knowledge is beginning to emerge" (Press, 2007). This emergence originates in the workshop not the lab (Bell, 2012) as crafters adopt digital technologies into their practices. Depending on the constellation of the participants, these three approaches often overlap and occasionally allow for novel approaches. But their success often depends on the dual-identity of a crafter-designer or a close collaboration that is noted but its nature and structure remain largely unclear. Here, we will focus on this form of collaboration.

1.3   Approaching Collaboration: Separating Practices

Our approach toward a structured craft-design collaboration emphasizes material and critical processes (like Ratto and Adamson) and aims at inclusion of specific craft practices (like Rosner and Buechley). However, it differs in its lay out through a co-design informed approach. As a result, it provides a differently weighed model for structuring collaborations between crafters and designers. Co-design manifests in a creative collaboration of different practitioners. Those processes are not easily structured and the initial phases of collaboration is described as an uneasy "crumple zone" (Stappers, 2005). It is, however, in this "zone" that the collaboration of craft and interaction design anchors itself. It is also here that the balance between partners needs to be struck.
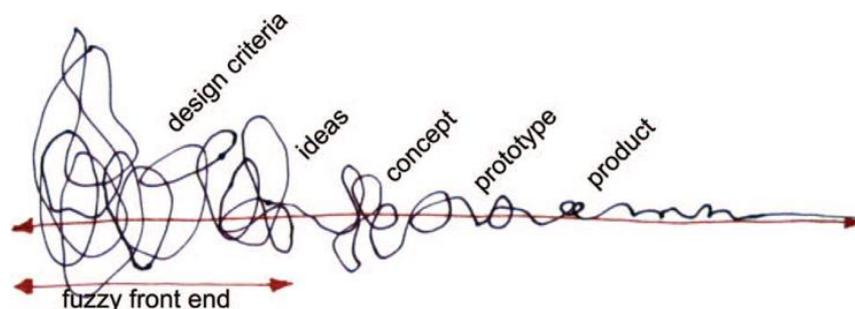

Figure 1. The "fuzzy front end" in craft and design collaborations as identified by Sanders/ Stappers (Sanders & Stappers, 2008).

Few projects target such a structured combination of specific local craft traditions with designers. Tung (Tung, 2012) structures the collaboration toward a commercial revival of craft in Yuan Li, Taiwan. Other case studies include participatory design approaches to support Indonesian bead crafts (Zulaikha, 2013). The here proposed model starts, like Tung's, from the designer's perspective. However, it differentiates itself through a focus on the material and the shared object. This object becomes a key component of an emergent practice without turning into a pre-conceived product upfront. Our approach abstracts a model that relates to existent concepts like Tung's but is itself not directly aimed at commercial deployment, focusing instead on the creative partnership between crafters and designers.

As a couple that includes one practicing crafter (a blacksmith) and an analytical STS scholar, Keller & Keller's provide another fitting reference for our approach. Their activity system traces an "umbrella plan" from an initial brief to an experientially informed encounter with the material and emergent object design (Keller & Keller, 1994). This approach informed the analytical first stage of our proposed approach. Because we remained interested in the encounter with the material, aother key concept was that of the "surprise" encounter with these material qualities during the production. Herein we relate to Ingold and Hallam, who outline creative practice with materials as *generative*, *relational*, *temporal*, and ultimately *improvisational* (Ingold & Hallam, 2007). Their concept of practice as a process of bringing-into-being shaped by in-the-moment encounters with others and

with the material influenced our own design of the collaborative process between crafter, designer, and material.

Ingold further proposes to look at "real" objects as constantly coming into being through relational networks wherein all participants collaborate and the human ones "*follow the materials*" (Ingold, 2009). He emphasizes objects not as finished constructs but as dynamically unfolding of forces. The thing, here, is not a proof or even a trace of the collaboration–but an active ingredient of a larger dialogue contextualized far beyond a single manipulation. Craft engages with the materials en route to the object. Ingold's particular focus on materials suits our approach for a material- and practice-based collaboration. It establishes the thing as an active part of an emergent dialogue between all partners involved. As the agency of objects increases we see their role in the design process becoming ever more important in a participatory design process. This physicality of materials has been outlined by Hansen and Dalsgaard as "framing" as well as "transformative" (Hansen & Dalsgaard, 2012) for participatory design events. Both are encountered only in a process-based approach.

Our approach differs from the ideal of a holistically educated crafter-interaction designer. It builds on a model that involves a designated designer and a crafter, wherein the two do not directly collaborate from the beginning, nor do they blend their fields of expertise into one. We argue that this space for dialogue is not an emerging shared practice but a dual one that includes the object in the unfolding discourse. The following will outline an example implementation of this approach as well as a discussion of results.

2 Creating an Interactive Ceramic

The project started in spring 2015 and continued into the next year, in the production labs at Georgia Institute of Technology on the one hand and the ceramic workshop of the crafter on the other. It consisted of a collaboration between Clement Zheng, as a designer in the field of Industrial Design, and Amy Roberson, a ceramic craftsperson. Its goal was to structure their collaborative process in a way that would harness the creative input and individual practice of both partners without diluting either one's expertise in the process. The project originated as a challenge to Zheng to explore a craft practice and apply the found knowledge to digital media design. Ceramics as the target practice was chosen by the designer personally, inspired by his lack of expertise in this field. This initial distance to the craft practice was seen as beneficial for the set up of the project as it supported differentiating between the two experts involved. The transactions with the craftsperson evolved from an initial *investigative* phase to understand craft and craftsperson, to an *exploratory* phase of discussing possible collaboration opportunities, to an *implementation* phase to prototype the interactive artefact. These phases manifested from the broader principles outlined above. The collaboration included Zheng but excluded co-author Nitsche who had no direct contact with the crafter. The analysis and discussion was based on a shared review of the process and its results.

2.1 Investigation: Mapping Craft and Crafter

The designer, Zheng, is trained in the fields of industrial design and interaction design, specializing in designing tangible interactive products. His practice typically involves designing, building, and programming electronics, often with the help of digital fabrication tools.

Zheng had no prior experience with ceramics in his work. The first phase of the collaboration involved an approach from the designer to the crafter. The explorative first encounter comprised of a series of informal interviews and observations of the crafter at her workplace, as well as personal encounters with the craft itself.

2.1.1 Combining Creativity

Definitions of creativity vary depending on the context they are applied in (Sawyer, 2012). Amabile's micro level looks at how immediate surroundings and social context might affect creativity and proposes a "Consensual Assessment Technique" (Amabile, 1996) based on subjective shared criteria. Amabile's method is included in the later stages of our model. In addition, Csikszentmihalyi

differentiates a three layered creativity system model of *domain*, *field*, and *individual* (Csikszentmihalyi, 1996) useful for understanding Roberson's practice: Roberson produces craft objects within the *domain* of ceramic arts and has been a practicing artist in residence at the Mudfire gallery in Atlanta since graduating in 2012 from a Fine Arts program specializing in ceramics. She describes this gallery not only as a working but also as a social space, one that is "great for idea sharing and brainstorming." Her attraction to ceramics stemmed from the utilitarian and tangible nature of the clay pieces; what she calls an "interactive three-dimensional canvas of expression." She is interested in pottery for its tradition of producing not only beautiful objects but also objects of utility. This balance of form and function remains important to her practice, and evident in her pieces.

Figure 2. Examples for Riberson's ceramic work; combining function and her personal aesthetic.

Roberson is an active contributor to the local craft scene in Atlanta, which can be seen as a *field*. As an artist in residence in a city gallery, she teaches and assists amateur and professional ceramic artists in the community. In addition, she participates in art festivals around the city. Her work is sold through those art festivals and through the online craft marketplace Etsy. Within this *field*, Roberson has established an identity for herself, especially for her use of simple, functional forms coupled with playful and vibrant glazes.

Roberson's work is influenced by her *individual* interests and passion. In particular, she is attracted to the Electronic Dance Music culture and tries to imbue her work with the same fun and playfulness through her use of glaze and colour. This establishes a unique signature in her work, even as she claims a much wider overarching influence of the Mid Century Modern ceramics. In line with her attraction to playful and vibrant visuals, Roberson is also attentive to color trends. In her repertoire of tools is a set of Pantone colour swatches which she refers to in choosing glazes for her pieces.

2.1.2   Exploring Process and Materials

Our approach sets out from the designer to the crafter. It started with an exploration of the crafter's identity and creative stance and continued into a look at ceramics as a creative material practice. Roberson's craft process could be divided into two distinct methods that either fall into a relatively structured "umbrella plan" (Keller & Keller, 1994) supporting a precise planning and effective performance, or into a more "improvisational" (Ingold & Hallam, 2007) crafting that embraces elements of surprise. Roberson deploys the latter method typically when exploring a new form on the wheel or with new glazes and colour combinations. The more top-down former method is used by Roberson, for example, when producing a series for a collection. It features a strong initial brief and a set procedure – what the Kellers termed an umbrella plan – with few improvisations or surprises allowed in the process.

2.1.3   Encountering the Craft

The designer had no experience of working with ceramics but experimented with the practice to experience the basics of working with clay and pottery tools over multiple sessions working on own (mostly flawed) ceramics. This experiential approach was carried out in tandem with the interviews and discussions with the craftsperson.

Limited as such a preliminary encounter with the craft was, it allowed the designer to discuss basic materials and processes with the same language as the craftsperson, even though their quality was far inferior. The conversation can now emerge over a shared experience, albeit between an expert and an amateur. In addition, this first-hand experience increased the sensitivity and empathy towards the craft. Experiencing the practice was not meant to turn the designer into an expert potter but to encounter the material and the practices as active components to prompt questions about them. As the collaboration gained specificity, the flow of ideas shifted away from generic issues towards Roberson's unique crafting practice and her identity as a craftsperson.

The tension between form and function stood out as a recurring dilemma throughout Roberson's work. As a craftsperson, she creates her pieces with the intent that customers will use and interact with the pieces. This is evident in a signature colorful detail that she creates at the base of each vessel, a detail that is only revealed through interacting with the object: one has to pick up the cup and turn it around to see her signature glazing on the bottom. However, many of her pieces end up not as functional objects but as gifts and display ornaments. Roberson recounts her own grandmother, who would not use the pieces as she deemed them "too pretty". In contrast, Roberson intends others to see and "use" her objects, uncover specifics, and manipulate them.

2.2 Exploration: Developing the Brief

If the investigative approach of the craft and crafter is a phase of research *into* craft, then the brief is the hinge which turns the collaboration to a research *through* craft and design (Frayling, 1993). As with most design briefs, it consists of a goal, constraints to work within, and is formulated between "motivation" and "creation" phases (Cross, 2008). However, some important aspects of the brief stood out in our case.

2.2.1 Role of the Brief Development

Up to this point, the perspective was that of the designer approaching the craft. The brief is developed by the designer as a concluding response that forms a turning point. We observed that the designer stands on fertile middle ground; the designer has gained insights on the craft practice and the practitioner and understands the motivations which drive the crafter in her work. At the same time, the designer is conscious of his training to integrate other, often diverse fields into a cross-disciplinary process (Owen, 1990). In contrast, crafters are trained on a specific material manipulation processes first and foremost. This difference of breadth versus depth between the design and craft practitioners was observed also in other collaborations (see (Tung & Chen, 2013)). Thus, the integrative nature of the design process supports the role of the designer as the developer of the brief. This brief should not only bank on the opportunities identified in the previous phase, but also exploit the strengths and motivations of both designer and crafter to drive a successful collaboration. This focus on process differs from the more uni-directional client-to-designer problem statement that defines a typical design brief (Cross, 2008).

In practice, the brief should be anchored in a shared object that is able to connect both practices and create opportunities for the collaborative object-making process. Besides anchoring the collaboration to a type of object, the brief also divided the work between crafter and designer. Neither crafter nor designer were experts in the other's domain. Consequently, the goal was to provide sufficient constraints, yet leave enough room for crafter and designer to explore within their own domain.

Lastly, our brief follows Amabile's consensual assessment - evaluating the outcome based on the judgment and expectations of both crafter and designer. This differs from a more formal, criteria driven evaluation approach found in a typical design brief (Cross, 2008). The brief had to be accepted by both collaborators and serves as a catalyst setting a new trajectory for craft and design to collaborate. Building on Ingold and Hallam's emphasis on improvisation in craft practice, we propose that the brief affords a process, which is malleable to the "surprises" that might emerge.

The brief marked the start of the task-driven and object-focused collaboration between crafter and designer.

2.2.2 Brief: Building an Interactive Lamp

In our case, the brief called for the creation of an interactive lamp. We were less concerned about the novelty of the object as a product (commercial interactive lamps exist) but about the appropriate framing of the next collaborative steps and the connection to the various creative practices. Its targeted outcome was not seen as a product but instead as a shared common ground for engagement.

The nature of the lamp object relates to Roberson's interest in electronic dance music and use of vibrant glazes as well as playful trademark details within her ceramics. It specifies a tangible user interaction with the lamp, where the movement of the lamp affects the hue and colour of the light. While this interaction model via object manipulation is fairly typical of tangible interaction design, it was included to support features which were personally unique and important to Roberson. The fact that a lamp needed to be picked up to function related to her concerns about the detachment of the objects from their function.

2.3 Implementation: Sharing Lamp-Making

The lighting component of the lamp was based on readily available RGB LEDs but the sensing system proved to be more challenging. It is impossible to embed electronics in clay that will be fired at around 2,300 Fahrenheit. This meant that the electronics had to be assembled onto the finished ceramic. It also meant that the ceramic needed to be constructed with this later assembly in mind. Both are non-typical conditions for the crafter as well as the interaction designer.

Figure 3. Lighting component design and implementation.

In the implementation, this led to the choice of accelerometers to sense the interactions, as they can be connected to the ceramics without disrupting the craft process. The accelerometers in turn informed the first interaction model of the lamps—the hue of the light is affected by the lamp's tilt direction, while the saturation of the light is affected by the tilt magnitude. This also allowed for gradual improvements of the interaction through reprogramming. The interaction design addressed a key concern of Roberson with her existing objects. She had complained about the non-use of her objects as they had been deemed "too pretty" to be touched. Yet, the interaction design required users to "pick up" the object.

The implementation went through iterations of divergent and convergent phases. During the divergent phases, the crafter and designer engaged in individual exploration, developing their respective components. During the convergent phases, the prototypes were assembled and evaluated.

2.3.1 Divergent Phase I: Independent Development

The housing and assembly of the electronics to the ceramic lamp body was the focus of the designer. Prototypes iterated through initial breadboard models, to more robust packages encapsulated with a custom-made chassis. Eventually, a clamping method was devised to secure the electronics to the ceramic body. This required a small hole to be introduced at the base of the ceramic lamp body, a standard procedure in ceramic craft.

Figure 4. throwing the first ceramic lamp shade prototype.

The form, size and texture of the ceramic body was the crafter's focus during this phase. The exploration began with paper sketches for possible forms of the lamp, as a reflector of light and as a form for users to hold and interact with but also as an object in itself with its presence in a room. A few forms were eventually shortlisted and turned in clay. These pieces were then fired with different colour glazes.

2.3.2 Convergent Phase I: First Assembly of Object

The assembly of the first prototype met the initial expectations of both crafter and designer. The lamp can be comfortably picked up, and the form afforded the interactions of tilting and turning. The electronics functioned inside the body and responded accurately to the interactions.

Figure 5. Assembled first prototype at work.

However, new considerations emerged through assembling and interacting with the first prototype. The glaze used was glossy and smooth and it raised the issue of the user's hands slipping during interaction. With respect to the electronics, the exposed LEDs were too bright to look at while interacting with the lamp. This critique of the prototype involved both crafter and designer and often reversed their roles. The designer would argue about the glaze and the crafter critique the light fixture. The object involved both participants in a shared reflection of the decisions made in the divergent phase and enabled both to engage in a better understanding of the collaboration process.

2.3.3 Divergent Phase II: Improvement and Iteration

The second divergent phase focused on addressing the areas of improvement identified in the first prototype. If the first divergent phase was based on the brief, then the second was based on the object (see Figure 5) and its shared discussion.

With respect to the ceramic lamp body, the crafter began experimenting with a new glaze which fires to a matte finish and mitigated the slipperiness of the first prototype. As for the electronics, a custom circuit board was fabricated to organize the wiring, while the code was modified to dim when a user interacts with the lamp, minimizing the glare experienced.

2.3.4 Convergent Phase II: Changes based on the Object

The crafter produced a ceramic lamp body with a different size and form for the second iteration. The electronics and ceramic lamp body assembled seamlessly and the new matte glaze provided an improved friction to the touch. However, the lamp's new form (that of an overturned cone) and its slightly larger size, made it difficult for a user to interact with the lamp in the same way as the smaller first prototype.

Figure 6. Different interaction methods explored with the second prototype.

Instead, the second prototype encouraged the user to pivot the lamp on the edge of its base, which then enables it to roll along its circumference. The designer had been unaware of this weight change, and the crafter had been unaware of its possible impact on the electronics. This new affordance required an improvisation of code optimization, which was quickly adapted to support the new interaction model. This surprise that emerged during the second assembly, and the improvisation that followed, gave rise to a different interaction concept. At this point, both designer and crafter had become more familiar with each other's process and domain. With the two prototypes as reference, the discussion went beyond improvements of the existing models. New approaches to develop interactive ceramic lamps, as well as innovative ideas for the different lamp components were raised.
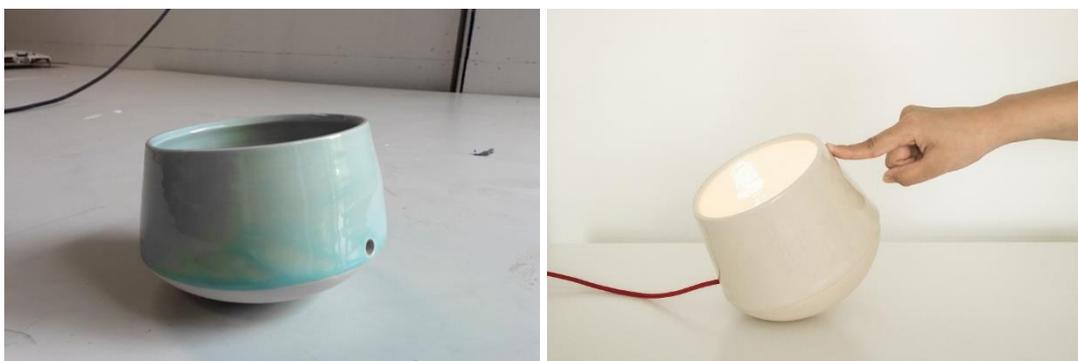
Figure 7. "roly-poly" variations; reflecting the manipulation technique in the shape of the lamp shade.

The collaboration between crafter and designer continued and more ceramic forms and interactions were explored, including the 'roly-poly' form as well as a new method of organizing the cables and electronics with the ceramic lamp body. We interpret these later steps toward the development and optimization of a possible product as signs for a successfully initiated collaboration. As establishing this collaboration was our declared goal, we exclude further development and iteration of the lamp and instead look back at the example project to combine craft and design as separate practices.

2.4   Evaluation: Consensual Assessment

The outcomes of each iteration were evaluated against the emerging expectations of the crafter and designer. Amabile's consensual assessment technique argues that "a product is creative to the extent that expert raters independently agree upon this judgment" (Amabile, 1996). This serves our goal of establishing a collaborative practice as it depends on shared engagement with the object. The *personal* and *domain* impact of this collaboration both provided evidence in support of such an assessment technique. Roberson varied her *personal* crafting and glazing techniques in reaction to the outcomes of each iteration—"This rounded form is good to hold, but I want to see how an open form will change the quality of light", and "I want to try a more neutral glaze to see its effect on the different color hues", were quotes in direct relation to the interaction design and exemplify her engagement with the collaboration through its objects. The collaboration pushed the designer to continually reassess the interaction design and programming of the embedded electronics. He reflected that "the variation in weight, texture and form of each ceramic piece presents a different set of affordances" and pushed him to consider "new tangible interaction models consequently different electronic behaviors in response to Amy's [Roberson] pieces".
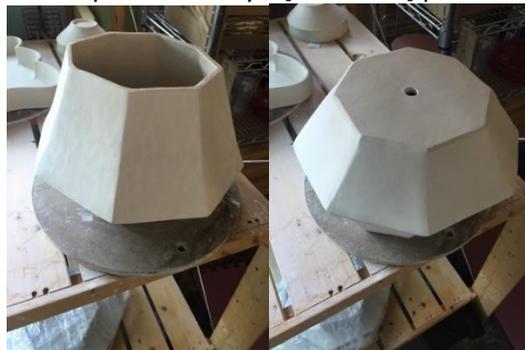
Figure 8. Facetted variation; inspired by responses from peers.

Furthermore, the outcomes of each iteration catalyzed discussion and idea generation among Roberson and her peers at Mudfire gallery (her *domain*). Roberson reported on an impromptu discussion with her peers about "incorporating electronics into ceramics" while she was working on her part at the studio, resulting in several new ideas, one of which was a "faceted lamp body that changes the lighting effect as it rests on different faces". These were conceptualized without the designer and indicate possible extensions of the model to reach wider collaborating partners within the targeted craft *domain*.

3   Developing the Synthesis Model

Tung et al. offer a helpful designer-crafter collaboration model (Tung, 2012; Tung & Chen, 2013). Their case studies outline four stages, namely a "fuzzy front-end stage", where crafters and designers got acquainted and designers explored the craft, a co-creating stage, where directions and concepts were established, a co-prototyping stage, where the concepts were implemented, and a feedback stage, where stakeholders evaluated the process and outcomes of the collaboration. Much of this corroborates with our case study. For instance, we also find the initial investigative phase to

be important in establishing a common 'language' between both parties, easing the differences in practice as well as concept explorations.
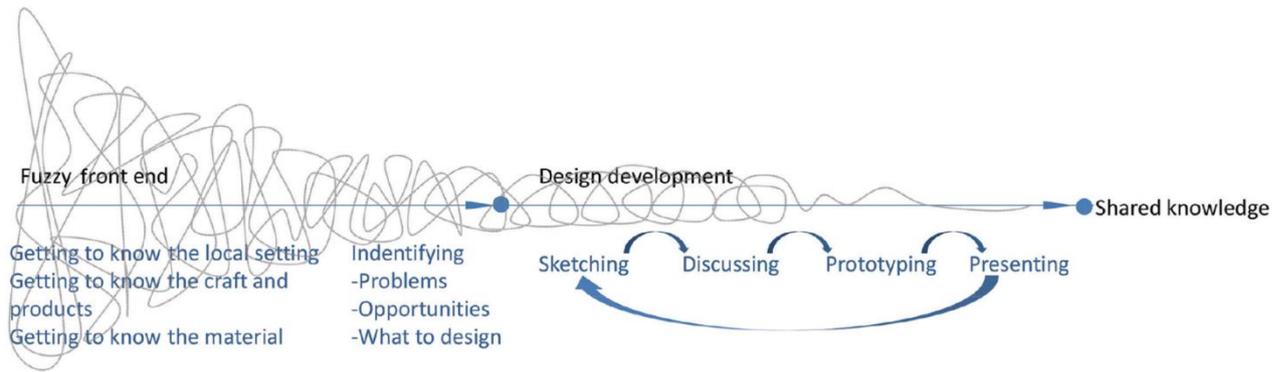

Figure 9. Tung's craft-design collaboration model [28] based on Sanders/ Stappers

While the process and themes were similar, there are notable differences. This paper outlines a model for fairly long-term collaborations between crafter and designer. This poses numerous challenges when compared to a shorter-term 'workshop'-style collaboration. Rather than a co-prototyping phase, which tightly couples the design and craft processes at an early stage, our case study revealed a need for individual exploration leading to subsequent assembly and evaluation. We observe that these individual explorations were also helpful in pushing designer and crafter to innovate on a domain-specific level, while keeping the shared brief in mind. In our case, the designer had to develop various physical joints to attach the electronics to the ceramic, without actually having the ceramic part yet; while the crafter explored additional techniques beyond turning to create forms that respond differently to the accelerometer. This cyclical process of co-investigation, individual exploration and assembly may prove to facilitate a longer-term craft-design collaboration beyond a single project. We can summarize these phases to our model for collaboration across craft and interaction design domains:
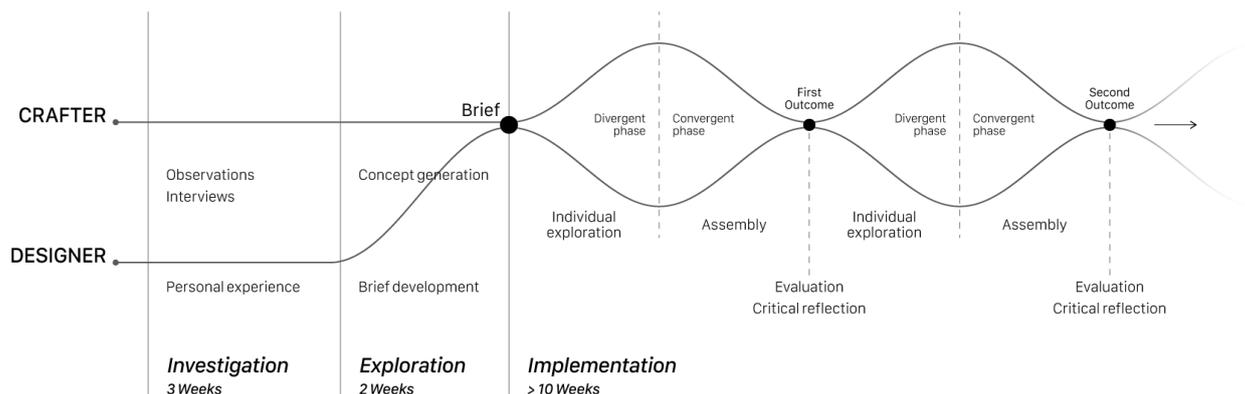
Figure 10. Collaboration Model

Our approach leverages the separate fields of expertise of crafter and designer as distinct and operating at times in asynchronous practices. The "fuzzy front end" appears less "fuzzy" and more distinct yet divided, whereby the initial division is not a problem but the basis for later creative

collaboration. This approach is both critical as well as experiential and enables the designer to formulate the brief. This brief stands out as a distinct focal point for both collaborators.

The brief is a turning point and establishes a collaborative feedback loop between crafter and designer. This dialogue continues over and through the emerging objects. These objects can neither be classified as speculative prototypes, nor as finished products, but as Ingold's things. The thing carries the qualities of a crafted object – including the weight, tactile affordances, and light properties. At the same time, these emerging qualities converse with its interaction design – including the code, the sensors, and the light emitters. As the designer noted in reflection: "I am accustomed to specifying every aspect of a 'product', from measurements to materials to color and texture. For this collaboration however, I felt like I was designing a system to work with the craft." The result is a process that assembles both practices over the evolution of a dialectic object. Notably, the thinking is not "*embodied in the artefact*" (Frayling, 1993) but the object itself offers active surprises that contribute to the shared development process.

Herein lies another difference between the collaborations outlined in Tung and our case. Unlike the collaborations discussed by Tung & Chen, commercial viability was never a consideration in our set up. Instead, we focused on the process as critical practice to combine creative collaboration. In this regard, our model responds to the notions of "critical making" outlined earlier. Here, the object serves as a stepping-stone for a critical engagement. *Making* is foregrounded with the objects providing reference points for the critical production and discourse work (Ratto, 2011). While we agree with the role of the shared object as part of the critical process, these shared objects stood out not only as traces but also as actors. They are reflective as well as creative. The object, as Mäkelä argues, can become "a method of collecting and preserving information and understanding" (Mäkelä, 2007). But while it is a collection method for Mäkelä's "artist-researcher" it becomes an operational tool for separating crafters and designers in our case. Scrivener suggests the term of a "knowledge artifact" that is "intended to inform" (Scrivener, 2002). Through the prevailing differences between crafter and designer, this "information" is no single message but a conversation that allows for the necessary divergence and convergence to develop. These developments have all the traits of a possible learning process, however the set-up of our study was not directly aimed to prove learning but explore collaborative options. The three stages of investigation, exploration, and implementation situate the key elements of our model: approach and brief, divergent and convergent phases centred around critical objects, that foster a dialogue instead of a merger of design and craft.

4   Conclusion and Outlook

Our model builds on existent concepts such as the Kellers' umbrella plan (Keller & Keller, 1994) but realizes them in a distinct dual approach. As a collaborative model, it allows to bridge the three identified approaches of craft and interaction design work: *technological*, *ethnographic*, and *craft-based* approaches. While the *technological* side is largely covered by the interaction design and the *craft-based* side by the collaborating crafter, the *ethnographic* approach realizes through practice: the initial approach of the designer to the crafter, the emerging collaboration, the focus on the object itself, and its settling in the community, as seen in the domain adjustment of the crafter in her gallery.

The challenge gains an anthropological perspective (notably Janet Dixon Keller and Tim Ingold are anthropologists) and builds on existent work that leans into that domain (e.g. (Goodman & Rosner, 2011)). We present a model for a constructive collaboration between the two domains that does not attempt a direct merger. Diversity between craft and electronics has already been noted as a defining quality criteria (Buechley & Perner-Wilson, 2012) and in our case, diverse practices realize through maintaining a collaborative but distinctly dual process. We did not attempt a teaching exchange, nor did we test for pre- or post-knowledge levels. But a benefit that emerged from our approach is the change of perception of the "other's" practice. The crafter was able to comment on

and contribute to the interaction designer's work and the designer reflected that "this relationship with the craftsperson removed the possible biases" on his side.

This paper outlined the underlying conditions and approaches, presented a sample realization of the model, and captured the underlying model that emerged from this work. Key components are the initial approach of the designer to the crafter, formulation of the brief, and the creative role of the shared object as a platform for discourse to unfold. We propose our current model to researchers as well as practitioners who work in the converging (and at times clashing) fields of interaction design and craft. It suggests an alternative to the proclaimed merger of craft and design into a new creative practice and offers a model to support this emerging area.

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About the Authors:

Michael Nitsche works as an Associate Professor of Digital Media at Georgia Tech. His research combines craft and performance to design new media and creative interaction with them. He has published in Media Studies and HCI and is co-editor for Digital Creativity.

Clement Zheng is PhD student at the ATLAS Institute, Boulder, and an industrial designer, researcher and educator. His work spans computational design, making and tangible interaction design to support other designers in their creative process, especially as they integrate digital fabrication.