Situated Design: Toward an Understanding of Design Through Social Creation and Cultural Cognition

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ABSTRACT

Video and transcripts of two architectural design meetings are presented in an analysis of a specific design process. The focus of the analysis presented here is the social and cultural aspects of cognition in design. The argument begins with a discussion of the parallels in design studies and cognitive science as each begun to consider the importance of environmental influences in how we design and how we think. By applying three situated frameworks to understand the situated nature of design meetings, the analysis shows that notions of social creation and cultural cognition are complimentary and necessary when trying to understand how the design process works.

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Author Keywords

Social Design, Collaborative Design, Empirical Study

INTRODUCTION

Over the past fifty years cognitive and social science has begun to look at the situated nature of human cognition. These perspectives have ranged from conceptualizations of cognition that account for the interaction between people and artifact [19], to the highly contingent and situated nature of cognition [15, 36], to explanations of cognition deeply embedded in culture and socialization [34, 37, 42]. Some of these perspectives, like distributed cognition and situated action, stem from a radical re-thinking of human cognition that argues "the traditional internal symbol process view of cognitive science has mistakenly attributed the properties of a complex, *cognitive system*, comprising both the individual and the environment to the individual mind" [29]. Here, the *cognitive system* can be understood as culture which includes the social, psychological, and material textures of human existence that provide a structure within which we learn and express ourselves.

At the same time, studies in design research have begun to consider the social construction of design. Over a roughly similar time period, design researchers have moved away from the designer as an individual font of creativity (e.g., [24, 33]), to designer as social member in a collaborative endeavor (e.g., [5, 7, 25]). Brereton in particular pointed out the role of social negotiation in the design process and attributed how well the design to the success in which the team was able to negotiate the collaborative design process [5]. This represented a real departure from traditionally romantic notions of creating a successful design strictly via the expression a single designer.

In both domains, the shift from notions of cognition and design as internal properties or expressions of a person to an acceptance of these as social or cultural phenomena has largely gone on independently. In cognitive science, this shift toward considering cognition that is *distributed* through the environment, *encultured* in practice, and *situated* in a particular social context has been collectively referred to as an "environmental perspective" [29]. And while the theories that inform these different views are some times at odds with each other [17, 28], they each foreground the importance of the environment in forming and enabling cognition.

Design research, however, has yet to develop an analogous environmental perspective of design; one that provides insight into different design processes across scales from individual designer, to the team of people collaborating on a design, to the culture of a particular design practice. This paper is an attempt to cross pollinate ideas of cultural cognition from cognitive science as useful for understanding the design process. In order to examine how and whether an environmental perspective of design has any basis in a real-world design context, video tape of architectural design meetings were used to analyze the distributed, encultured, and situated aspects of the design of a crematorium. The analysis presented here demonstrates how notions of cultural cognition are relevant to understanding design and provide a lens through which to understand how design occurs at different scales of interaction—from the individual designer, to the group, to the professional practice.

Social Creation in Design

Earlier work in design research focused on the individual production of design [24, 33]. While these explanations of design provided some account of interaction with the social world, such interactions were largely viewed as form-

ing constraints on the internal work of the designer [24]. In these early works, design researchers were still dealing with romantic ideals of the designer and they did not take into account the rich social interactions that occur throughout the design process.

Several different researchers have since sought to bring in a broader understanding of the social world in which design is situated. In parallel work, Brereton *et al.*, Cross and Cross, and Radcliffe focused on the role team dynamics played during the design of a bike rack [5, 7, 32]. Their work marked some of the first efforts in design research to advance the consideration of social context in the design process.

The relationship design has to creativity represents another front in moving the understanding of design away from the individual actor toward one that is socially situated. Here again, the traditional view of creativity has lent itself to the presumption of the creative individual [4, 10, 21]; however, as others have pointed out, such a view of creativity undermines our ability to accurately assess the importance of the social setting as enabling and enhancing creativity [14, 40]. This argument flies in the face of conventional wisdom; the collective is not often seen as being a particularly creative entity as anyone who has had to suffer through design-by-committee knows, but Warr and O'Neill argue in part that the shortcomings in collaborative creativity have more to do with the social mechanisms that have been employed to support creativity than on human capacity for working in groups [40].

By recognizing the potency of the creative group, it is also necessary to recognize the need for varied points of view within the group. Importantly, the move toward considering the social setting of design must also consider collaboration that includes non-designers. As an example of how the social situation informs the design process, McDonnell analyzed the social roles that designer and client don during collaboration and showed that they are only partly informed *a priori* [27]. She found that throughout a collaborative design meeting, roles are renegotiated as part of the dynamic exchange in expertise. Her findings are consistent with Jones, who studied how artists and technologists collaborated to create new forms of expression, identifying the cultural exchange of domain expertise as a critical component to design [20].

Using the notion of cultural exchange from Jones, it is reasonable to consider the collaboration between designer and client a variant of collaboration between individuals with different domains of expertise. While some have endeavored to model this cultural exchange [11], more recent work has examined in more depth the different aspects of social creation in design. Le Dantec and Do revealed how value transfer occurs during design meetings [25]. They claimed that the introduction of values into the design discourse is an important component in the development of a shared understanding of the design space, and represents a key component in enabling the designer and client to asses the design. In a related study, Luck examined how idea production, ownership, and conflict resolution are handled within a collaborative design meeting [26]. By analyzing the spo-

ken interactions, she was able to identify how participants in a design meeting recognize different non-tangible attributes of the design that might be beyond their expertise. By focusing on how designers engage with their clients, these researchers have been able to call attention to social design processes that are more difficult to identify when everyone in the room is an expert. This understanding in turn deepens the understanding of design as an intensely social practice and not simply a synthesis of training and creativity.

While the views within design research have moved to an understanding of design predicated on social interaction, the field has yet to look at how the context of design impacts the cognitive process of design. In considering how design is socially situated we also need to consider how cognition is socially situated, and let a broader view of cognition inform our understanding of design beyond the sociology-of-design meetings that has been described here.

Cultural Cognition in Design

Cultural cognition, as the term is used here, refers to both the role of the environment and of the social practices— professional or otherwise—that support cognition. Hutchins' work provides the basis for understanding an environmentally informed notion of cognition [18, 19]. His development of distributed cognition places an emphasis on understanding cognition as a coherent system of people, environment, and supporting artifacts. Two examples that lead to the formation of distributed cognition dealt with systems that easily lent themselves to cognitive description: the bridge of a ship and the cockpit of an airplane [18, 19]. In both cases, Hutchins looked at the entire scene as one cognitive unit rather than focusing on individual actors within the system. In this way he was able to see the entire bridge and cockpit as a cognitive systems and the individual people, instruments, and channels of communication as components in that system.

In the types of systems that Hutchins investigated, the metaphor of cognition as computation is easily mapped to the larger system. Both the ship's bridge and the airline's cockpit are computationally rich environments; input arrives into the system via a combination of instrumentation and human communication, and that input is used to compute all of the variables that go into correctly setting course and speed.

Moreover, the procedural nature of ships' bridges and airplanes' cockpits help expose the distributed cognition as it takes place. Yet other domains that are not as procedural can be usefully understood under distributed cognition as well. In Alač and Hutchins' investigation of how novice's learn to interpret functional magnetic resonance images, they examined the embodied nature of instruction [1]. By characterizing the types of charts and physical gestures that accompany learning, Alač and Hutchins demonstrated the rich interaction between external cognitive artifacts, social interaction, and distributed cognition [43].

The social practices that inform cultural cognition build on Nersessian's investigations of biomedical laboratories [30]. While Nersessian holds with the general notions put forward by Hutchins, e.g., considering "cognitive artifacts as mate-

rial media possessing the properties of generating, manipulating, or propagating representations" [29], she demonstrated that these media are not fixed tools within the context of the lab but are constantly being re-purposed or redesigned in *ad hoc* response to problems that arise during experiments. This departure from Hutchins' sense of cognitive artifacts as fixed media provides a level of fluidity necessary for the framework of distributed cognition to be more ably applied to broader, creative, domains. Furthermore, it reinforces the social practices and negotiations that drive evolution of the cognitive media.

By starting with the *ad hoc* re-design of cognitive artifacts in the laboratory, we can begin to overlay a similar notion onto the cognitive system of design. In an exploration of *ad hoc* design in the home, Wakkary and Maestri identified a number of patterns that home-dwellers use in re-appropriating aspects of the domestic environment for problem solving [39]. Many of the patterns that were presented in that work can be viewed in the light of distributed cognition: e.g., the sorting of mail to identify important bills can be viewed as a cognitive artifact; likewise, the use of the shared whiteboard calendar can also be incorporated into a holistic view of the home as a cognitive system with shared media. In both cases, the cognitive media within the home arise from the environment and from the social relationships present and shed light on how we should expect to see similar phenomena present in formal design practice.

Like the laboratory, collaborative design requires a level of fluidity in how cognitive artifacts are explained within the system [27]. The need for fluid reconfiguration comes in part because of the specialization that comes with design training. Specialization in turn requires that groups of designers with complimentary skills work together, making collaboration necessary since no one person can know everything about the design. This situation leads to a state Fischer calls the symmetry of ignorance [8]: with specialized knowledge of how to solve a particular design problem distributed amongst designers and users, it becomes necessary to use external objects to express knowledge, build models, and come to a shared understanding. Yet this shared understanding and the cognitive tools and media that are employed to reach it are fluid and reconfigurable around the specific knowledge and practice represented within the context of collaborative design.

The social creation that occurs within design and the cultural and distributed qualities of design reasoning suggest that an environmental perspective of design should be able to weave these different elements together into a complimentary view.

METHODOLOGY

While Hutchins' and Nersessians' contextual investigations discussed above were ethnographic in nature [18, 19, 29, 31, 30], the analysis presented here uses data from a study of two architectural meetings and builds upon an earlier analysis of these meetings that focused on the role values play in the design discourse [25]. Both design meetings were video recorded from several angles, providing wide views of whole-group dynamics that enabled analysis of gesture and body language, as well as a top-down view of the ta-

ble that permitted the observation of drawings, sketches, and tools that were used during the meeting. The videos were analyzed for actions such as gestures and sketching from any of the meeting participants. Transcripts of the meetings were coded using a grounded approach to qualitative analysis: codes were developed based on the conversational interaction and recorded gestures of the meeting participants, the meeting data was then iteratively analyzed against the codes with particular attention placed on the negotiation of shared conceptual frameworks as participants discussed different aspects of the design.

While the recording equipment was visible to the meeting participants, every effort was made to be unobtrusive when collecting the data. A researcher was present during the design meetings, but did not participate in the design discourse and only interacted with the meeting participants a few times at the beginning of the meeting during equipment setup, and toward the end as the interaction became more casual. The meetings took place at the building site, and aside from the presence of an observer and equipment, represent normal interactions that occur between architect and client.

The recorded meetings took place seven months apart and represent mid- and late-design milestones in the design of a crematorium. The first meeting was between the head architect, Adam, and the two clients, Anna and Charles.[1] The stated goal of the first meeting was to familiarize Anna and Charles with the details in the design Adam had completed. To that end, Adam presented a number of drawings of the building design to familiarize the clients with how the design would accommodate the requirements of the project.

The second meeting was primarily a review of changes discussed during the first recorded meeting and a chance for final modifications to be made prior to the project moving forward into planning. A number of architectural drawings were again presented along with new 3-D renderings of the building and site plan. A second architect, Tony, was present at the meeting, along with a project manager from the architectural firm, Sally.

Throughout the presentation of the meeting analysis, references to the first and second meetings are presented as A1 and A2 respectively.

ENVIRONMENTAL PERSPECTIVE OF DESIGN

By analyzing design with an *environmental perspective*, we can see how several different frameworks can be woven together to illuminate the complex nature of design. The key to looking at design in this framing is to acknowledge that design is not something that is done in the abstract, but rather an activity that is necessarily connected to its real-world expression. The context of the design, both in terms of how and for whom, cannot be intelligibly stripped away when studying how design happens, how designers think, and how stakeholders collaborate around the design. Each of the following sections include examples from the transcripts that demonstrate how the distributed, encultured, and situated aspects of design are made manifest in a design meeting.

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[1]Note that the names of the meeting participants have been changed to preserve their privacy.
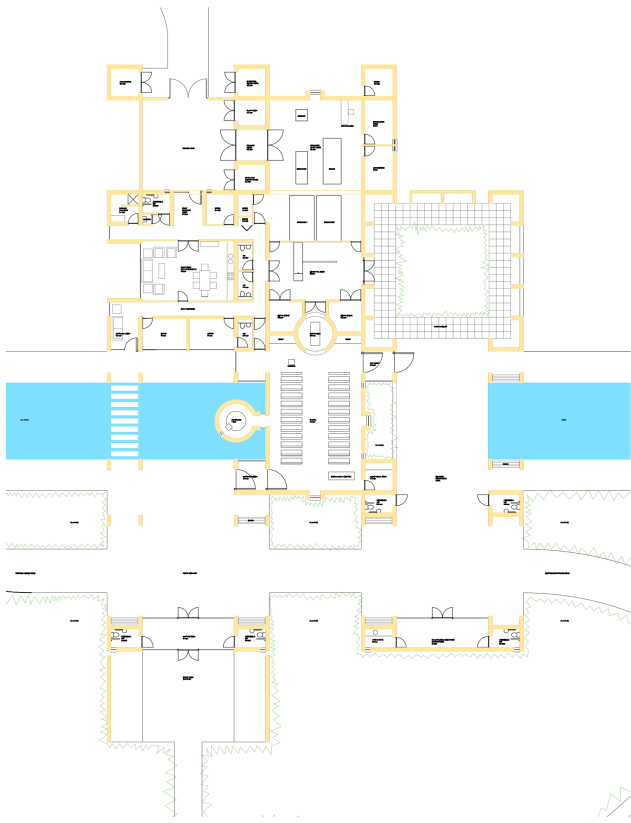
Figure 1: Crematorium site plan.

Distributed Cognition in Design

In both meetings, but especially in A1, building a shared representation of the crematorium design was a priority. Without a shared understanding, neither Adam, nor Anna, nor Charles could begin to assess if the design would work in the real world. By the time A1 was recorded, much of the initial and more tenuous planning had been completed and Adam arrived at the meeting with a complete, but not final, set of plans. It was around these plans that the meeting took place. The site plan that Adam brought became the main focus of the meeting and acted as a repository for design modifications (see Figure 1). It was the medium used as long term memory for the design and served as a shared artifact that each of the people in the meeting could access as they discussed the progression of the design.

The setup of of the meeting informed how cognition was distributed around the room and amongst the members of the group. As noted above, the site plans were in the center where everyone had access. Additional tools for calculating scales, drawing modifications, taking notes, and providing external reference were also available though not to every person at the meeting. For example, neither Anna nor Charles had access to modifying the site plan. They could gesture and point but they were never in a position to update the shared representation themselves. This point is interesting because it shows that while everyone could access the site plan as a form of shared representation, only Adam, as the architect, "owned" the plan and was allowed to make changes to it.

Throughout the design meeting, as different ideas or changes were suggested, Adam sketched the changes onto the site plan. Adam's sketches took place on tracing paper placed over the plan, a practice that enabled experimenting with several changes without actually scaring the plan and making the current state unreadable. By making modifications directly to the external media of the drawing, Adam updated the shared representation that everyone in the room had access too. The act of sketching played an important role in the design meeting and is consistent with previous work on sketching and design [2, 13]; however, beyond sketching, gesturing and pointing also played important roles in how the different members of the group accessed the shared representations and made "calculations" about the design should develop.

The use of gesture in conjunction with sketching enabled meeting participants to explain and interpret details depicted on the site plan as well as enact hypothetical modifications to the plan. Gestures provided a mechanism to indicate activity, scale, relationships of different building features, and direction or angle of view. Throughout the design meetings, gesturing was the main vehicle for inscribing meaning and solving problems around the design. Despite the impermanent nature of gesturing, it was used repeatedly and effectively to communicate complex concepts without requiring the specialized training associated with sketching. The effectiveness of gesture and the way it was shared between all members of the group exemplified both how multiple members with multiple specializations contributed to the distributed system, and how design is an "activity of the mind…grounded in mechanisms that evolved for interaction with the environment" [43].

Over the course of the first design meeting, Adam's and Anna's use of gesture converged as they developed their understanding of the design space. For example, in Extract 1, Adam explained how the funeral cars would arrive, where the hearses would park, and how coffins would be off-loaded and taken into the building for the service. There were a number of activities being explained, and in order to understand how each activity related to the other it was necessary to make transient changes, by way of gesture and sketching, to the site plan.

Gestures were also used when talking about features of the design that could not be communicated by the flat site plan. In the analysis of video from A1, Adam used large, sweeping gestures to describe the shape and placement of small windows in the crematorium's antechapel (see Figure 2). The gestures, in conjunction with details from the transcripts, indicated direct representations of shape and size but also had a metaphorical quality of how the space would engender calm and support the building's purpose as a place of mourning (see Extract 2). In this case, the use of gestures to express both physical properties and metaphoric qualities is consistent with the findings of Casasanto and Lozano in their investigation of the role gesture plays in activating abstract concepts [6].

Through the course of sketching out changes, Adam used an architect's scale, which he kept adjacent to the drawing. An architect's scale looks much like a three sided ruler and

Extract 1: A1, Gesture and sketching.

Adam	that wasn't the idea I was anticipating that the hearses would be parked here [sketches]
Anna	were there OK that's fine yeah
Adam	exactly as they are at the moment that the coffin would be drawn out here and they would simply [points] walk it in I wasn't thinking that they'd try and park
Anna	no that's OK
Adam	in there
Anna	yes well that's what they're wondering how that would work then so we'd work I wasn't quite aware
Adam	we'd work it exactly the same way as the present system I mean maybe this should be made more obvious by perhaps a different colour in the paving or something [sketches] I mean what I'm trying to say here is that that's the vehicular line [sketches]
Anna	yes
Adam	and that these areas [points] are for people to mill about in and you've got
	a place for people to stand
Anna	yes they will probably want to know how [points] how + how far that is
	from the because they're going to be possibly carry the coffins in and most of the men are sort of in their seventies and eighties [laughs] carrying the coffin

easily enables translation between real-life measurements and the most common scaling factors used in architectural plans. Being able to quickly translate between the drawing and real-life measurements was necessary for Anna as she attempted to assess the fitness of the design. In Extract 3, Adam explained a cross section drawing for the building and used the scale to draw in a small figure for Anna. Adam modified the external media of the drawing to aid Anna's understanding of how the plan related to real-life by using the scale and drawing a representation of a person in the cross section of the building. These changes to the media were not in response to negotiated changes to the design, rather, they enabled better translation of information across the media to account for different speicalizations.

The use of the architect's scale was one way the design was repurposed to enable different group members access to the details of the site plan. This re-purposing of artifacts was very similar to the kinds of repurposing of equipment Nersessian observed in the laboratory [29]. Throughout the meetings Adam made small changes to the plans, usually through little sketches, notes, or by holding up items that would help establish scale. This repurposing was necessary as the types of problems being tackled in the design meeting were not fixed in nature; some issues might be about the size of a doorway, the height of a ceiling, or path the parking lot followed. Yet the site plan had to provide affordances for all of

Extract 2: A1, The use of stained glass.

Anna	I'm thinking of COVENTRY CATHEDRAL with the
Adam	oh yeah I know what you mean I've shown a very tall narrow slitty window which faces directly south if my orientation is correct or is it west
Anna	little bit that's north [gestures] that would be north up this way +
Adam	it faces directly
Anna	south-west +
Adam	it faces directly west to get the setting sun in it that was the original idea I wanted to give you a small view of the pond as you came in and you get a small view through it of the pond but if it's stained glass it'll be a much more intimate space again top lit so you get sun and feeling of any cloud movement overhead but essentially it's a very private sanctuary that's why it'll be the sanctuary on the plan

Extract 3: A2, Use of architect's scale.

Adam	this is what we call a section it's really a slice through the building and this shows the cremator room here at the moment I think I've got a scale here [shuffles papers] somewhere ( ) a scale of one mil to one hundred yeah so it's ++ from floor to the soffit there is four point nine metres so it's quite tall +++ I mean to get the scale right ++++ the guy would be standing there like that
Anna	OK [6 seconds pause] OK
Adam	so its quite a high

the meeting participants to manipulate any number of these different relationships. As a result, Adam would modify the plan when such affordances were missing or unclear.

In addition to being a repository for design changes, the site plan also acted as a model for testing how the design would accommodate the activities that take place at a crematorium. As above, Adam used gestures and pointing during the design meeting to indicate intended use, human traffic direction, and lines of sight. Extract 1 demonstrates how sketching and gesturing were used in developing the design with an understanding of scale and activity.

The range of activity that takes place around and on the different forms of external media show the complex nature of distributed design cognition. The discussion in design meetings was free form and the use of different parts of the site plan was not procedural as it was in Hutchins' work; yet, there are clear examples of different external media, of shared representations, and of channels of communication that are variously verbal, written, and embodied. The special expertise of Anna and Charles was mostly represented as verbal exchanges as the details of funeral services were communicated to Adam. As the three individuals worked to refine the design and participate in its development, the external media of the site plan, the tools of calculation like the architect's scale, and the act of sketching and gesturing developed as a complex system of cognition.

Enculturation in Design

While the process of group design can be described in terms of distributed cognition, the act of design also sits within a social and cultural heritage that shares traits with the social
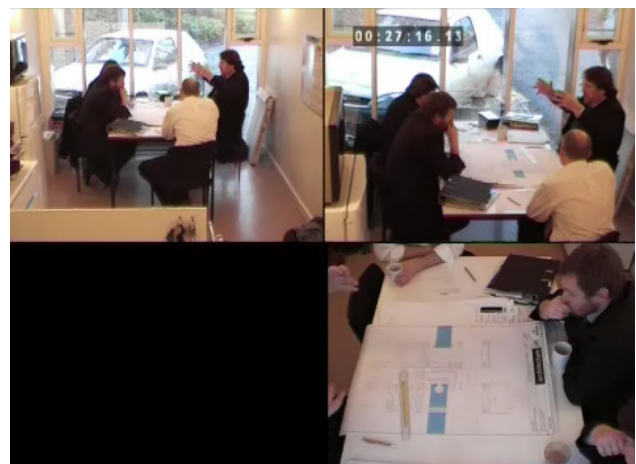

Figure 2: Adam gesturing to indicate building features.

and cultural processes that develop human cognition. Both cognition and design are formed and informed by various social and cultural forces and to expose how these inform collaborative design, we need to consider how those forces impact the design process. Talking about social and cultural forces can be difficult because these two terms are overburdened with connotation. Ghose pointed out the stickiness in considering culture and design by exposing two assumptions that get wrapped up in discussions of either: "[First,] that there exists something called *design* as ontological equipment…[that] then could accommodate architectural, industrial, communications, and fashion/garment design, woven together as it were by a common methodological thread. [Second,] that nation states have identifiable cultural, socioeconomic, and aesthetic aspirations and predictable patterns of life, which despite all their variegated heterogeneities, exhibit at least a certain identifiable common cultural substance and provide the necessary *tabula rasa* on which modern design maybe projected" [12]. Ghose's sense of culture is tied to larger grained groups of people or states whereas the version considered here is slightly more malleable to include groups of professional practice in addition to the larger cultural domain in which those groups might sit [41]. In either case the point remains—the assumption of design and culture as two monolithic concepts is problematic and obscures the nuanced influence each has on the other.

The notion of enculturated design presented here is derived from Shore's and Tomasello's work considering the cultural origins of human cognition [34, 37]. Put briefly, both argue in their various ways that the socialization of the human mind is far more important to the development of cognition than genetic traits alone. By using their notion of cultural cognition, we can begin to see that the process of design is not just situated in a particular time and place, but also in a cultural context that informs the kinds of problems and solutions that are conceived through design. In this way we can see that the culture of design would exhibit traits of evolution; moreover, as several cultures mix together through the course of collaborative design, they influence each other in a process of co-evolution. In turn, the co-evolution of several cultures leads to notions of intertextuality and the mechanisms that inform how audience and designer communicate through designed objects [3, 9, 22, 38].

One way to look at enculturation in design is by observing how different stakeholders express themselves. In the design meetings presented here, Anna and Charles represent a broader number of stakeholders not present at the meetings. Throughout the design discourse, both Anna and Charles take turns pointing out concerns that different stakeholders might have and explain the way they might see a particular requirement. In Extract 4, Anna points out that funeral directors have a particular preference for moving coffins around during memorial services. The hand-borne coffin is the stated preference, despite issues of worker safety and the availability of a mobile catafalque that would aid in the process. By representing these wishes, despite them being against what she might consider good sense, Anna is creating a bridge to the culture of funeral directors and ensuring that culture is well represented in the design process.

Extract 4: A1, Funeral director's preference.

Anna	they could use a bier yes they don't particularly like to they find it undignified some of them at the moment ++
Adam	to use a trolley
Anna	a trolley yes I mean it's health and safety it's much easier for them to do that and the original concept of this chapel was that the bier the catafalque would actually come out and meet the hearse and it would be put on to the catafalque and then they would then wheel that in on there and so that was the original idea but that never really worked
Charles	mainly because of the funeral directors
Anna	funeral directors and the fact that they've always carried coffins in through churches and things like that there's still this concept of doing it of sort of shouldering them carrying them in

Anna also works to defend the design against stakeholders who would detract from it. By being in the design process, she has been enculturated into a highly local practice of architectural design—between herself, Charles, and Adam amongst the other actors not in view during the videos—in a way that external stakeholders were not. This enculturation gives her a sense of ownership in the design and as she is meant to defend the needs and preferences of stakeholders in absentia, she is also assuming the role of defending the developing design from those same stakeholders. In Extract 5, Anna explains how she defended the form of the new crematorium to the funeral directors who did not universally appreciate the modernist shape of the building. Her participation in the design process has brought her in closer contact with design decisions, compelling to defend a design she had a hand in. Her defense of the design is not just on the merits of the design, but also a point of cultural difference between herself as a participant in the design process and the funeral directors that have not been direct participants.

The culture of the individual areas of expertise present at the design meeting is another aspect of enculturation; as mentioned above, access to modifying the site plan was strictly the purview of Adam. The reason for this is tied into the way in which the plans come be used as a dynamic external representation for all of the participants in the design meeting. By preserving a particularly strong division of labor the cognitive system of the design meeting can ensure that the external media does not get overwritten in ways that do harm to the representations held there. In essence, the enculturated practice of only allowing Adam to sketch ensures that a certain quality of sketch will be made, leading to better transfer and storage of information within the design meeting.

While the analysis done here does not endeavor to pick apart the culture of architectural practice, there is a culture and system of values that inform it. Adam's building design, having been based on the architectural fundamentals

Extract 5: A1, Dealing with negative feedback.

Anna	because I think what they can't quite see from the drawings obviously the first drawings that we've got there is the the fact that some of them have mentioned the feeling that they get from those sort of what they think it is some of the comments that have been made about
Adam	the aircraft hangar
Anna	the aircraft hangar or a chicken hut or-
Adam	[makes a sound with his lips]
Anna	I'm just pre-warning you what they might use as a comment so I don't want to make you feel you know that's what they might mention but they can't as I've said to them

of Louis Kahn's Kimble Museum, tell us something about the kind of design culture Adam is a part of (i.e. high modernism). He brought Kahn's notions of servant and served space (see Extract 8) into the design of crematorium, and in so doing presented a radical design from the contemporary crematoriums the meeting participants discussed at the beginning of A1—likening them to McDonald's and Tesco which are in turn part of a larger culture of contemporary British life.

This layer of different cultural influences creates a form of ratcheting consistent with the ideas put forward by Tomasello [37]. Advances made within the culture of architecture are applied to the design of the crematorium. These design choices also stand as a particular reaction to existing building design while incorporating knowledge about how to best support the funerary purpose of the building—including the staff who care for the deceased, the family and friends who arrive to mourn, and blend of function and spirituality that needs to be present to support both. Furthermore, by looking at the design process as one of enculturation, we can begin to understand how co-evolution occurs through the negotiation and convergence of several different cultures. It's not just the co-evolution of the design space that is occurring, it is the co-evolution of cultural engagement between two or more groups with different background.

Situatedness of Design

The physical setting for the design meeting is the most basic manifestation of the situated nature of the collaboration. The location, time of day, interruptions, and social practices (like serving coffee) are all part of the physical situation in which the meeting is set. None of these characteristics may be unique to this design meeting, but they make up the backdrop against which the human interaction takes place. The physical setting informs the contingent actions and decisions that form the collaborative system creating the design.

To that end, the design meeting centered around a table with Adam on one side and Anna and Charles across from him. On the table, Adam had a stack of architectural drawings that were used to guide discussions of the building's features. To Adam's right were a notebook, tracing paper, and drawing implements such as pencils and rulers. The layout of equipment and positioning of people in the room informed the relationship between meeting participants—for example, while both designer and client had equal access to the table and to the drawings that were placed on it, implements like pencils and tracing paper, as noted, were strictly reserved for Adam (see Figure 2). Such aspects of physical and social situatedness of the design meeting are also irrevocably connected to the enculturated practice of design, and to the topology of the distributed cognitive system ascribed to the meeting location.

Both Suchman and Greeno offer slightly differing ways of understand how the situatedness of action. Greeno's version focuses more on the impact on learning within a situated practice and pulls in perspective on design from Simon and ideas of situated learning developed by Lave and Wenger [15, 23, 35]. Suchman's take emphasizes the contingency of action within the situated context and represents a break from the assumption that action—and in this case design—can be adequately represented and understood via symbolic systems [36]. Both of these views are instructive: on the one hand the situatedness of the design meeting certainly leads to learning via the kind of enculturation discussed above; on the other, the design decisions made are contingent in nature and not specifically amenable to the kind of procedural decomposition that can follow from symbol-system descriptions.

One way to understand the activities in the meetings is as a constant re-orienting of current design moves against the over-arching goal of completing a design of the crematorium. In order for the design to proceed, a certain type of work needs to be accomplished. Looking at how each party reveals their goals to each other, and responds in turn to those expressed goals gives us an understanding of how the design process is neither a linear progression of ideas nor a set of systematic responses to known requirements. Rather, the activity in the design meeting is a collection of *ad hoc* design moves made in response to inquiries and clarifications from both designer and client.

In considering the interactions in the recorded design meetings, both meetings started with an explicit agenda. Despite this, the course of the meetings was fluid and ultimately followed a freeform process of engagement as the the designer and client worked through the design and negotiated meaning around the site plan. This point draws directly from Situated Action in that the initial plan of actions was quickly abandoned once the work of design was underway [36]. In the first meeting, it was not until over an hour into the first meeting that Adam made a reference to his agenda, and that was to say that he lost it. Up to this point, the interactions were deep into the details about the building and the conversational flow was fluid as Adam, Anna, and Charles were all more closely aligned along developing the details of the crematorium design.

By the second meeting, the agenda was used more prominently to steer the course of the meeting. Adam had to recognize that the course of the meeting had veered from the agenda making it necessary to bring it back "on track" to ensure all topics were covered. This kind of steering was particularly true when new avenues of contingent design were opened by Anna and Charles. In Extract 6, Anna and Charles had become side tracked by whether the number of cremators planned for the facility would be enough. Adam entertained their concerns for a little while but ultimately brought them back to the shared goals of the plan, pointing out that the number of cremators was decided previously and that making such a change at that time would imply a significant amount of re-work to the design.

The fluid nature of topic change demonstrates the situatedness of the design meeting; moreover, this type of fluid exchange enables creative responses to specific design problems; in several exchanges throughout the two design meetings, comparisons were made to other buildings known to all parties. The range of references included McDonald's and Tesco as examples of what not to be, Le Corbusier's chapel at Ronchamp as an exemplar of design for spiritual-

Extract 6: A2, Discussion on the number of cremators.

```
Adam    well this is fairly fundamental-
Anna    yes
Adam    deciding the number of cremators
Anna    yes
Adam    because originally there were going to be no cremators
Anna    no that's right
Adam    and then we said there were two
Anna    yep
Adam    erm if you want us to look at three this might have a fundamental
        change on the whole width of this bay and so I think we need a clear
        direction from yourselves of how many cremators we are to t- look at
```

ity, and Coventry Cathedral's stained glass as achieving the kind of effect sought in the design (see Figure 3). Because the flow of ideas was not tied to a regimented set of steps, all of the participants in the design meeting were able to add their own notions of what might work for a particular problem. Furthermore, these references were situated within the a culture of design and consumption that informed on-the-spot decisions about how to best create or break reference to culturally understood elements in order to achieve a successful design.

In this sense the meandering re-calibration of the design plan could be pointed to as a critical piece that enabled creativity in the meeting. The kind of conceptual distribution observed in these meetings was spread across all of the meeting participants, enabling each to present an idea, respond to other meeting member's ideas, and in turn generate innovation. The situatedness of the design meeting gave each meeting participant access to a greater distributed memory and a wider range of expertise on which to draw responses to the design problem.

Throughout the design meeting there were also tensions between Adam and Anna. The tension present was not of a personal nature but rather a constructive tension between the designer's goals and client's goals. The process of negotiating the differences generated an environment where each participant was continually responding to, and reformulating plans. The most common occurrence in the first architecture meeting was for Anna to question if a particular change she wished to make to the design would upset the balance of the designed space Adam had developed. In Extract 7, Anna proposed changes to the chapel layout to better accommodate an audio-visual system. In doing so she wondered if the changes she made would disrupt the design and asked Adam, "is that too heartbreaking for you." In Adam's response, we can see that he first points out the fundamental nature of the change and how it affects design principles that have gone into forming the building; however, he also responds constructively by suggesting he could come up with a solution if necessary.

Another aspect of the situated nature of the design meeting can be found by considering the situated learning that takes place when different domain experts work together [15, 16, 23]. With this in mind, we can understand the interactions that occur during the design meeting as situated learning. Not only is situated learning unavoidable, it is necessary for designer and client to being to understand the nuances of each other's domain. Adam, as the trained architect, has ac-
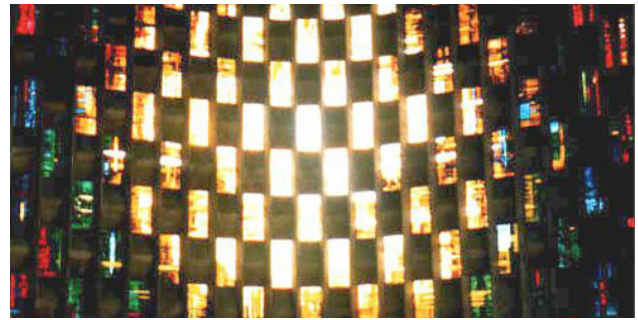
(a) Coventry Cathedral

(b) Chapel at Ronchamp

(c) McDonald's

Figure 3: Examples used during design: (a), stained-glass at Coventry Cathedral; (b) interior of Le Corbusier's chapel at Ronchamp; (c), the ubiquitous McDonald's.

cess to very specific knowledge about building construction and how to shape the built space in a way that is appropriate for the crematorium. Likewise, Anna and Charles are expert in the requirements that need to be met by the design. As they worked together, they each needed to being to understand the vocabulary and concepts of the other. This meant that while much of the design meeting was about the building, the details in the social interaction where about the concepts that were being used to construct the building and whether or not each side understood those concepts fully enough to judge how they fit into the design. This negotiation of expertise can be viewed as a dual apprenticeship in that Anna and Charles became apprentice architects and Adam became an apprentice funeral director. As the two exchanged domain specific knowledge they each took on more responsibility in engaging with the other's domain. At an early point in the design, Adam learned what a catafalque was and as a result, was better able to understand what he was designing for. On the flip side, in Extract 8, Anna and

Extract 7: A1, Discussing fundamental changes to the design.

Anna   yes that's what we're looking for but the concern that we have at the moment is whoever is operating and perhaps working some of this the video they need to be able to see sort of in a sense rather than just at an angle so what what in an ideal world and I don't want to compromise your design the door the viewing room at the existing site which is very similar to this we are putting on here so that we can then see down that way so I'm trying to think of a way that we can get them to look through maybe at this angle through here that's what I'm looking at so they're able to view near enough both sides of the chapel

Adam   yeah [begins to sketch] I wonder if it's possible to do something like that where they'd have a sort of vision spot through there

Anna   yes

Adam   I mean if I made this feel like a room with its own lid on it that was inside the chapel that was just token toke tucking its nose into the chapel we might be able to get it to work it does go slightly against the grain for me to do that but it does satisfy what you wanted and it means that we could link this up to it actually so- ++++++

Anna   OK is that too heartbreaking for you [all laugh]

Adam   well it's not as pure a summation as I was looking for but I mean maybe there's another way of doing it maybe if I keep my thinking cap on because you can see I'm trying to keep the spaces pure the purer the space the more spiritual I think it will be the more you mess around with it

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Charles began to understand the architectural principles that informed the building design and they worked that understanding into how they formulated requirements.

The overall picture that emerges here is that the situated nature of the design meeting plays an important role in informing how the design emerges as an artifact of negotiation and innovation. Learning on both the part of the client and the designer shapes the outcome and the creation of a small enculturated unit that share specific knowledge, experience and goals. The contingency of the design process also point to the importance of distributing knowledge around the design setting so that the different participants can share information and knowledge across media.

CONCLUSION

The cognitive, social, and cultural work that goes into design becomes more clear after examining design meetings *in situ*. It is the process of negotiating a number of different cognitive resources and social mechanisms that enable collaborative design to take place. Identifying the design problem, building a potential solution, and testing that solution against the activities meant to occur with and around the artifact all require access to cognitive features beyond the scope of the individual designer's mind. Building a shared representation that both designer and client can work from and manipulate is critical to moving a complex design forward.

In the analysis presented here, the facets of design that are *situated*, *embodied*, and *distributed* are not easily separated from each other: situated learning affects the adoption and convergence of gestures used during design meetings; the way the meeting is physically situated informs how different types of cognitive artifacts will be used; the cultural practices of a particular design profession and the relationship with the client affects the physical layout; and gestures and sketching cannot be separated from each other in a meaningful way. That each of these pieces necessarily informs the other shows how deeply situated design is both through social creation and cultural cognition.

Extract 8: A1, Description of servant & served space, followed by application of the new concept.

Adam   yes if I could go back to the architectural concept [pulls out drawing] on that show you where I'm coming from I've done these concept diagrams to try and explain how what holds the architecture together because the building as I mentioned before is a combination of four strips of what we call servant space which are low spaces and three strips of served space which are the barrel vaulted spaces and you put those together and you get this combination of ser- servant served servant served. . .

. . . omitted

Anna   again that will perhaps I'm trying to think of where that is in the that 1:18:00 what cover the that's the areas that you called the servant area would be the end of that then wouldn't it

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This paper began with a discussion of the similar arc design studies and cognitive science have gone through as frameworks in each domain have been created to consider the importance of our environment in how we design and how we think. As the the body of design research moves forward, it is imperative to bring a coherent set of frameworks to bear on understanding how design is done. Through the analysis presented here, three such frameworks were used to understand a collaborative design meeting, showing the complimentary traits of each framework in illuminating the rich and nuanced relationship the act of design has with the environment.

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