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A Situation Specific Analysis

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How Cultural Knowledge Shapes Core Design Thinking - A Situation Specific Analysis

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The growing trend of co-creation and co-design in cross-cultural design teams presents challenges for the design thinking process. We integrate two frameworks, one on reasoning patterns in design thinking, the other on the dynamic constructivist theory of culture, to propose a situation specific framework for the empirical analysis of design thinking in cross-cultural teams. We illustrate the framework with a qualitative analysis of 16 episodes of design related conversations, which are part of a design case study. The results show that cultural knowledge, either as shared by the cross-cultural team or group specific knowledge of some team members, shape the reasoning patterns in the design thinking process across all the 16 episodes. Most of the design discussions were approached by the designers as problem situations that were formulated in a backward direction, where the value to create was known first. Then the designers were using available cultural knowledge to articulate the unknown what to design (products/services) and how the design would work (the working principles of product/services). In conclusion, we demonstrate a novel approach for understanding how cultural knowledge shapes core design thinking in specific situations.

Keywords: cultural knowledge, design thinking, abduction, situational analysis.

Introduction

The advent of internet connectivity and globalization has given designers new opportunities to work closely with future users in cross-cultural design teams. The growing trend of co-creation and co-design in cross-cultural design teams, challenges numerous aspects of the design thinking process. When design teams work with consultants and translators from different cultures, information is lost in the communication due to a lack of understanding and sensibility of cross-cultural interactions. Co-creation and co-design processes in cross-cultural design teams facilitate learning of the cultural context of the design problem, as the design team brainstorms about the user needs with the help of a consultant who has a good understanding of the local culture, while the team works together towards turning an idea into a user-friendly product. However, this design process can be challenging without accurate understanding and awareness of the culture specific knowledge that is applied in cross-cultural interactions. Products may fail miserably, when designed without a good understanding of the target users' cultural background. Therefore, there is a need to understand the design thinking process in the light of activation of shared and not shared knowledge in cross-cultural interactions within design teams.

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We propose a novel approach for situation-specific understanding of the design thinking process in cross-cultural teams. We explore assumptions about ‘core design thinking and its application’ as outlined by Dorst (2011), based on a social-cognitive theory of culture that sees culture in terms of activation of ‘cultural knowledge’, i.e., culturally shared knowledge networks (Hong and Mallorie 2004). We propose an initial framework for exploring how cultural knowledge shapes design thinking in a dynamic and situation specific way. We further discuss a sample analysis of core design thinking in relation to specific cultural aspects of the situational context and individuals in the team.

Theory

This section first presents a theory of basic reasoning patterns as part of core design thinking, and secondly a theory of culture as situation specific knowledge activation. Thirdly, we integrate the two areas of theory to make our research contribution. Compared to related approaches, for example, the team-centric view of culture and creativity approach that assumes that design conversations are influenced by the cultural combinations of team members within the group (Paletz, Sumer, and Miron-Spektor 2017), or the culturally situated difference approach that aims to identify stable embodied practices that expresses group values (Dhadphale, Yilmaz, and Paepcke-Hjeltness 2017), our focus is on the dynamics of reasoning and knowledge activation within and across situations.

Dorst's core design thinking

Dorst (2011) suggests that to describe and understand design thinking in its many variations, it is useful to provide a high level, simple or ‘sparse’ description of design thinking. Even though rich descriptions are important, as design unfolds in a dense context, we may learn something from thinking about reasoning patterns that humans use in problem solving in design- induction, deduction and abduction. In particular, we may learn something from studying the ways that designers reason about the different settings of the knowns and unknowns. Dorst describes the basic design reasoning patterns by reference to the ‘equations’ with different ‘settings’ of the knowns and unknowns in the design process, Table 1.

The basic idea in Dorst design equations is to model design reasoning patterns as an equation consisting of: WHAT (thing) + HOW (working principles) leads to RESULT (observed). Each design equation has a different setting of knowns and unknowns. Thus, the equation for induction states that WHAT + ??? = RESULT. For example, a designer may know a message application that communicates with pictures that disappear after a short time, and have observed that many young Danes enjoy using this application, and by induction figures out a possible HOW, e.g., young Danes prefer noncommittal communication. For deduction, the equation states WHAT (thing) + HOW (working principle) = ???; a designer may know a message application that communicates with pictures that disappear after a short time, and that young Danes prefer noncommittal communication, and may deduce the RESULT that many young Danes will enjoy using this application.

However, Dorst argues that a basic design reasoning pattern is *abduction*. This is what signifies design thinking or productive thinking, and it is about value as a unifying concept for design, see also (Cockton 2006). Abduction differs from classic problem solving because the outcome of abductive reasoning could be a value (e.g., ‘this product

should reflect honesty’) rather than a result dependent on a discrete, well known input (e.g. the solution to a math problem). Such forms of problem solving involve mainly deductive or inductive analytical reasoning. Dorst (2011) suggests two equations for abduction. The first kind of abduction is closed problem solving, *abduction 1*, where the designers do not know what thing or design artefact or service they are discussing, but they do know the working principle that will help achieve the aspired value, i.e. $??? + \text{HOW} = \text{VALUE}$. Using our example from above, a designer may know the HOW that young Danes prefer noncommittal communication, and have observed the VALUE that many young Danes enjoy communicating with pictures, and by abduction figures out the WHAT as in what application should be designed. According to Dorst *abduction 1* is a common way of working for professional designers.

The second kind of abduction is open problem solving, *abduction 2*, where the designer neither knows the thing to be designed nor the working principle, but only the aspired end value is known, $??? + ??? = \text{VALUE}$. In our example, a designer may know that many young Danes VALUE communicating with pictures, and by abduction figures out which app they probably use or would like to use, and how the noncommittal principle makes the app work for their preferred mode of communication. Dorst argues that this is what designers do, when they do conceptual design, e.g., when there is no familiar working principle available to guide the design. In such situations, the designer has two unknowns in the equation, which is a different situation from the closed problem solving in abduction 1. In this second type of abduction, ‘framing’ can be used to facilitate progress. Framing involves applying analogies from other design thinking scenarios with similar aspired end value to the problem at hand. This helps identify the *working principle* and *thing* to design in the ongoing design process. For example, a designer may know that both young Danish and young Chinese people enjoy communicating with pictures, and that young Chinese use WeChat because it has possibilities for noncommittal communication, and thus frame the design problem to be a Danish WeChat. Dorst emphasizes that even though design thinking is often described as abductive reasoning, it typically involves a mix of different ways of thinking. Thus designers use much inductive and deductive reasoning for ideation, and to rigorously test and evaluate ideas to assess whether a proposed design solution will work. Table 1 shows the equations proposed by Dorst (2011).

Table 1. Dorst (2011) design reasoning equations.

Type of design reasoning	Dorst equation
Induction	WHAT + ??? leads to RESULTS
Deduction	WHAT + HOW leads to ???
Abduction 1 (Closed problem solving)	??? + HOW leads to VALUE
Abduction 2 (Open problem solving)	??? + ??? leads to VALUE
Framing	WHAT + <u>HOW leads to VALUE</u> FRAME

Dorst’s core design thinking ‘equations’ help formulate a clear and easy to follow analytical scheme that provides an overview of how thought processes can lead to innovation and “outside the box” thinking. However, as Dorst himself acknowledges, his approach is problematic, as design thinking cherishes multiple perspectives and rich articulations over simplification. Like Kimbell (2011) in “Rethinking Design Thinking”,

we argue that a significant flaw in much thinking about design thinking is the oversimplification of the creative thought processes to be unaffected by cultural contexts. Kimbell (2011) emphasizes cultural components and external factors, which are hard to simplify without losing their meaning and therefore credibility. However, we position ourselves somewhat in between Dorst and Kimbell, as we attempt to integrate Dorst's simplistic framework on reasoning patterns in design thinking with a framework that simplify the notion of cultural context.

The dynamic constructivist theory of culture

The dynamic constructivist theory of culture conceptualizes culture not as a static, huge, holistic unit, but as a loose knowledge network of domain-specific cognitive structures, including implicit theories and beliefs (Hong and Mallorie 2004). The theory suggests that domain and situation interacts with more essentialist aspects of culture. Thus people may hold more than one cultural meaning system, even if such systems may contain conflicting cultural knowledge, e.g., contradictory cultural models of how people use design products (Clemmensen 2009). Which of these is activated depends on what situational constraints are salient. For example, a bi-cultural Chinese-European will tend to use a design product like a Chinese person when in a 'Chinese situation', and reversely, think to use the same design product like a European when in a 'European situation'; activation of different cultural knowledge about the same product may result in different user experiences (Clemmensen 2009).

The dynamic constructivist theory of culture borrow the concepts of *availability*, *accessibility*, and *applicability* from the theory of knowledge activation (Wyer and Srull 1986), which underscores that cultural knowledge must be activated by some stimulus in order to be put to use. In the dynamic constructivist theory of culture, these concepts are used to denote three ways of activating cultural knowledge. *Availability* refers to the effortless activation of existing cultural knowledge structures (e.g., stereotypes of customers/users, designers, consultant translators) within a cultural group. Becoming a member of a cultural group usually requires being brought up or otherwise becoming familiar with specific cultural knowledge, or as Hong, Benet-Martinez, Chiu, & Morris (2003) argue, acculturation can make specific cultural knowledge systems become available. For example, a Danish designer in a design session may effortlessly activate her or his cultural knowledge about young Danes enjoying noncommittal communication through the SnapChat app. *Accessibility* refers to explicitly getting primed to access the cultural knowledge structures. For example, a non-Danish designer may need explicit activation cues from design material or other designers to access relevant cultural knowledge about the emotional value of noncommittal communication through smartphone apps for young Danes. *Applicability* refers to activation cues related to appropriateness and feasibility of cultural knowledge in the current social situation. For example, the presence of a non-Danish designer in a design session may cue a Danish designer to present a more neutral version of the kind of emotional value and typical content of noncommittal communication delivered through smartphone apps by young Danes. The applicability of cultural knowledge thus depends on whom you are with, what they know, and what norms for behaviour are present. Table 2 shows the three ways of activating cultural knowledge.

Table 2. The triple A of a dynamic, situation specific concept of culture (Hong and Mallorie, 2004; Clemmensen, 2009).

Triple A	Definition
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Availability	Existence of cultural knowledge structures (i.e., including stereotypes of customers/users and Eastern facilitators)
Accessibility	Getting primed to access the cultural knowledge structures
Applicability	Appropriateness and/or feasibility of culture-related behaviours in situational context (i.e., in context of setting design goals)

The triple A design equation framework

With the intent to support the active use of cultural knowledge in design thinking, we propose a dynamic and situation specific framework for the empirical analysis of design thinking episodes. Figure 1 integrates the two frameworks presented above, in our own framework, the ‘The triple A’ design reasoning framework. Figure 1 illustrates Dorst’s design reasoning equations on the right side, and on the left side the ‘triple A’ of the dynamic constructivist theory, and at the bottom the integration links that we propose to analyse. The double-sided arrows connecting the design reasoning processes (induction, deduction and abduction) and the cultural knowledge activation types (availability, accessibility and applicability) depict the interactive and dynamic nature of the design thinking process. The design reasoning gets actively shaped by the cultural context.

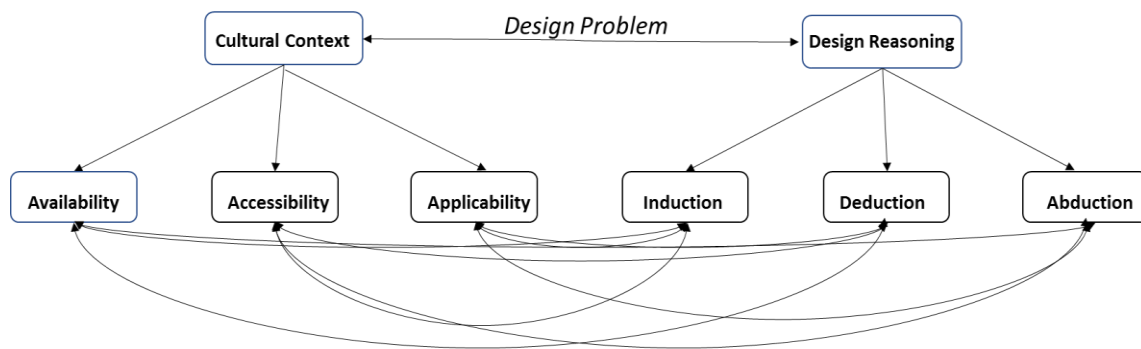


Figure 1. Triple A: Our proposed framework for interaction between the cultural context and design reasoning in a design process.

Method

The paper is part of a large case study (Christensen, Ball, and Halskov 2017). The data from the case study contains material from design meetings and co-creation workshops as part of the design processes in a Scandinavian design team’s daily routine. The data consists of 13 hours of video and audio recordings with additional pictures and other material. Observations and data collection did not interfere with the normal work routines in the design team. The deliveries of the design team are products and services aimed at the Chinese market and at Chinese lead users. The design case thus comprises real examples of a design process with cross-cultural co-creation as a central component. The design case was made to provide multiple entry points of analysis allowing researchers a wide range of analytic options (Christensen and Abildgaard 2016).

From the design case, we analysed two sessions with a total of 16 episodes, using a dynamic and situation specific qualitative content analysis as outlined below. We could not analyse the actual co-creation workshop sessions that took place in China with

Chinese users because of our lack of understanding of the Chinese language. Hence, we chose to investigate two debriefing sessions that took place immediately after each of two co-creation workshops, as depicted in Table.3. We will refer to these as ‘debrief of Co-Creation workshop day 1’ (CC1), and ‘debrief of Co-Creation workshop day 2’ (CC2).

The debriefing phases in CC1 and CC2 were critical to the whole design process, because this was where the designers worked on empathizing with the Chinese participants that had been recruited to represent the Chinese lead users. Based on the insights generated in the collaboration with the participant-users, the designer defined a problem statement, and a guiding statement that focused on insights and needs of a general user, i.e., a composite character developed in interaction with the participant-users. In this phase all the varied findings about the participant-users were put together and evaluated in light of the design themes (i.e., health, environment, self-reliance etc.) defined in phase one of the design process.

Participants

Two cultural groups made up the design team in the debriefing sessions we analyzed: Asian consultants and Scandinavian design team members. Out of the five Scandinavian design team members, two were external stakeholders who were not as actively involved in the above sessions as the three designers. The core design team consisting of three designers had been working in the same department the last four years, and knew each other well. The three Asian consultants had expertise in Chinese markets and served the role as moderators in interactions with Chinese lead users. They were not part of the whole design process, but became part of the project during the Scandinavian designers’ field trip to China. The consultants participated in the meetings on equal terms with the designers. They were familiar with design thinking approaches and they aided in the translation of Chinese to English, and the translation of cultural concepts and traditions.

Figure 2 demonstrates the interaction among the three main groups that participated in the co-creation workshops. The overlapping areas in the Venn diagram in Figure 2 depict the cross-cultural interactions between the Scandinavian designers and the Asian consultants (left side of figure), and the Chinese participants representing the future users and the Asian consultant (right side of figure). When the Asian consultants were moderating the co-creation workshops and actively interacting with the Chinese participants, the Scandinavian designers were only making observations and had no active interaction with the participants due to lack of understanding of the Chinese language. After each workshop there was a debriefing session, where the Asian consultants debriefed the Scandinavian designers about the workshops in English.

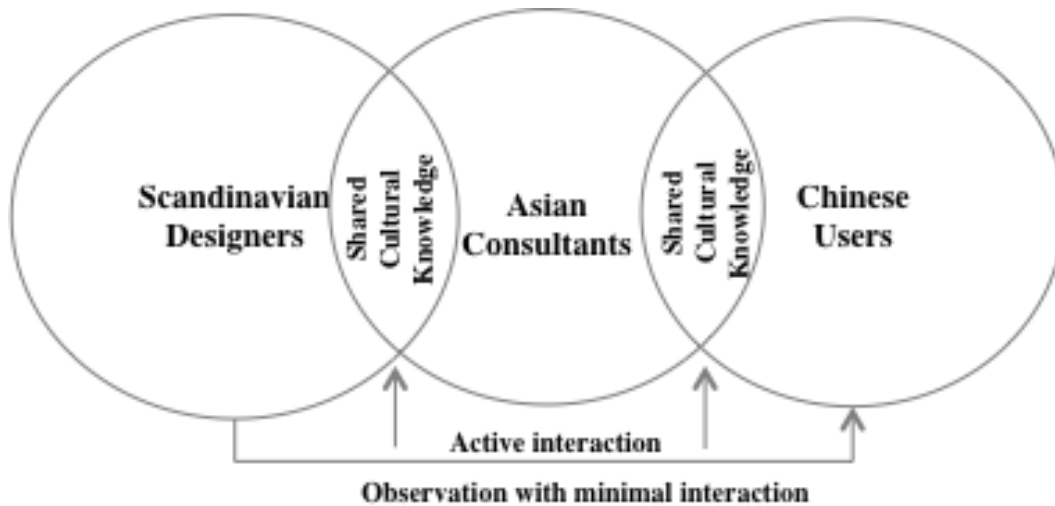


Figure 2. Shared cultural knowledge in the co-creation and debriefing workshops.

Material and procedure

The analysis focused on the discussions among the designers and consultants in the debriefing meetings CC1 and CC2, held after each of the co-creation workshops.

Table 3. The 16 episodes analysed.

Sessions	Duration	Content	The 16 episodes
CC1 debrief of co- creation day 1	18 mins	Asian consultants and Scandinavian designers sharing observations, translating and explaining the different post-it clusters that had been written and put on one of the walls in the preceding co-creation workshop, where the participants as well as the moderators were present. Explaining some of the participants' characteristics and statements, trying to draw insights about how the participants conceive of leisure time, family relations, and general ideas about the theme of "Health" and "Good life".	1. CC1, 009 - 015 2. CC1, 021 - 035 3. CC1, 038 - 051 4. CC1, 055 - 080 5. CC1, 096 - 119 6. CC1, 140 - 158
CC2 debrief of co- creation day 2	78 mins	Asian consultants and Scandinavian designers sharing and discussing observations and notes with each other from the co-creation workshop, and slowly beginning to connect some of the	7. CC2, 056 - 071 8. CC2, 072 - 085 9. CC2, 093 - 112 10. CC2, 128 - 140 11. CC2, 143 - 151 12. CC2, 232 - 246 13. CC2, 273 - 304

insights to the overall design project	14. CC2, 314 - 328
themes and concepts.	15. CC2, 420 - 440
	16. CC2, 683 - 692

In the debriefing sessions the Asian consultants and Scandinavian designers shared observations and notes from the co-creation workshops. This included activities such as brainstorming, problem-solving, re-interpreting the personas of Chinese users, and evaluating participant responses to the questions based on the overall project themes and concepts. Given the collaborative nature of these meetings, the designers and consultants were constantly talking aloud, thereby providing a rich, ongoing, external record of their thinking and reasoning. We selected 16 episodes each of 2-10 minutes for our analysis, Table 3. The criterion for selecting the episodes was to have the two cultural groups actively participating in the discussion.

Analysis

The transcripts were subjected to thematic analysis (Braun and Clarke 2006). The main analytical categories used in our coding procedure are depicted in Figure 1 (availability, accessibility, applicability, induction, deduction, abduction). The first and second authors, who are trained psychologists, familiarized themselves with the theoretical framework and applied it to coding all the episodes. The first and second authors primarily did the coding. In an initial pilot coding, the first author focused on the cultural aspects. Then the second author systematically coded the selected episodes based on the all the analytical categories. After this first round of coding, the authors refined the definitions of the analytical categories, and a consensus was reached. Then the first and second author for the selected episodes each did a second round of systematic coding, followed by discussion and correction. Finally, the transcripts selected for the analysis were checked for inclusion (did we include all the quotes from the episodes analysed?), and transparency (was the content and learning points of each quote reasonably presented?) for the coded examples (Dahler-Larsen 2008). The suggestions from the third author helped to refine the codings and the coding procedure. In total, we evolved the coding across four iterations. In each round of coding, we first did the coding for Dorst equations, and after that coded for the triple A's. We explain this in more detail below.

In the first part of the analysis, all the selected episodes were coded for the Dorst equations. We did the coding based on Dorst's model of design thinking: WHAT (thing) + HOW (working principles) leads to RESULT (observed), see Table 1. To do this, we identified segments of conversations of the design team members in the session depicting examples of induction, deduction, abduction and framing in the thinking process. All examples identified were subjected to coding of (1) 'what' – the thing/idea/product being discussed, (2) 'how'- the information on the working principles of how the thing/idea/product will be made to work, (3) 'result' – the value one wants to create/observe e.g. designing something in a certain way to meet the goal of representing the company's value of *trust*. We identified which of the three variables were missing in the equation (i.e., the what, the how, or the result) to code an event as indicative of the specific type of design reasoning.

In the second part, we applied the dynamic constructivist framework. For each identified design equation instance (i.e., instance of induction, deduction, abduction), we coded for the triple A: Availability, Accessibility, and Applicability, see Table 2, in four steps:

1. Whether the individuals in the conversation had similar cultural background or not, and whether any of individuals had been exposed to two cultures (e.g., Chinese origin person living in Europe). When the individual was saying something available to only one cultural group, we coded it as ‘group specific’. For example, Chinese consultant accessing available knowledge about a specific Chinese tradition, which was not known to Scandinavian team members. When the cultural knowledge was shared, i.e., available and accessible to all in the design team, and not specific to just one cultural group, we coded it as ‘shared cultural knowledge’. For example, a Chinese-European consultant accessing, making available and applying the cultural knowledge about dating in Europe in a design conversation with the European team members.
2. Whether the episode disclosed any evidence of the *availability* of cultural knowledge. Did the dialogue require exposure to the cultural knowledge being discussed in order to be meaningful?
3. Whether there was any evidence that the situation primed and thus gave *access* to relevant cultural knowledge, i.e., did the situation prime the participants to access available cultural knowledge?
4. Whether there was any evidence of *applicability* of cultural knowledge, i.e. did the cultural knowledge shared seem socially appropriate to say and relevant to the design conversation in the current social situation?

Results

Overall results

Overall, our qualitative analysis of the 16 episodes indicated that the abduction equation was frequent in the design thinking process, but less so than inductive and deductive equations combined. Figure 3 illustrates variations in shared and group specific cultural knowledge across the 16 episodes from CC1 and CC2 design sessions.

Figure 3. Distribution of group specific and shared cultural knowledge across 16 episodes from two design sessions.

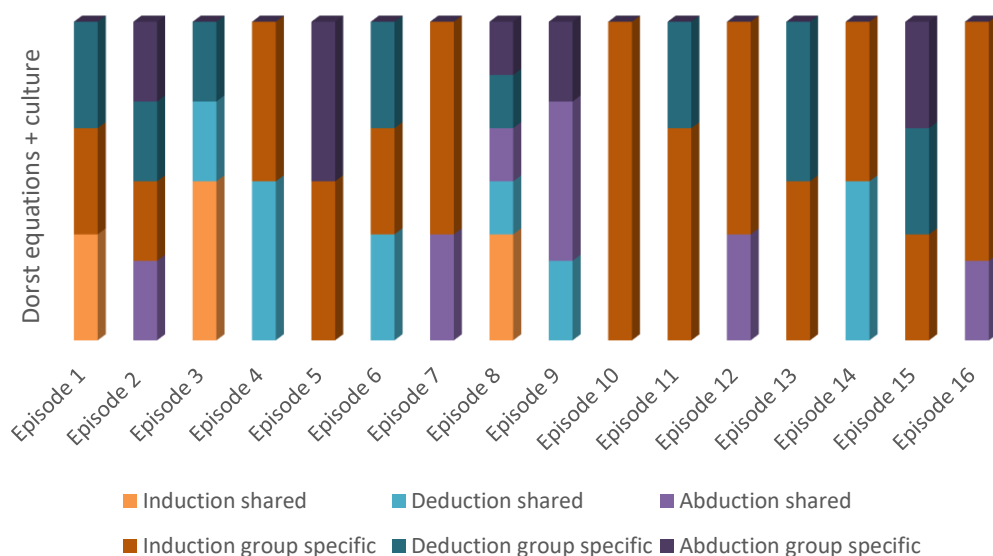


Figure 3 suggests that differences in cultural knowledge activated by design team members appeared and disappeared across the episodes during the debriefing sessions. In some episodes the activated cultural knowledge was group specific, i.e., the cultural knowledge available to one group was not made accessible and applied in the conversation with the other group members. In other episodes the cultural knowledge was shared, i.e., the cultural knowledge was available, accessible and applied in the conversation with the other group, or both shared and group specific cultural knowledge were activated. For example, group specific and shared abduction equations disappeared and appeared across the 16 episodes: episode 1: not present, 2: both shared and group specific, 3: group, 4: not present, 5: group, 7: shared, 8: both, 9: both, 10, 11: not present, 12: shared, 13, 14: not present, 15: group, 16: shared, Figure 3. In all the 16 episodes there was active participation of both the two cultural groups (i.e., Asian and Scandinavian). Below we present results from the in-depth analysis of two of the episodes shown in Figure 3 (no. 1 and 9) to illustrate how cultural knowledge shapes induction, deduction and abduction equations.

How cultural knowledge shapes deduction and induction

To illustrate how deductive and inductive design equations are shaped by cultural knowledge, we analysed episode 1 from CC1 (lines 09-15), see appendix for the full transcript.

How deduction is shaped by available cultural knowledge

In episode 1, the Asian consultant, W, uses *available* cultural knowledge to deduce that the Chinese user's behavioural data suggests that he lives a healthy life in the traditional Chinese way. This kind of thinking process is deductive as W is drawing conclusion about the user's personality based on the marketing data and the behavioural characteristics of a typical Chinese user:

So, eh, I think there was one guy who, the younger guy, who I think leads a slightly more disciplined life, I mean like, he's not married, he's not, you know, has his own family and whatever. He talks about things like sleeping early, going to bed by ten, waking up really early by six, you know, because your body starts to detox at eleven a clock. [CC1, 09]

The Dorst equation for deduction is WHAT+HOW=???. To fill in the equation, the WHAT and the HOW is the data about the potential user (WHAT) and a particular Chinese cultural stereotype (HOW). These together leads W to formulate hitherto unknown, the '???' in the Dorst equation; in this case the design team's aspired value of what is a healthy user. Dorst (2011) points out that deductive reasoning is a gold standard of reasoning for scientific discovery, and that even in design, rigorous deductive reasoning is necessary to inform justification of the value to be created by the designer.

However, the content of the Dorst equation for deduction in this example is shaped by what cultural knowledge is available to those doing the deduction. Hong, Benet-Martinez, Chiu, & Morris (2003) argues that what makes cultural knowledge available is acculturation, and since that W has been hired as a cultural expert on China, he is expected to be well acculturated and to have detailed knowledge about Chinese culture available.

How deduction is shaped by accessible cultural knowledge

Our analysis suggests that W comes to think about Chinese medicine in the situation, because prolonged exposure to a culture, i.e., acculturation, increases the chronic *accessibility* of the shared knowledge in the culture (Hong et al. 2003). In addition, his available knowledge becomes *accessible* to W because he has been primed by the team's ongoing discussion about the design theme 'health' and Chinese users.

W then makes this cultural knowledge *accessible* to his Asian and Scandinavian team members by repeating the deduction that the user sleeps early and gets up early (WHAT), this demonstrates the aspect of traditional Chinese medicine in the user's life (HOW), as the user is letting his body detox at night while sleeping. W suggests that the value, the unknown ??? in the deduction equation, can be understood as the implicit aspired health behaviour.

That's actually a little bit of eh: (.) traditional Chinese medicine, that's part of the concept. Your body starts to work itself eh actually: from that time which is eleven at night, your body should start resting before that, so you need to go to bed before that, so that, you know, it can work its magic. [CC1, 011]

W is a bicultural individual who has been exposed to two cultural meaning systems, Asian and Western. Such individuals provide particularly clear demonstrations of the interaction between availability and accessibility (Hong & Mallorie, 2004). The accessibility of each knowledge system appears to vary as a function of situation. In the above example, W has the cultural knowledge available, being raised in Chinese culture, and he makes it accessible because the situation (the design discussion about concept of health for Chinese users) primes him to articulate the user behaviour and its meaning as an expression of certain aspects of the Chinese cultural context. Hence, he makes the purely Chinese culture specific knowledge about 'Chinese medicine' accessible to the team members. The deduction process of making sense of the particular user characteristics will be meaningless without the cultural knowledge being both available and accessible.

How deduction is shaped by appropriate cultural knowledge

To make the cultural knowledge *appropriate* to the design context, W makes the cultural knowledge *available* and *accessible* by using deduction to explain to the Scandinavian team members that if one was in a western context one would sleep at twelve or one, but within a Chinese context going to bed before the magic hour of detox is essential (WHAT), and, since the user is traditional (and follows principles found in traditional Chinese medicine) (HOW), the concept of being disciplined appears to be an *appropriate* way to think about a health and relaxation in life (the unknown ???).

So people like us who sleep at twelve. Sleep at one, you have really bypassed that magic hour of where we can actually get that. So...[CC1, 013]

Hong (2004) explains that applicability or *appropriateness* refers to the feasibility of culture-related behaviours in context; the expression of appropriate cultural knowledge in a situation is influenced by the cultural knowledge systems held by partners in the social interaction, the nature of the interpersonal situation, the general behavioural applicability, and more. W is in a situation where most of the others in the design team do not have any Chinese cultural knowledge systems available so he discusses

relaxation/health in a Western context to further explain what the concept of ‘Chinese medicine’ means and signifies in life of a traditional Chinese person. The design team is cross-cultural, so W uses shared cultural knowledge about young people in the West staying up late and AM mentions the trend of partying as an example of relaxation in Western context to make an analogy to ‘Chinese medicine’: had the user been a young person like the design team members, the user would have been partying after midnight. Furthermore, W is hired as a consultant, so he needs to be polite, and cannot really say more about the partying behaviour, so he ends without finishing the sentence, leaving further interpretation open. In this way, W is repeating his deduction, but from a Western perspective, and by letting cultural knowledge shape the meaning of the argument, W makes the deduction *appropriate* for design thinking in the situation.

How induction is shaped by cultural knowledge

W’s reasoning and presentation to the group is followed by an induction process, in which the Asian consultant AM supports W in making the Chinese medicine concept *appropriate* to use. The Dorst induction equation is WHAT + ??? = RESULT. AM introduces partying late at night as something which is also relaxing and something which western people do (WHAT), but traditional Chinese people will not do and traditional Chinese person cannot relate to partying (???), when talking about health and relaxation (RESULT).

But that's interesting here, since how about partying? But I think it kind of (INAUDIBLE), because the other people couldn't relate it with, and they felt that (INAUDIBLE) (.) [CC1, 014]

Towards the end of the episode W performs inductive reasoning about the user behaviour to suggest that the user does appear to be aligning to the cultural stereotype of traditional introvert Chinese male rather than to the party going young male in Scandinavia or China.

Yeah. But I also suspect given my - my reading of him, I don't think he's very hard core in partying... [CC1, 015].

W suggests that since the user is following traditional Chinese medicine for health and wellbeing (WHAT), he must be an introvert (???), because he appears to be a person who would fit the stereotype, hence he would not enjoy partying as a way to relax (RESULT). Our dynamic-situationist cultural theory sees the interaction as a kind of knowledge-based negotiation situation (Morris and Gelfand 2004); what W is doing is to try to keep the Chinese cultural knowledge now *available* to the design team highly *accessible* to the designers by using himself as a role model in the design work, and *appropriate* by using the analogy to partying again.

Summary

In summary, both deduction and induction are shaped by the Triple A of availability, accessibility and applicability of cultural knowledge in this episode. In the example above, the content of a Dorst equation for deduction is shaped by what cultural knowledge is available to those doing the deduction, primarily W, who is the Asian culture expert and has this knowledge easily accessible. However, in the situation W needs to repeat and explain his deduction by making cultural knowledge accessible to the Scandinavian

design team members, and make it appropriate to use in the design context by using shared cultural knowledge about young people in the West. The content of a Dorst equation for induction is similarly shaped by cultural knowledge about both WHAT they are talking about and the end RESULT of the design thinking about health/relaxation.

How cultural knowledge shapes abduction and framing

To illustrate how abductive design thinking is shaped by cultural knowledge, we have chosen to focus on abduction 2 and framing in an analysis of episode 9 from CC2 (093-112), see appendix for the full transcript. In first part of this episode (093-101), the team leader E asks a question to the team with an assumption in his mind and then he *frames* it by reference to an Apple Store example.

- 093 E Mmm, and eh, why, do you think it was important to touch the product?
- 094 N Eh, because she also said she wouldn't invest in something like she wouldn't believe. So, she wanted to like, try it out, because that's what - was something like with eh, with the price, like if I don't know, if I'm not like sure, like I wouldn't trust it, so I wouldn't invest too much money in it.
- 095 E Mmm, is it trust of quality or trust in they needed it?
- 096 N The (.) quality
- 097 A Yeah
- 098 K I think it's kind of an idea one of the guys refers to Apple stores, they get kind of this experience that they are (INAUDIBLE) as you get.
- 099 E But it had- did it have to do with trust, or did it like - I might- this is my crazy assumption, but I assume that people trust Apple, but they still go to the store, it has nothing to do with trust, it has to do with I wanna be part of it, I wanna aspire to this culture, hang out.
- 100 A But that was exactly what they said
- 101 E Yeah

This is an example of *abduction with framing*. It is problem solving, as the team members are trying to identify whether the product or the corporate culture is the more important for the design. E asks a question with an assumption in his mind – that physically touching a product has nothing to do with trusting a company - and he explains his assumption by framing the problem as what actions people take in an Apple Store.

In terms of Dorst's equations, the design team is using *abduction 2 with framing* to build a need for a yet unknown product (WHAT is unknown) by using an analogy to what works (HOW is unknown) and framing is used to see whether touching the product or knowing about the company culture in an Apple Store is necessary (VALUE: Trust).

Cultural knowledge comes into play in framing

The analogy in the above example of abduction with framing requires the articulation of cultural knowledge about the Chinese context to be made available, accessible, and to then become appropriate in the situation. Based on the *availability* of their cultural knowledge, all the team members explore the probable reasons for why it might be important to touch the product or whether it is the company or brand that carries the trust by consumers. Inductive thinking comes into play, while hypothesizing various reasons behind why users would like to touch the product.

One of the Scandinavian team members, A, does not share with E the cultural knowledge – E’s “crazy assumption” - that people trust the company, not the products. A reverts to the *available* knowledge about the users that is shared by all in the design team, and try to use inductive reasoning to argue that the FRAMING suggests that the working principle in the Apple Store is knowledge and experience that builds the VALUE of trust, episode 9 from CC2 (102-112), see below.

- 102 A About they actually wanted to go and see what it was all about
103 E Yeah
104 A Because no one knew them, knew their product

As it happens, A’s inductive reasoning about the actual users is supported by deductive reasoning by the Asian consultant AM. She makes her *available* cultural knowledge about ‘lack of trust for the products in China’ *accessible* to everyone, by stating that people (WHAT) want to touch the product for knowledge, to know whether it is authentic and to not just trust the second hand knowledge (HOW, WORKING PRINCIPLE). She argues that this should be the basis for thinking about what VALUE that can be achieved in an Apple Store in China.

- 106 AM I think, knowledge, right? You go there, you see, you experience it. You know and you're authentic of knowing rather than just second-hand information.

E makes his cultural knowledge about Apple Stores in the West *accessible* to all by stating that there is not much information about the company at an Apple store, it is mainly the products, and still people trust the brand, suggesting that the particular FRAMING chosen defines the WORKING PRINCIPLE (HOW) in an Apple Store as the building of trust in the company which leads to the VALUE of trust in general.

- 107 E And I think that is fantastic thing about the Apple store. There is nothing else there, there's photos of products and products. That's it. There's (INAUDIBLE), just a little text, no nothing, maybe just a little price, or whatever.

Then A induces from the data, working up another idea about the WORKING PRINCIPLE of an Apple Store, and states that one of the users actually mentioned that the company culture of Apple leads to the liking for the brand.

- 108 A And our:- one guy in our group also mentioned about the culture, how the Apple and the culture and what they do, influence them liking the brand.

Then E uses deduction based on another Chinese user (WHAT) who commented on the open and approachable culture of the company Panasonic (HOW) to argue that this is part of ‘building the product’ – and A agrees that the Apple store as a place for building trust in corporate culture is an *applicable* framing. They agree that corporate culture is important in one way or another.

- 109 E Mmm (.) Yeah, and I think that is also, so: good for us, as THE COMPANY, that it actually has an impact to that. The corporate culture will actually be part of, you know, building the product.
110 A And what parts of the culture?

- 111 E So the- so the:- In our group they- yeah, in our group they mentioned openness, for example, and they used an example from- from Panasonic. At Panasonic, even the low level assembly dudes can write a message to the CEO and say, I think this is (INAUDIBLE), approachable. So it means that, you know-
- 112 A They take care of their own

The slight disagreement between W and A is perhaps an interesting feature of open problem solving such as abduction 2; though the *available* knowledge about the culture may be quite similar among same culture designers, slight changes of the priming in the situation may lead to differences in what knowledge becomes *accessible* and is deemed *appropriate*. A is primed by the data about users, but when it comes to the social situation W's deduction is perhaps more convincing to A than AM's deduction, because W and A share the cultural knowledge about Apple Stores in the west, and have little cultural knowledge about what it means to be in an Apple Store in China.

This is a good example of abduction; the group knows the value to create in the market (improved quality of life), however the product/service and the working principles are not known, it is very open-ended, a complex problem solving. However, by framing the problem in culturally underspecified context; making it unclear if the Apple Store was in the West or in the East, the designers had to also make their available knowledge accessible to the team in order to close in on the outcome of the abductive reasoning.

Discussion

The results indicate how the cultural knowledge activated in a design team consisting of Scandinavian designers and Asian consultants in the analysed design situations shaped the core design thinking in the team. The basic reasoning patterns in design thinking - induction, deduction and abduction - were shaped by the appearance and disappearance of differences in activated cultural knowledge among the team members. Our results are in line with previous studies showing that the interaction between accessibility and applicability is directly based on who the person is interacting with in in-group members (same culture) or out-group members (different culture) and may also be primed by cultural stereotypes (Wong & Hong, 2003; Hong, 2000).

Capturing situation specific cultural design thinking

We have argued that culture shapes design thinking, using the approach to design thinking formulated by Dorst (2011). In Figure 3 we illustrated the dynamic and situation specific nature of how cultural knowledge shapes design thinking across time. The similarity in the cultural knowledge of the team members varies throughout the design sessions, i.e., either the cultural knowledge is shared by both the cultural groups, or the knowledge is specific to the cultural group of the member sharing the knowledge. Thus, extending the current research, we suggest to apply our approach to a complete design project.

We also propose that one way to judge the similarity between different cultural knowledge shared by team members is to obtain average ratings of similarity for knowledge structures about the currently discussed topic, and obtain these ratings for individual episodes along the whole design thinking process. The ratings of similarity can be obtained by accessing the available and accessible knowledge structures of the team members in each situation/episode and rate them for similarity (i.e., how similar they are to each other). Note that we suggest to initially base the analysis on what cultural knowledge is made accessible, since this can be observed from sessions of design work.

Available knowledge, on the other hand, is tacit cultural knowledge widely shared and assumed in a cultural group, and it may have to be identified from judging if the current dialogue requires exposure to the cultural knowledge being discussed in order to be meaningful. Expert analysts could be supported in their identification of available cultural knowledge by methods such as concurrent thinking aloud or stimulated recall interviewing.

Overall, we believe that examining the variations in activated cultural knowledge across the complete design process will provide insights about how a design thinking process works in general. Further research may consider how situational differences in accessibility might lead to frame-switching, which means understanding the problem with a new perspective that is understood by all. Future research could look into how differences in situational applicability of design ideas may lead to ‘culture sampling’, which is the idea that people select the culturally normative behaviours that are the most appropriate in the given social situation (Hong and Mallorie 2004). To understand how cultural knowledge is activated, researchers must thus go beyond participants’ nationality or similar salient cultural features and go deep into understanding the situation.

Limitations and scope

Dorst mentions the basic design reasoning patterns such as abduction to be applicable to the whole design thinking process. However, in our analysis we found that it was possible to identify core patterns even in subsections that are parts of the overall design thinking process. Secondly, our access to the design thinking process was limited by the pre-selected design sessions provided in the larger design case (Christensen, Ball, and Halskov 2017). For future studies, our suggestion is to incorporate data not just from one design team, but from several design teams to comprehensively study the topic.

Conclusion

This paper highlights the need for further research on the interaction between culture and problem-solving methods in design thinking. It presents a novel approach to the understanding of design thinking in the context of culture. To our knowledge this is the first empirical study of induction, deduction, and abduction in a cross-cultural context of a design thinking process. We believe that the integration of Dorst equations with the triple A in our proposed framework can serve as a starting point for further empirical research that explores and analyse cultural aspects of core design thinking processes.

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Appendix A

1.1 CC1 episode 1, (segment 009-015)

- 009 W So, eh, I think there was one guy who, the younger guy, who I think leads a slightly more disciplined life, I mean like, he's not married, he's not, you know, has his own family and whatever. He talks about things like sleeping early:, going to bed by ten:, waking up really early by six:, you know, because your body starts to detox at eleven a clock.
- 010 A Yeah.
- 011 W That's actually a little bit of eh: (.) traditional Chinese medicine, that's part of the concept. Your body starts to work itself eh actually: from that time which is eleven at night, your body should start resting before that, so you need to go to bed before that, so that, you know, it can work its magic.
- 012 A Mhm.
- 013 W So people like us who sleep at twelve:, sleep at one, you have really bypassed that magic hour of where we can actually get that. So-
- 014 AM But that's interesting here, since how about partying? But I think it kind of (INAUDIBLE), because the other people couldn't relate it with, and they felt that (INAUDIBLE) (.)
- 015 W Yeah. But I also suspect given my- my reading of him, I don't think he's very hard core in partying.

1.2 CC2 episode 9, China, Co-creation room (segment 093-112).

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- 093 E Mmm, and eh: why: do you think it was important to touch the product?
- 094 N Eh: because she also said she wouldn't invest in something like she wouldn't believe. So: she wanted to like, try it out, because that's what- was something like with eh: with the price, like if I don't know:, if I'm not like sure, like i wouldn't trust it, so I wouldn't invest too much money in it.
- 095 E Mmm, is it trust of quality or trust in they needed it?
- 096 N The (.) quality
- 097 A Yeah
- 098 K I think it's kind of an idea one of the guys refers to Apple stores, they get kind of this experience that they are (INAUDIBLE) as you get.
- 099 E But it had- did it have to do with trust, or did it like- I might- this is my crazy assumption, but I assume that people trust Apple, but they still go to the store, it has nothing to with trust, it has to do with I wanna be part of it, I wanna aspire to this culture, hang out.
- 100 A But that was exactly what they said

- 101 E Yeah
- 102 A About they actually wanted to go and see what it was all about
- 103 E Yeah
- 104 A Because no one knew them, knew their product
- 105 E So it was about excitement
- 106 AM I think, knowledge, right? You go there, you see, you experience it. You know and you're authentic of knowing rather than just second hand information.
- 107 E And I think that is fantastic thing about the Apple store. There is nothing else there, there's photos of products and products. That's it. There's (INAUDIBLE), just a little text, no nothing, maybe just a little price, or whatever.
- 108 A And our:- one guy in our group also mentioned about the culture, how the Apple and the culture and what they do, influence them liking the brand.
- 109 E Mmm (.) Yeah, and I think that is also, so: good for us, as THE COMPANY, that it actually has an impact to that. The corporate culture will actually be part of, you know, building the product.
- 110 A And what parts of the culture?
- 111 E So the- so the:- In our group they- yeah, in our group they mentioned openness, for example, and they used an example from- from Panasonic. At Panasonic, even the low level assembly dudes can write a message to the CEO and say, I think this is (INAUDIBLE), approachable. So it means that, you know-
- 112 A They take care of their own