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Aysha Alwazzan
Arizona State University, United States of America

G. Mauricio Mejía
Arizona State University, United States of America

Yumeng Xie
Arizona State University, United States of America

Daniel Fischer
Arizona State University, United States of America

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Aysha ALWAZZAN[a*], G. Mauricio MEJÍA[a]**, Yumeng XIE[a], Daniel FISCHER[a]

[a] Arizona State University, United States of America
* Corresponding author e-mail: aalwazz2@asu.edu

Abstract: As design research develops, theory is increasingly available for designers. However, there is a limited understanding of how practitioners incorporate theory in activities such as ideation. This exploratory study aims to understand how novice designers respond to and incorporate theory in the ideation phase of the design process. A theory from behavioral economics – nudging – was introduced to the participants while ideating in problems of changing sustainability behaviors. Data collected included focused observations and interviews. Participants appeared to understand some behavioral theoretical concepts, which can be explained in the current pervasive use of human-centered approaches. While there were some mixed initial responses to the theory in terms of its ethical implications, all participants found the theory was useful to support and enhance their ideation. This study shows that designers are more confident with and appreciate theory when they can clearly see that theory supports their design process.

Keywords: ideation; theory-driven design; design for behavior change; sustainability

1. Introduction

When a designer is asked to develop a design solution to a problem, many factors go into that process. Some factors that previous research has shown to influence the ways in which designers tackle problems are personal mindsets (Hamat et al., 2019), contextual issues (Hu & Reid, 2018), emotional experiences (Tonetto, 2014), and creative-thinking skills (Davies & Talbot, 1987). Education is another critical factor that impacts a designer's approach to the design process. While design educators have different ways of teaching studio classes, most studio class design education settings revolve around traditional concepts of form, materials, and expression (Norman, 2010). Theories directly related to visual composition are used for teaching design studios to create well-rounded artifacts. However, several design scholars have expressed the need to broaden the use of theory as design approaches change from composition to communication and more recently social and behavioral change (Vezzoli,

2003). For designers to effectively refocus their work on the goal of individual behavioral change in the context of socio-ecological problems, they must make assumptions about how to trigger such behavioral change, or engage with existing behavior change theories (Daae & Boks, 2014). Nevertheless, currently, limited research explains how designers deal with corresponding theories and how such engagement influences design processes. This study addresses this gap. It provides an exploratory study about how novice designers incorporate behavioral theory in ideation activities for solving sustainability problems. This study addresses the DRS conference theme of synergy between theory and practice.

2. Theoretical Background

Designers' mindset and approach usually form in the ideation phase, where the inspiration, framing, and molding of the project takes place. Kolko (2010) describes the process of synthesis as "an abductive sensemaking process" (p. 17). He also explains that a designer's creation is a combination of data manipulating, organization, pruning, and filtering. This can suggest that theory is capable of driving, framing, and influencing the ideation process. The process of design in practice is in part an outcome of design education that has been based on the master-apprenticeship model. Many instructors of studio courses utilize experiential approaches through experimentation and learning through trial-and-error (Sawyer, 2017), often unable to explain the theory and principles that guide their actions (Frascara, 2007). Basic design principles like form, space, and contrast will always be the foundation of design, but with time new concepts and guidelines have emerged. For instance, semiotic theory is as crucial as other contemporary approaches of design (De la Cruz & Mejía, 2017). The shift towards socially useful design (Thorpe & Gamman, 2011) has also influenced design education. In sum, theory has rarely been a core component for design education or design practice.

Designers tend to borrow theories from different disciplines and use them for decision making. Theory-driven design connects the design process with concepts and ideas derived from certain theories and models. For instance, employing theories from social sciences to identify, change, and maintain target behaviors is an effective tool in communication design campaigns (Fishbein & Yzer, 2003). As design projects become increasingly complex (Eastman, Newsetter, & McCracken, 2001), the need for grounding the design process on solid theoretical bases is critical. Theory is a model or set of principles derived from any discipline that can be an asset to practitioners. Friedman (2003) attributes design failures to lack of method, knowledge, and preparation and believes that theory-based approaches can enrich the creative quality of design. Raein (2004) argued that integrating theory in studio teaching is essential. When theory, text, and visuals are combined, he claimed students were able to attain a deeper understanding of their subjects. Raein further explains that approaches like empathetic design and problem-based learning also require students to seek suitable knowledge to attain innovative solutions. Theories, mindsets, and methods borrowed from other fields can be useful in design. In a case study of fashion design, Jung & Ståhl (2018) used a branch of philosophy called somaesthetics to elaborate somatic wellbeing

through combining bodily perception and fashionable creations. On a more science-based approach, Gentes and colleagues (2016) brought together design and fundamental physics as an interdisciplinary approach for a design experiment, and stated that it played a "reflexive role in design practice" (p. 564). In both previous cases, the authors suggested that introducing foreign theories into the design process is effective; yet, students struggled with digesting and implementing those theories in design. Additionally, time was considered as a limiting factor to comprehend complex concepts for design-oriented students. This suggests that the more the concept is further away from design disciplines the more time students require to understand and implement it in their designs.

2.1 Theory-Driven Design for Behavior Change

In design for behavior change, designers appear to demand behavioral theory to design effective solutions. Several contemporary strategies have been developed with the purpose of designing for behavior change, like Fogg's (2009) *persuasive design*, Lockton's (2009) *design with intent*, and Tromp and colleagues' (2011) *social implication framework*. Tromp and colleagues argued that the type of strategy used is based on the desired behavior and presents a framework that explains the relationship between the product, human behavior, and the implication of that behavior. Such models have the potential to empower designers' mindsets by providing them with a nuanced and empirically grounded perspective to entice change. The *persuasive technology* model emphasizes the need for three specific factors to create persuasive designs: motivation, ability, and triggers (Fogg, 2009). The model is a simplified theoretical framework to be used by practitioners in the design process.

The use of theory in the design of persuasive products has shown impacts on people's behaviors. Studies have been focusing on empirically documenting the success of behavior change processes in design (Cash, Hartlev, & Durazo, 2017). Consolvo et al. (2009) used two theories from social psychology (*representation of self in everyday life* and *cognitive dissonance)* in their experimental technological designs to increase people's everyday physical activity. Based on results from their two case studies of using persuasive technology, they concluded that the proposed merging of (a) theories from psychology and (b) design strategies can be effective in shaping and sustaining positive behaviors. This provides insights into the effectiveness of theory incorporation in the design process.

Another example of the use of social psychology theory in design for behavior change stems from John, Flynn, and Armstrong (2018). The authors not only focus on how visual stimuli trigger sensory determinants to encourage behavior but also incorporate Bandura's Social Learning theory into their co-design methodology. As a scoring matrix, the latter assessed the validity of a design prior to testing and implementation. This suggests combining different methodologies of co-design with fundamental behavior change knowledge can create effective shifts in behavior. The study, however, did not provide details about the role of theory in the design process.

In the search for theories explaining human behavior, in particular consumer behavior,

the design discipline has recently begun to discuss theories from behavioral economics. In behavioral economics, researchers argue that people make irrational decisions based on intuition. Kahneman (2003) argued that individuals make decisions with two thinking systems: reasoning and intuition. Reasoning is an effortful and slow cognitive system used, for example, in mathematical computations and filling forms. Intuition is a fast and automatic cognitive system used, for example, in speaking one's native language. Thaler and Sunstein (2008) called these reflective and automatic thinking systems. They argued that the artificial environment can be designed considering cognitive biases of the automatic system to *nudge* people towards desired behaviors. Mejía (forthcoming) asserted that nudges can be particularly valuable for the ideation activities of the design process.

2. Method

Based on the literature review, it can be noted that although social-behavioral theories have been discussed in the realm of design, there is limited knowledge about how designers incorporate behavioral theory in design practice. This study addresses this gap. We conducted an exploratory case study to shed light on how novice designers incorporate and apply theory within the design process. We selected a theory from behavioral economics – nudging – as a current and prominently discussed approach to behavior change interventions in sustainable consumption (Lehner, Mont & Heiskanen, 2016). The research question we were trying to answer was: How do novice designers incorporate and apply behavioral theory in the design process?

The exploratory study uses case study research as the methodology. Case study research allows researchers to understand and explain complex phenomena that are difficult to control (Yin, 2017). Novice designers (senior design students) joined a three-hour design workshop session which included different ideation cycles towards problems of sustainable behavior change (Figure 1 and 2). Senior students were selected because their education and experience level are closest to being professional designers. A combination of industrial, interior and graphic students was recruited a week prior to the workshop. A total of nine participants: two males and seven females ranging from 20 to 33 years of age were involved in this study. Participants from each of the aforementioned majors were assigned into three teams with different design disciplines, and each team tackled a unique problem of design for sustainability. Participants aimed to entice positive behavior through their designs. Shorter shower times, less plastic consumption, and increased multimodal transit were the three predefined themes. Design for behavior change was used as the intention of the ideation session towards the specific target behavior. This study received the approval of the ethics committee (Institutional Review Board).
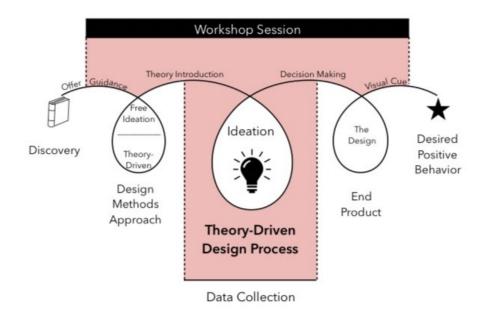
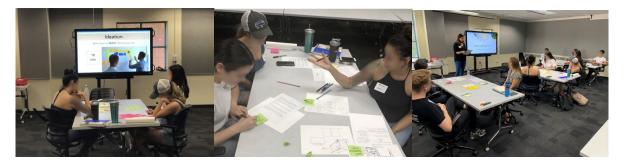*Figure 1   Approach to the case study workshop session.*

Figure 2   Photographs of the workshop session.

At the beginning of the design workshop, participants spent some time to ideate using sticky notes and sketch paper with their own framing and problem-solving tools. The goal of the first session was to warm up and allow for a comfortable ideation activity without the restriction of any predefined theory. Then, participants were introduced to nudge concepts from the theory of behavioral economics through a short presentation and a descriptive handout. They were then asked to go through ideation again utilizing nudge concepts this time. Doing so is considered a *method mindset* for designers as explained by Daalhuizen (2014). The introduction of nudge, therefore, acts as a *mental equipment* for the participants to produce effective inferences "about prerequisites and necessary conditions needed for an effective brainstorming session" (Daalhuizen, p. 58). The purpose was to observe how designers incorporate theory into their ideation process. There was no intention to compare ideation with and without theory. The purpose of the first ideation without theory was to have students develop ideas as they intuitively would first.

The workshop was broken down into six phases within the three-hour session:

1. Preliminary post-it ideation.
2. Discussion and sketching.
3. Theory presentation.
4. Theory-driven post-it ideation.
5. Theory-driven discussion and sketching.
6. Storyboard development of a selected idea, see figure 3.

Figure 3   Storyboards developed by the participants.

A qualitative approach is utilized to understand how participants incorporate, apply, and respond to theory in the design process. Since the objective was to understand the integration of theory in the design process, focused observations were conducted throughout the participant's ideation process. Semi-structured post-workshop interviews provided in-depth insights into the participants' experience with the theory. The interview guide included items about idea generation and selection, the use of theory, and the collaboration process. Participants articulated their thought process, idea inspirations, and decision making. Data was collected for investigating what participants relied on in their ideation; whether it was past experience, concepts from other disciplines, or purely based on creativity and aesthetics. Audio recordings along with direct observations documented the ideation process and the different discussions revolving around framing and decision making. Specifically, data was collected to reveal the information and knowledge that participants relied on to generate their initial ideas, and what happened after the behavioral economics theory introduction.

Data collected from all ideation activities resulted in a series of audio recordings, written observations, sketches, and notes from participants. The audio recordings were transcribed using an online speech to text transcription software - Temi. Results from transcriptions were later manually edited for inaudible parts. Some recorded segments of participant discussions during the ideation sessions were not audible and were therefore excluded from the analysis. Collected data was then thematically analyzed (Braun & Clarke, 2006). The web-based software for qualitative and mixed-method research analysis, Dedoose (*Dedoose*, 2018), was utilized to assist with coding the transcriptions and creating categories. The validated transcriptions were thematically coded to focus on the inspiration of participants for their ideas and how they responded to the theory introduction. The coded data were then exported into a structured text format for further analysis.

From there, coded text excerpts were extracted and grouped under similar themes to derive meaningful results.

3. Findings

This section is a report of the findings about the design process and how the novice designers use theory.

3.1 Influence of Design Education in the Design Process

Participants follow broadly established, generic practices taught in formal training. Half of the participants reported that in approaching problems they initially apply what they learned in their design education including brainstorming tools and design principles. For example, Participant 8 said, "It's my education, what I've learned about typography and grids and balance and then a lot of it is, is just instinctual". Another half expressed their approach being revolved around the end-user and using design empathy to relate to the user. For example, Participant 1 mentioned "[S]o it's like really putting a lot of empathetic understanding to really put yourself in the user's shoe[s] and understand what they need from this and do it".

3.2 Presence of Non-Design Related Concepts in the Design Process

Designers are eager to use non-design knowledge. Half of the participants said that they used marketing and advertising knowledge in their designs. Participant 1 said "I definitely think like digital marketing, advertising, especially with something like this would be pretty I think pretty effective. And wow, this is the power of advertising". Other participants mentioned disciplines further away from the design field influenced their designs, for example, participant 4 stated:

> I'm taking sensation and perception right now for my psychology minor. So, I have a little bit of background in psychology. So, thinking about [things] like motivation and perception and how the brain works and how we intake stimuli like a lot of that it just comes naturally to my brain and knowing how we form habits.

3.3 The Design Process Between Research, Functionality, and Brainstorming

Half of the participants elaborated on their design process; for instance, participant 5 stated: "I like to do research, before I start ideating. So, it was really interesting for me trying to just come up with something just made reading like a little brief that you guys gave us". Some said that they initially focus on functionality of the design and later on the aesthetics; participant 5 said "we can kinda lay out like the features, the benefits of the idea that we have and later on actually like develop the aesthetics". Others said that they start their design process with sketching their ideas, for example, participant 8 stated: "So I mean the foundations all there […] I will draw things out and try it and you know, go back and take my time and then let it rest for a day and then go back to it".

3.4 Intuitive Awareness of Behavioral Theory

All participants explained their awareness of external influences on behavioral outcomes in their personal experiences. Half of the participants recalled their own personal encounter with businesses effectively using such approaches and incentives. Almost all reported that they instinctively knew some of the rules or incentives to change behavior without knowing specifically about the behavioral theories. One participant claimed knowledge of the nudge theory, awareness of the published material, and interest in learning more about it prior to the ideation session. Others claimed that they did not know of its existence and lexicon. They, however, strongly felt that their ideation thinking was related to the subconscious applications of human behavior concepts. Even though their previous knowledge was neither accurate nor linked to a specific theory, it was related to theoretical concepts of human responses to certain prompts or stimuli. In the first free ideating activities, participants intuitively included aspects of behavioral theory. Those of which include reduced inattention, positive and negative reinforcement, and using senses to make people more aware of the effects of their behaviors. Participant 1 explained by saying: "Actually even before you even said this [nudge theory], I was thinking about these rules and theories without knowing what they were [...] I already kind of was using it without knowing the theory".

Data analyzed from the first ideation activities of one team revealed that participants as a group intuitively used aspects of behavioral theory. They alluded to *social norms* in their discussions by saying "it's really fun if you make it culturally cool, like everyone's saving water now. Everyone will do it". In response, another group member states "if everybody is doing it, you are being conscious of like doing it too. It's more like a movement and then everyone like follows". In another team, they focused more on the visual impacts on behavior and how visually seeing damage can effectively influence behavior. One participant explains by saying: "every disposed plastic bottle, I guess it's displayed, I can, be able to see like this is how much plastic we're using and he's just so like you kind of feel bad for it".

3.5 Influence of Personal Experiences and Cognition in Ideation

Half of the participants asserted that their personal experience drives their designs and how they perceive it through their own eyes. They recalled their own personal encounters with similar campaigns and would constantly relate the situation to themselves. For example, participant 2 said: "I thought about what would work on me, thought about similar initiatives on the campus and how they had been done and what I thought was successful." Similarly, participant 9 explained: "I picture myself in these situations. I mean obviously I'm only one perspective on planet earth, but I think of why I don't do this or why I do that."

3.6 Mixed Attitudinal Reactions to the Nudge Theory

Participants had mixed responses to the nudge theory. Three participants expressed positive views, four participants a neutral position, and two participants were objecting to some of the premises of nudging theory. Participant 1 expressed excitement about the potentially

powerful theoretical contributions of nudging:

> But then after really thinking about like the nudge theory and after the examples that you gave us, I was like, oh my god, this is effective because it changes my behavior even so, and I didn't even realize so I'm like, it will be really effective if we do implement it.

Among the more reserved participants, two indicated that they had intuitively used the theory before. Participant 9 stated "we were probably thinking subconsciously about this as well before we were introduced to it, like in the first part of the ideation process". The other two participants thought that it's a good way to start the ideation but not to solely depend on it. Participant 6 explained by saying:

> I think ideation is based on theory so that you can try things based on what has worked in the past or what theoretically could work in your head, and then you sketch it out to how you think it could work in theory. You know, and then you further it by trying it, you know, and then through like projects in school, I've learned that theory doesn't always work. Like you have to try it through the process of it and then alter like your idea based on that.

Two participants held some initial concerns about the theory, pertaining mainly to the ethical permissibility of using nudging. They, however, had different views after they had discussed it further. Participant 4 said:

> But it's hard to knowingly implement those things because it almost feels like you're manipulating the end user. But when you think about the cause that it is for, you kind of understand the necessity, the necessity and you're just kind of using the brain's processes like for the benefit of your cause instead of, like, for evil or for malicious intent.

3.7 Impacts of incorporating Nudge Theory in the Ideation Process

Most of the participants stated that the nudge theory had an impact on their design outcomes. Participant 6 elaborated that the theory "started to influence the solution to the problem... it can be more focused". Participants expressed that it gave them a more developed, effective and solid idea. Participant 2 said, "I think after having that review over the nudge theory, then we were able to create a more concrete and tangible product that would create a result". Participants mentioned that they used specific aspects of the nudge theory, naming the exact terms from the theory, for example, participant 1 explained:

> The social norms is like huge. Like if everybody else is doing it, like humans just feel a need to, like, blend in with everyone else and fit in. So you're so much more prone to doing it if everyone, it's like peer pressure. It's like if everyone is doing it, it's cool now. And it's like a cultural change development.

Although there were mixed responses to the nudge theory, participants clearly valued the theory. Some participants relied on the theory to give more credibility for their ideas, for example, participant 5 said: "at first it was just like a really rough idea. But once it relates to a specific nudge, I think there'll be more effective now because it's been studied and it has a base". Other participants thought of it as a good tool for ideation. Participant 1 said "but then after post to knowing the theories, I developed more ideas from it. So I feel like theory

is actually are probably the core of ideation". When using nudge theory in ideation, one participant changed their idea about positive reinforcement to negative reinforcement and said "so maybe it's best not to show the positive impact people are having. Maybe it is best to show just the negative, you know".

4. Discussion

The influence of studio-based education was highly visible in the participants' design process and approach. Not only did they use basic design principles in their ideation, but also strongly relied on brainstorming tools such as mind mapping and sketching. This suggests how curricula are highly absorbed and grasped by design students. The employment of contemporary design approaches, such as design empathy and human-centered design, was also evident in both ideation sessions. This proposes how emerging design approaches can be relevant and salient in framing design practices.

In addition, personal interest in non-design topics had an apparent influence on participants' processes. Participants that have pursued minor degrees or taken electives such as in psychology, entrepreneurship or marketing adopted certain concepts that supported their judgment throughout the design process. Generally, the participants displayed a strong interest in expanding their knowledge base either by taking classes or independent research outside of formal education. This could be either a result of (a) institutional efforts that support and invest in inter/transdisciplinary learning modules or (b) personal efforts and curiosity. Both of which can fluctuate with different institutional programs and personal interests.

Furthermore, participants intuitively applied some social behavioral concepts in their unrestricted ideation activities. Although their application did not necessarily reflect a high level of sophistication, its tangential implementation was certainly apparent in the data. This can be explained by the proximity between design and psychology, and how subconsciously designers utilize human connection and behavior into their designs. Further, designers today are actively using human-centered design theory and methods. Exposure to these design products in everyday life could result in forcing participants to unconsciously make sense of human behavior even with tacit knowledge about behavioral theory. Another reason could be that social-behavioral theories are intertwined with contemporary design and marketing campaigns, which can be seen when participants recalled experiencing nudges in their everyday lives. There were no issues with participants grasping concepts of the nudge theory after it was introduced to them. Previous authors such as Gentes et al., (2016) and Jung & Ståhl (2018) have reported cases where designers needed more time or had difficulties digesting and employing theories foreign to the design field. Results from this study provide new insights towards the practicality in the applications of theory-driven design in relation to nudging theory.

Although the participants did indicate their application of design education throughout the design process, most of them leaned into their personal experiences, logic, and cognition

to relate and tackle the issue at hand. While its effectiveness can be debatable, this could suggest how much designers prefer to initially approach a design problem with their personal intuition and knowledge, which is an abductive thinking process (see Kolko, 2010). A sense of comfort was observed with participants who grew excited knowing more about the nudge theory after it was introduced. The same participants heavily relied on this new knowledge and applied it systematically and diligently throughout their design process. Others perceived applications of nudge theory as manipulative or coercive, but still recognized its effectiveness and credibility when applied. These dichotomous perspectives have been widely debated in behavioral economics in regards to ethics (Blumenthal-Barby & Burroughs, 2012; Haug & Busch, 2014). Haug and Busch (2014) raised these ethical concerns in the use of nudges in consumer goods. They urged designers to be ethically responsible for their designs by being mindful to vulnerable users who can be easily targeted and cognitively challenged.

Despite the diverse responses, all participants ultimately integrated the theory into their design processes. This was evident in the analyzed data from observations, post-workshop interviews, and more so in the participants' documentation using the storyboards (Figure 3). The participants believed that they were able to strengthen and improve design ideation processes using the theory. Some participants were comfortable and excited to have guidelines from a validated theory to back up their decision making throughout the design process. The credibility of the theory made participants more confident in their designs. Some participants felt that the theory was an effective ideation tool, sourcing them with ideas that are diverse, developed and more tangible. This supports Mejía's (forthcoming) assertion that "nudges are a rich source of inspiration in design processes". The simplicity and practicality of nudge as a theory is also to be regarded for such ease of incorporation. The time and effort needed from participants to digest the theory was not a limitation and thus implies the relationship between complexity and usability. It is relevant to note that participants applied consciously or unconsciously concepts and methods from a variety of theories.

As with any other research, this study has some limitations that were identified as part of the workshop and data collection methods. First, the participants were few, inexperienced, young, and novice designers. Second, the type of theory chosen was considered simple and thus comparatively easy to incorporate. Theories with increased complexity can be difficult to comprehend and thus could have led to different results. Third, the length of the workshop was found to be a limiting factor for generating and developing more ideas. Additionally, participants' brainstorming was inherently restricted; while unintended, they had no access to resources such as a simple web search to gather additional information. They were also tasked with a specific ideation process (sticky notes documentation and collaborative sketching activities), which might have controlled the way they naturally ideate. Lastly, some of the data collected through audio recordings of ideation sessions were found inaudible, which influenced data analysis to some extent.

5. Conclusion

This exploratory case study focused on the early stages of the design process, the ideation, and framing and how designers approach problem-solving using a theory. With theory-based ideation activities, participants were able to gain another perspective. Instead of focusing on the effectiveness of the end designs, this study focuses on how theory-driven approaches affect the ideation part of the design process and how designers respond to and incorporate theory.

The study findings indicate that the participants generally approached ideation with their personal intuition and design education. Some participants utilized concepts and knowledge gained from other non-design classes to generate ideas. Some ideas shifted after the nudge theory was introduced in the ideation. Although most participants felt that they applied similar concepts intuitively, yet they had mixed responses towards it. Excited participants used it as guidelines to base their ideas on, neutral participants thought that it can improve their designs while helping stem more ideas, and hesitant participants thought it was restrictive and manipulative yet credible and necessary when justified. Regardless of their responses, they seem to easily digest and apply the theory. This suggests that when designers are exposed to an environment where they encounter social theories (i.e. for marketing and advertising purposes), they are prone to relate and use some aspects of it in their own design processes. On the contrary, scholars have discussed some cases that designers struggled with applying theories further away from the design field (e.g. Gentes et al. 2016; Jung & Ståhl, 2018). Further, novice designers not only apply theory that is intentionally introduced in their activities but also apply consciously or unconsciously a variety of theories they hold in their minds.

The findings of this study suggest a number of noteworthy areas for future research. For example, there is a need to study differences between professional designers, novice designers, and students when they incorporate theory in the design process. Also, additional studies employing different behavioral theories are needed, as the literature indicates that the complexity of theory could be a major factor in altering designers' approaches and methods. Future research should also aim to utilize and study different intervention formats (e.g. longer workshop sessions) and their outcomes on theory embracement in design processes.

The need for evidence-based design strategies to address the behavioral dimension in grand societal challenges like sustainability is pressing. The field of design research is challenged to respond to this need by experimenting with and consolidating approaches to incorporate theoretical insights from other disciplines and increase the effectiveness of design solutions. This study was a first exploratory contribution to this effort.

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About the Authors:

Aysha Alwazzan is a graphic designer based in Kuwait. She did her Master of Science in Design at Arizona State University. Her research focuses on design methods, theory-driven design, and cultural differences for design.

G. Mauricio Mejía is a design educator, practitioner, researcher and assistant professor of design at Arizona State University. His work focuses on how to design for change and contemporary design practices such as interaction design, service design, speculative design, and systemic design.

Yumeng Xie is a Ph.D. student in Design, Environment and the Arts at Arizona State University with a Master of Fine Arts in Environmental Design. Her research interests are transdisciplinarity in design education, collaborative design, team science, participatory design, and sustainability.

Daniel Fischer is an assistant professor for sustainability education at Arizona State University. In his research and teaching, he casts an educational perspective on the question of how sustainable consumption can be promoted through communication and learning.