PRIMING CULTURE DIFFERENCES IN A CREATIVE DESIGN COURSE: THE INFLUENCE OF DIGITAL STIMULI

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ABSTRACT
Extensive research has focused on the influence of culture on individuals' performance in design, with either positive or negative effects. Moreover, studies have shown that it is possible to prime individuals' cultural values to influence their behaviours in design. However, to the best of our knowledge, no study has explored priming culture in design, especially with digital stimuli. Therefore, we conducted a pilot study to explore the influence of priming culture by digital stimuli in design. First, we created video-based digital stimuli to prime individuals' individualism versus collectivism (IC) cultural values. We tested the digital stimuli in an ideation exercise during a creative design course that aimed to explore and implement essential creative problem-solving and design thinking methodologies in practice for students. The results showed that the collectivism digital stimulus increased the participants' IC value. However, in the other two conditions, the participants' IC values also increased, which was unexpected. Therefore, we discussed the role that enjoyable group ideation plays in participants' IC values. Furthermore, we found that their design aim changes by priming IC values. These findings can support the development of educational practices aimed at encouraging design novices in teams independently of their culture and inspire researchers to further explore the influence of priming culture in design.

Keywords: Digital stimulus, priming cultural differences, creative design, individualism, collectivism

1 INTRODUCTION
Previous research has demonstrated that culture affects design [1, 2], such as individuals' performance and experience during design [3, 4]. We follow Hofstede's definition of culture, in which culture is "*the collective programming of the mind that distinguishes the members of one group or category of people from another*" [5, p. 9]. This definition is further categorized into six dimensions: power distance (PD), uncertainty avoidance (UA), individualism versus collectivism (IC), masculinity versus femininity (MF), long-term versus short-term orientation (LSO), and indulgence versus restraint (IR). On the one hand, culture positively affects individuals' performance in design, such as in people with a higher IC value who generate more original ideas or perform better in group work [6, 7]. On the other hand, culture negatively affects individuals' performance. For example, individuals with a higher PD value are less likely to express their true thoughts and feelings, resulting in a restrained collaboration with their team members, because of their views on the hierarchy between superiors and subordinates [5, 8]. Moreover, cultural values can be primed [9], and previous studies have investigated the influence of priming culture on individuals' cognitions and reactions [10]. However, no study has investigated priming culture in design teams. Considering the increasing internationalization of design programmes and design agencies around the world, it is important to understand how potentially negative cultural influences can be mitigated in design work. Thus, we aim to investigate *how we can prime cultural values* and *the influence of priming cultural values on design* to support novice design work.

2 PRIMING INDIVIDUALISM VERSUS COLLECTIVISM
Priming is a widely used research approach for understanding how performance or behavior can be unconsciously affected by a stimulus [9, 11]. Regarding priming culture dimensions in particular,

several studies have demonstrated the effectiveness of textual stimuli in priming IC [10, 12, 13]. IC, as one of the cultural dimensions, refers to the degree to which people in a society are integrated into groups [5, 11]. People who score low in IC are considered individualists with loose ties to the community, who care mostly about themselves and their immediate family. Conversely, people with a higher score of IC, as collectivists, cultivate solid and cohesive ties between groups, such as in the society or country they belong to [5]. Previous studies have verified that IC value had the most considerable effect on individuals' performance in design, such as the number of ideas and sketches in ideation [14]. Therefore, as one of the first studies priming culture in design, our study only focuses on IC value. For priming IC, one of the most popular priming stimuli used in past studies is considered to be the story of Sostoras [10, 12, 13], "*(…) a warrior in ancient Sumer, [who] was largely responsible for the success of Sargon I in conquering all of Mesopotamia. As a result, he was rewarded with a small kingdom of his own to rule. About 10 years later, Sargon I was conscripting warriors for a new war…*" [13, p. 652]. Sostoras has to decide who to put in command of a detachment of soldiers to aid the king, and as such, participants are exposed to different content, depending on the condition they are in. On the individualism condition, Sostoras nominated a "*…talented general. This appointment had several advantages. Sostoras was able to make an excellent general indebted to him…*" [13, p. 652], while also increasing Sostoras' own prestige. In the collectivism condition, participants received a different story in which Sostoras nominated a family member, which benefits their family and increases loyalty among them ("*This appointment had several advantages. Sostoras was able to show his loyalty to his family…*") [13, p. 652]. Particularly in Gardner, Gabriel, and Lee's study [10], these priming stimuli triggered participants to demonstrate collectivist and individualist behavior in the corresponding collectivism and individualism conditions. As such, one's sense of IC is malleable within the constraints of one's culture.

With the development of technology, it is possible to adopt digital stimuli (e.g., videos) for priming cultural differences, more vividly and immersive [15]. However, it is still unclear how such approaches influence creative design work in relation to culture. Thus, we add one more component to our research aim: *to investigate the influence of digital stimuli on priming cultural values (the IC dimension)* and to understand the *influence of priming culture on novice design work*.

3 PILOT STUDY

3.1 Digital stimulus design

To design the digital stimuli, we used the story of Sostoras [10, 12, 13]. We built it with the game engine Unity 3D, which offers code in C #, and the required items for the design could be purchased from the Unity Asset Store [16]. In presenting the story, we divided it into three views, starting with the background of the story, with a 360-degree view of the environment with a fixed interface in front to show the background of the story in 75 seconds, as shown in Figure 1 (a). Then, the camera stops in front of the building and starts to introduce the king (15 seconds), as illustrated in Figure 1(b). Afterwards, the camera moves to the king's view to tell the story in 90 seconds (Figure 1 (c)) into three branches as three single conditions. The individualism condition branch was designed to prime a lower IC value (i.e., trigger individualistic goals), where the dialogue shows that Sostoras decides to choose a talented general, Tiglath, which benefits him. The collectivism condition branch was meant to prime a higher IC value (i.e., trigger collectivistic goals). There, Sostoras decides to choose his brother, also named Tiglath, which brings unity and prestige to the whole family. For the neutral branch as a control group, Sostoras also chooses the general, Tiglath, without explaining any reason, resulting in no cultural priming in the neutral condition as a control group.
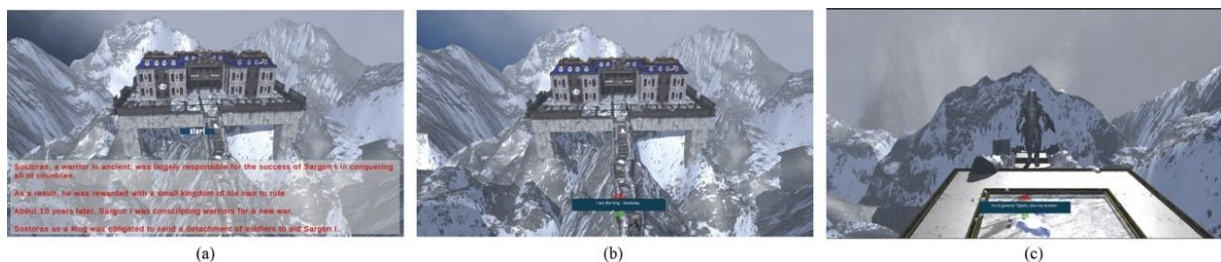

Figure 1. Screenshots of the digital stimuli

To design the scenes, we used the keywords "ancient Sumer", "a small kingdom" and "a new war." This resulted in a scene that transpired in an ancient and tense atmosphere because of the coming war, with an imperial palace in the background, as shown in Figure 1 (a and b). Moreover, we excluded a few keywords, such as "Mesopotamia," because our participants were from different countries and might have specific feelings about this historical location. In addition, to create a tense atmosphere of impending war and to avoid potential biases, the characters were dressed in military uniforms that covered their faces and skin, hiding their race and geographic characteristics. The background audio is intense to match the story, purchased from Unity Asset Store.

3.2 Study set up

We applied the digital stimuli in an exercise during a creative design course, a seven-week class that aims to understand and implement essential creative problem-solving and design thinking methodologies in practice. Before the first week of the course, we asked the participants to complete a questionnaire to obtain their initial cultural values used to compare the difference between pre- and post-digital stimuli, which was developed by Yoo et al. based on Hofstede's cultural dimensions with acceptable reliability and validity [17]. In the sixth week, participants were randomly divided into one of three subsequent days (the first day for the neutral condition, the second day for the individualism condition, and the third day for the collectivism condition), as a between-subjects study. The corresponding digital stimuli were integrated into each condition before the group ideation exercise (two or three participants in a group). We asked them to complete a questionnaire to collect their IC values (to compare them with the previous questionnaire's results) [17] after the exercise. Although 46 participants participated in the exercise, we only included data from 22 participants (21 participants did not complete both the pre- and post-questionnaire, while three participants were excluded during the analysis because their data were outliers). The 22 participants were master's or doctoral students from different majors (e.g., mechanical engineering). The mean age of the 21 participants was 24.24 years, with a standard deviation of 2.17 years (one participant preferred not to say). In addition, 9.1% of the participants were female, and 86.4% were male (one participant preferred not to say). Thirteen of the participants were from Finland, two were from Italy, two from Indonesia, and one participant each from China, Iran, Sri Lanka, Pakistan, and Vietnam. The number of participants in the three conditions was six (neutral condition), seven (collectivism condition), and nine (individualism condition). The exercise consisted of the following seven steps, using collaborative sketching (C-Sketch) [4]. The only difference between the three conditions was the digital stimuli.

1. The participants were introduced to the C-Sketch and task: "Generate as many ideas as possible for a means of transport for the mountain area" (Figure 2(a)).
2. Different versions of the video were presented with the digital stimulus (the participants were not told about the aims of the study or stimuli) (Figure 2(b)).
3. Participants were asked to ideate individually by generating as many ideas as possible via sketching and annotation (Figure 2(c)).
4. During group ideation, participants were encouraged to edit, elaborate, and add more ideas, based on each other's sketches and notes (Figure 2(d)).
5. During group discussions, participants could ask and answer questions about the other group members' contributions (Figure 2(e)).
6. Finally, participants had to select and develop their best ideas (Figure 2(f)).
7. The participants filled in a questionnaire about their cultural individualism–collectivism views [17] by scanning the code, as shown in Figure 2(g).
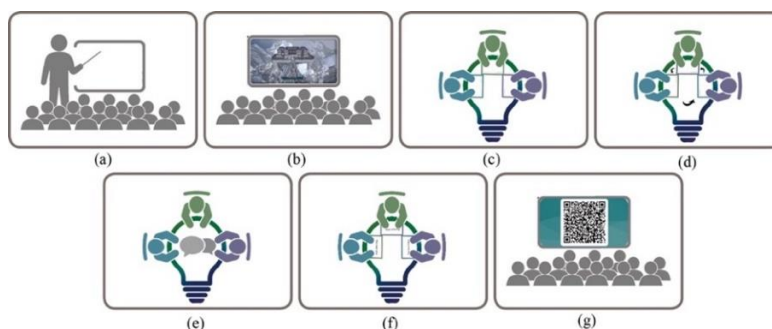

Figure 2. Exercise procedure

4 RESULTS

To analyse the effectiveness of the digital stimuli in priming IC values, we extracted the difference between the two individuals' cultural value questionnaires; then, we ran the Shapiro–Wilk test, which showed that our data was not normally distributed, and there were outliers in the data. Therefore, we deleted the outliers and tested our data with nonparametric tests.

Although all conditions showed an increased mean of IC values difference score between the pre- and post-questionnaire (Figure 3 (a)), only the collectivism condition had a statistical difference $z = 3.22$, $p = .001$, tested by related-samples Wilcoxon signed-rank test. A Mann–Whitney U test was used to determine if there were differences in the difference scores between the three conditions. The mean difference score was statistically significantly higher in the collectivism condition (2.57) than in the neutral condition (0.5), $U = 4.5$, $z = -2.411$, $p = .016$, and in the individualism condition (mean = 0.33), $U = 5.5$, $z = -2.806$, $p < .005$.
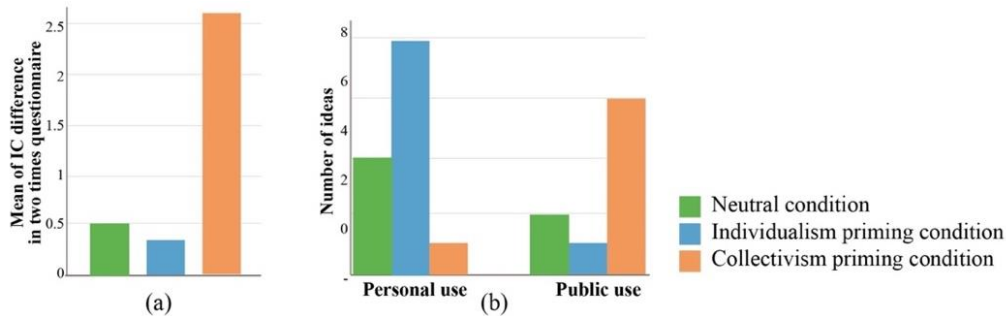

Figure 3. Comparison of the three conditions

Considering the goal of the ideation task (to generate ideas for a means of transport for the mountain area), the participants' output could be divided into two categories of design aims: transportation for personal use (e.g., a wearable small aircraft, Figure 4 (a)) or public use (e.g., a hot air balloon with stations, Figure 4 (b)). We ran a Mann–Whitney U test, and the design aim was statistically significantly different in the collectivism and individualism conditions, $U = 8$, $z = -2.899$, $p = .012$. As such, participants in the collectivism condition generated more ideas (6) for public use than for personal use (1), while the individualism condition led the participants to generate more ideas (8) for personal use than ideas (1) for public use (Figure 3 (b)).
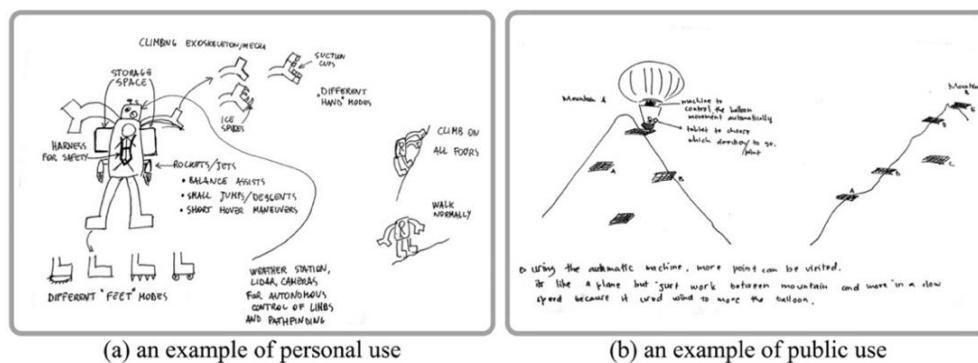

Figure 4. Examples of outputs for different design aims

5 DISCUSSION AND LIMITATIONS

The IC value of the collectivism condition increased with statistical significance, as we could expect based on previous literature [13], which confirmed the effectiveness of the digital stimuli in influencing the score of IC cultural dimension. As such, participants in this condition became more focused on the "we," rather than the "I" [10], which also influenced the ideas generated. The individualism and neutral conditions seemed to have marginally increased their IC value to become collectivistic-oriented, which is unexpected considering previous studies [10, 12]. Nevertheless, there was no statistical difference, meaning that the neutral and individualism conditions did not significantly trigger a change in the participants' IC values. By looking more carefully into the participants' course documentation, which they had to upload weekly, we could infer that the method (C-Sketch) and process we applied in the

exercise could possibly have influenced the participants' IC values in the neutral and individualism conditions. One participant with an increased IC value (from the individualism condition) said: *"Working with the Collaborative Sketching method felt very natural, because it feels almost like working alone while keeping the advantages of working in a team. By cutting out discussions and confrontation, you can focus on creativity and only at the end evaluate the idea each one has come up with and discuss them"*. Another participant also expressed: *"I really liked the ideas generated by my peers and had a lot of fun adding my own upgrades into their designs"*. Therefore, it could be that the pleasant experience in group ideation may have triggered the participants to think with the "group" in mind, which might explain the slight increase in IC value in the neutral and individualism conditions. Nevertheless, these insights cannot be confirmed with our data.

Another finding in our study was that the stimuli influenced the participants' outputs (design aims). When the participants developed their final and best ideas, most of them portrayed public transportation solutions in the collectivism condition, while the participants in the individualism condition developed more ideas meant for personal transportation, such as for one person. Although numerous studies have explored the use of stimuli and the influence of these stimuli in design [18, 19], stimuli priming culture in design is a little-discussed topic. Our study shows evidence of the impact that digital stimuli can have on cultural dimensions and design (i.e., design aims). As such, it presents an opportunity to explore how cultural dimensions can be malleable to influence novice designers in their design.

Several limitations should be considered. First, the small number of participants might limit the generalizability of the results. Second, the unbalanced number of participants in three conditions (e.g., the neutral condition had only six participants) might have influenced the results compared with other conditions (seven in the collectivism condition and nine in the individual condition). Third, we tested the digital stimuli in a class without strict experimental procedures and controls, which may have influenced the results. These are aspects to take into consideration for our future studies.

6 CONCLUSIONS AND FUTURE WORK

We designed digital stimuli as videos for priming cultural differences, specifically the IC dimension, during an exercise in a university creative design course. Our results show that the collectivism stimulus effectively primed individuals' IC value, resulting in a higher IC value than in the neutral and individualism conditions. This means that individuals' cultural values can be primed by digital stimuli. Furthermore, we found that, by priming participants' IC values, their design aims differed based on the corresponding digital stimuli. Participants in the individualism condition developed more transportation solutions for personal use, while participants in the collectivism condition created more ideas for public transportation. In addition, we discussed the possible influence of the group ideation method (C-Sketch), which might have positively influenced the participants' experience of group ideation and caused a slight increase in their IC values. These insights reveal potential benefits for design and engineering education, as it often involves a significant amount of collaborative work, which may pose a challenge for novices who have more individualistic behaviours. One potential approach is to foster collectivist values within groups, which may facilitate greater collaboration (e.g., mitigating the negative influence of individualism in collaborative ideation of one conversation at a time [20]) among students and encourage them to prioritize collective goals over individualistic perspectives. In addition, it is possible to promote individualism during the ideation process, with the aim of motivating individuals to generate a greater number of ideas [14]. Conversely, collectivism can be emphasized during the idea selection phase, in order to achieve an objective consensus [20]. As more and more design schools increase their internationalization, it is important to consider the impact of culture on how we teach design and prepare our students to ideate without creative constraints, such as those implicitly imposed by culture.

Our study might serve as the groundwork for further exploration of digital stimuli from a cultural perspective in engineering and design education, and creativity research. In future studies, we aim to improve the digital stimuli to provide an immersive experience with virtual reality (VR) equipment for participants and investigate whether a digital stimulus supported by VR could prime individuals' cultural values, thus affecting their performance in ideation and design creativity.

REFERENCES

[1] van Boeijen A., Sonneveld M., Hao C. and Khodadadeh Y. Developing cultural sensitivity: A student's perspective. In *International Conference on Engineering and Product Design Education, E&PDE'19,* Glasgow, September 2019. The Design Society.

[2] Almrott C., O'Kane C., Tully R. and Buck L. Do differences in educational culture affect the process and outcome of undergraduate design practice? In *International Conference on Engineering and Product Design Education, E&PDE'20*, Herning, September 2020. The Design Society. https://doi.org/10.35199/EPDE.2020.20

[3] Adair W. L. and Xiong T. X. How Chinese and Caucasian Canadians Conceptualize Creativity: The Mediating Role of Uncertainty Avoidance. *Journal of Cross-Cultural Psychology*, 2018, 49(2), pp.223–238. https://doi.org/10.1177/0022022117713153

[4] Gong Z., Nanjappan V., Lee L.-H., Soomro S. A. and Georgiev G. V. The Relationship Between Culture and Design Creativity at the Individual Level: A Case Study Based on Design Tasks. *International Journal of Design Creativity and Innovation*, 2023, pp. 1-24.

[5] Hofstede G. *Culture's consequences: Comparing values, behaviours, institutions and organizations across nations,* 2001 (Vol. Sage publications, sage).

[6] Brezing A., Childs P., Yim H., Bland P. W. and Rau P.-L. P. Approaches to a cross-cultural engineering design theory. In *International Conference on Engineering and Product Design Education, E&PDE'11,* London, September 2011. The Design Society. pp.487-492.

[7] Saad G., Cleveland M. and Ho L. Individualism–collectivism and the quantity versus quality dimensions of individual and group creative performance. *Journal of business research*, 2015, 68(3), pp.578–586.

[8] Naparat N. The Cultural Dimensions of an Interdisciplinary Design Approach. In *International Conference on Design Creativity, ICDC'10,* Kobe, 2010.

[9] Oyserman D. What does a priming perspective reveal about culture: culture-as-situated cognition. *Current Opinion in Psychology*, 2016, 12, pp.94–99.

[10] Gardner W. L., Gabriel S. and Lee A. Y. "I" Value Freedom, but "We" Value Relationships: Self-Construal Priming Mirrors Cultural Differences in Judgment. *Psychological Science*, 1999, 10(4), 321–326. https://doi.org/10.1111/1467-9280.00162

[11] Gong Z., Wang M., Nanjappan V. and Georgiev G. V. Instrumenting Virtual Reality for Priming Cultural Differences in Design Creativity. In *Creativity and Cognition*, *C&C'22*, Venice, June 2022. ACM. https://doi.org/10.1145/3527927.3535205

[12] Ybarra O. and Trafimow D. How priming the private self or collective self affects the relative weights of attitudes and subjective norms. *Personality and Social Psychology Bulletin.*, 1998. 24(4), pp.362-370.

[13] Trafimow D., Triandis H. C. and Goto S. G. Some Tests of the Distinction Between the Private Self and the Collective Self. *Journal of personality and social psychology*, 1991, pp.649-655.

[14] Wodehouse A. J., Maclachlan R., Grierson H. J. and Strong D. Culture and concept design: A study of international teams. In *International Conference on Engineering Design, ICED'11,* Copenhagen, August 2011, pp.12-21.

[15] Gong Z., Wang M., Nanjappan V. and Georgiev G. V. Effects of Digital Technologies on Cultural Factors in Creativity Enhancement. *Design in the Era of Industry 4.0,* Volume 3, Smart Innovation, Systems and Technologies 346, https://doi.org/10.1007/978-981-99-0428-0_32

[16] Hocking J. *Unity in action: multiplatform game development in C.* 2022 (Simon and Schuster).

[17] Yoo B., Donthu N. and Lenartowicz T. Measuring Hofstede's Five Dimensions of Cultural Values at the Individual Level: Development and Validation of CVSCALE. *Journal of international consumer marketing*, 2011, 23, pp.193–210.

[18] Gonçalves M., Cardoso C. and Badke-Schaub P. What inspires designers? Preferences on inspirational approaches during idea generation. *Design Studies*, 2014, 35(1), pp.29–53.

[19] Jang S. H., Oh B., Hong S. and Kim J. The effect of ambiguous visual stimuli on creativity in design idea generation. *International Journal of Design Creativity and Innovation*, 2019, 7(1–2), pp.70-98. https://doi.org/10.1080/21650349.2018.1473809

[20] Thoring K., Luippold C. and Mueller R. M. The impact of cultural differences in design thinking education. In *Proceedings of the DRS 2014: Design's big debates,* Umea, Sweden, June 2014, pp. 744-756.