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DEMOGRAPHIC FACTORS AND THEIR INFLUENCE ON DESIGNER CREATIVITY AND EMPATHY EVOKED THROUGH USER EXTREME CONDITIONS

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ABSTRACT
Past work has demonstrated that simulating an extraordinary user scenario could have an impact on increasing designer empathy and creativity. It is likely, however, that an individual's background could make a difference on how such simulated scenarios influence designers and how well the design method works. In this paper, we study the impact of demography and personal connection of the participants to any given simulated scenario versus their response to different empathic simulation workshops. With a variety of design tools and techniques available, understanding such influencing factors could help designers decide on the appropriate design tool for effective ideation. In this study, we investigated the effect of 81 (49 female and 32 male) users from three different workshops that simulated three different extraordinary user scenarios. Results of the study show that personal connection to a population being simulated significantly affects the impact a simulated scenario has on evoking creativity and empathy. And, for the given set of participants, gender did not show significant impact on the participants' response.

INTRODUCTION
A wide range of ideation tools and techniques are available to designers and design teams, enabling them to enhance their creativity[1, 2]. A designer's choice of design techniques for any given design opportunity could be influenced by the designer's personality [3, 4] or even their demographic background [5]. Work by Choo et al. shows that a designer's personality type has a significant effect on the way they respond to different ideation techniques [4]. Similar effects has been shown on the influence of a designer's cultural background on their choice of design process[5]. Apart from these effects, an empirical study by Christine et al. showed how ownership bias over a concept is stronger among male students when compared to that of the female students [6]. In this paper, the influence of a simulated scenario is analyzed to study the effect of external factors like participant gender, age and previous connections on participant empathy and creativity evoked through such scenarios.

While the design techniques for co-designing with users provide better understanding of the end users [7-9], empathic design techniques, on the other hand, allow designers to experience the user perspective themselves [10, 11] in hopes of developing empathy toward the target users. Past research also shows that empathic design techniques, like Empathic Lead User (ELU) [12] and Empathic Experience Design (EED) [13], can help designers identify a higher rate of latent needs compared to other techniques. Latent needs here refer to the

needs that are not readily articulated by the users otherwise. This result is achieved by enabling designers to empathize with an extraordinary user population. The term extraordinary user refers to users with some form of physical or cognitive impairment or disability. In a previous study, a workshop with 36 participants, showed that a series of simulated extraordinary user (visual impairment) scenarios evoked an increase in creativity and empathy when compared to that of receiving a briefing about the extraordinary user population [8, 14]. What was not explored in previous works was the influence of factors such as participant demography and previous exposure on the participant response. Understanding such influences could not only help designers choose appropriate design tools, but also develop a deeper understanding by exploring if the discovered effect is due to the given design technique or due to factors like participant demography or connection.

In this study, we conducted three separate simulation workshops that contain ideation. The three workshops focused on visual impairment, hearing impairment, and aging. Ideas developed by the participants from the workshops were included in the study. The study thereby focuses on empathic modelling, through which we seek to understand the impact of demography and personal connection on the quantity, variety and novelty of ideas shared by the participants. These three metrics are intended to capture the creativity of the participants. We analyze the workshop results at different levels of granularity to answer the following two research questions:

1) To what extent does the factors below influence the impact of a simulated scenario on participant creativity and empathy?
   a. Participant demography (factors assessed: gender, age, nationality)
   b. Personal connection
2) How does empathic self-efficacy influence the effect of personal connection and demography on participant creativity?

APPROACH

All procedures followed for the study were approved by the Singapore University of Technology and Design (SUTD), Institutional Review Board (IRB).

Initially, 85 different participants within an age group ranging from 18 to 52 with median age at 22, volunteered for the workshops. The primary intention of the workshops was to evoke empathy among participants through briefing and a series of simulated scenarios from the lifestyle of an extraordinary user population. The briefing sessions were for 10 to 15 minutes and this was followed by one hour simulated experience and discussion. The study was built on this opportunity to understand the effect of briefing and simulated scenarios in evoking participant empathy and creativity. Participants were given three similar questionnaires at three different stages of the workshop: (i) pre-workshop: a control stage for participant response before experiencing any workshop treatment; (ii) post-briefing: stage for participant response after receiving briefing; and (iii) post-simulation: stage influenced by simulated scenarios and discussion session. Participants answered the questionnaires following their consent expressed via a set of the consent forms. All three questionnaires had the following two questions in common:

i) List as many issues as possible in order of importance that needs to be solved for the target population (users with visual impairment, users with hearing impairment, the elderly users)
ii) Provide solutions/ideas to solve the listed design issues.

This approach helped capture any influence the briefing and simulated scenario had on the opinion of the participants. All participants were given a folder that they used to store the questionnaires provided at each stage. This helped track the questionnaires from each participant without collecting any identifying information.

Along with the design issues and solutions, basic demographic information such as age, gender, previous experience and their personal connection to the target population was collected during the pre-workshop stage. Participants were categorized as having personal connection if they answered 'yes' to the question that asked if they knew somebody from the population targeted in the workshops, instigating a deeper knowledge that could influence their presumptions of the respective workshops. For example, a visual impairment workshop participant who is personally connected to a person with visual impairment. Participants' self-efficacy ratings on their ability to understand and solve the design issues of the target population were also recorded through the first and last questionnaires.

Figure 1 shows the research approach followed for each workshop. The following sections briefly discuss each workshop and then present the combined analysis and discussion.

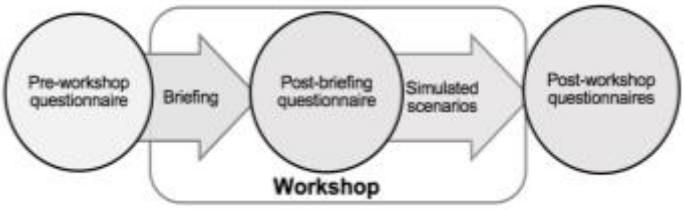

Figure 1 Research approach followed for each workshop

Workshop 1: Visual Impairment

The workshop themed with visual impairment had 36 participants with an age group ranging between 18 and 52 (median=22).

Briefing included a presentation on visual impairment along with the tools used by people with visual impairment. Participants were also given simulation glasses that helped them have a better idea of different types of visual impairments.

Following briefing, participants were taken through a series of scenarios.

Simulated scenarios included boarding a bus, relaxing at a park, buying food and navigating inside a house. All these scenarios were simulated within a completely dark space. A facilitator with visual impairment guided the participants through the dark space during the simulated scenario.

Workshop 2: Hearing Impairment

28 participants within the age group of 18 to 33 (median=20) took part in the hearing impairment themed workshop.

Briefing session for this workshop scenario presented basic information on hearing impairment and the sign language used to communicate by people with hearing impairments.

Following the briefing, participants were into groups with 4 to 5 participants per group, where the groups went through a series of scenarios with their hearing completely blocked using noise cancellers.

Simulated scenarios included listening to a musical video, a short film, shopping for clothes, buying food and an unheard emergency alarm triggered amidst experiencing the scenario. Participants where facilitated by a volunteer with hearing impairment throughout the workshop.

Workshop 3: Aging

20 participants in total within an age range of 18 to 36 (median=26) took part in this workshop.

Briefing explained the lifestyle of the elderly in Singapore, their day to day activities and their jobs. After penning their response on the post briefing questionnaire, participants proceeded to the simulation experience.

Simulated scenarios included home, hospital, office, market and an academy station that offered courses. During the simulated scenario, participants were given an age suit that restricted their movements. The scenarios were related to the lifestyle of elderly in Singapore.

Questionnaires were used to record participant responses during all three stages of the workshops.

METRICS USED

Many approaches exist in the literature to measure creativity and ideation results [15-18]. In this study, Creativity is measured through the quantity, variety and novelty of the concepts/ideas shared by the participants [15, 18]. Following works by Shah et al. and Moreno et al., metrics listed below were used to measure the quantity, variety and novelty of ideas.

Quantity: Ideas were grouped into overall and non-repeated ideas to understand the impact of each simulated scenario in increasing participant creativity. Overall ideas represent all ideas including the ones that were repeated during the previous stages, and the non-repeated ideas are the ones that that were specific to each stage. The following equation (Eq. (1).) represents the approach used to separate overall and non-repeated ideas [15]:

$$Q_{Total} = \sum \text{all ideas generated} = Q_{NR} + \text{Repeated ideas} \quad (1)$$

In Equation (1), Q_{Total} denotes both repeated and non-repeated(Q_{NR}) ideas shared by the participants. Q_{Total} in this paper, as mentioned earlier, is termed 'overall'. Hence Q_{Total} and Q_{NR} were calculated as the quantity of overall and non-repeated solutions/ideas generated respectively during each stage of the workshop.

Variety: All ideas were grouped into different categories based on their similarity to determine their variety[18]. The categories were determined separately for each workshop. Categories for each workshop were chosen only upon achieving more than 80% agreement between two raters. Each rater was directed to categorize the ideas in a way that it does not lose the depth of the shared idea. This approach helped group the ideas into higher categories that helped understand the variety of the ideas shared by the participants. Grouping similar ideas in a single category also helped to overcome duplication of categories. For instance, the ideas, 'using tech device and spell out the word' and 'apps to help communicate' were grouped into the same higher level category. Hence, the number of categories denoted the variety of ideas shared by the participants at each stage.

Novelty: Novelty, representing the uniqueness of the ideas, was calculated based on Eq. (2)., where S is the novelty score for each idea under a category, C is the count of ideas in each category and T is the sum of all ideas across all categories, where $i=1$ to n, with n denoting the number of ideas in each category. The value of 10 is multiplied to normalize the expression[18].

$$S_i = (T_i - C_i)/\ T_i \times 10 \quad (2)$$

Almost all ideas shared by the participants were feasible and, hence, the quality of the solutions based on the feasibility was not specifically evaluated or calculated.

Empathy: The Empathy analyzed in this study is based on the participant's self-evaluated empathy. For this, the participants evaluated their ability to understand and provide solutions for the target population. The self-efficacy metric followed a five-point Likert scale that ranged from -2 to +2 with -2 denoting strongly disagree and +2 denoting strongly agree for various dimensions of empathy.

RESULTS AND ANALYSIS

Individual Workshop: Analysis & Results

Data from all three workshops, when tested, did not correspond to a normal distribution. Hence, a Wilcoxon signed-rank test was used on SPSS to test the significance of the results obtained. This test was used to check the significance of increase or decrease in creativity through number, variety and novelty of ideas shared by the participants, at every stage of each workshop. Table 1 illustrates the significance *(p-value <0.05)* of results obtained from individual analysis of each workshop. In the table, green indicates a significant increase in the quantity, variety and novelty of ideas shared, and red

indicates a significant decrease in the same. The numbers 1, 2 and 3 in table 1 denotes each workshop in the order they are described above. One outcome that was common to all workshops was the significant increase in participant self-efficacy. While workshops when analyzed individually showed variations in results, the sample size in each workshop was not suffice enough to identify the factors that influenced such outcome. Hence, the individual outcomes were combined for further analysis.

Table 1 Statistical significance of results from individual workshops

		Overall									Non-repeated		
	For α=0.05	Pre-workshop to post-briefing			Post-briefing to post simulation			Pre-workshop to post simulation			Post-briefing to post simulation		
		1	2	3	1	2	3	1	2	3	1	2	3
Creativity	Quantity												
	Variety												
	Avg Novelty												
	Max Novelty												
Empathy	Ability to understand behavior and mindset	NA			NA								
	Ability to solve issues	NA			NA								
Key	Implies significant decrease between two stages				Implies significant increase between two stages								

Combined Workshop Data: Analysis and Results

The combined data from the three workshops failed for normality when tested. Hence, the Wilcoxon signed-rank test was again used to test the significance of the outcome for the combined set of ideas. Figure 2 shows the combined quantity and variety of both overall and non-repeated ideas during each stage, Fig. 3 displays the combined average and maximum novelty, and Fig. 4 shows the combined self-efficacy obtained while the participants evaluated themselves on their ability to understand and provide solutions for the target population. To interpret this outcome, Table 2 illustrates the significance *(p-value<0.05)* of the results. Based on the results obtained, it can be interpreted that simulated scenarios had a significantly higher impact on participant creativity when compared to that of briefing.

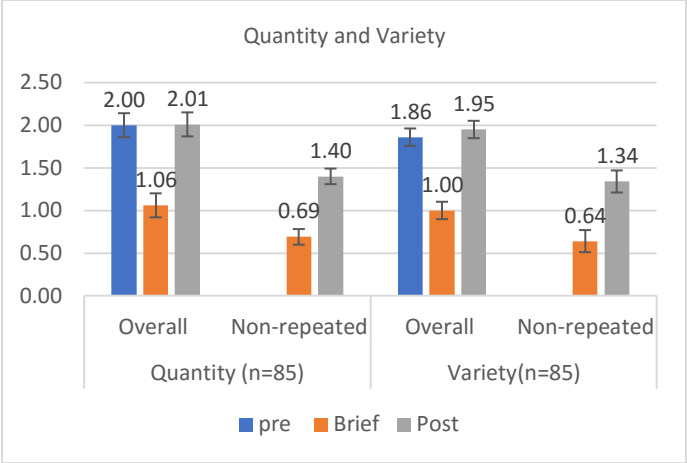

Figure 2 Quantity and variety for Overall and Non-repeated ideas for the combined data (along with the S.E.)

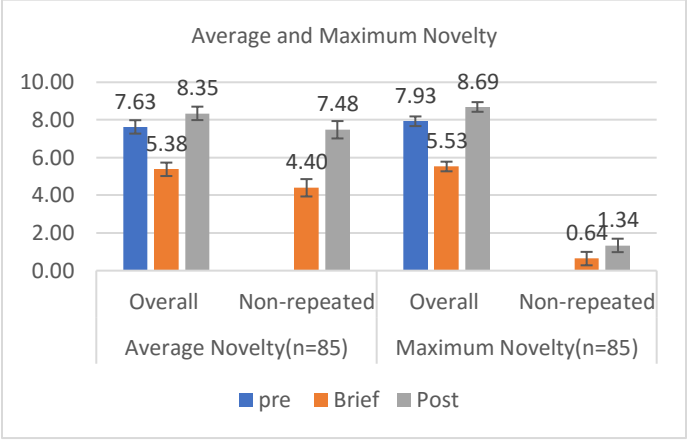

Figure 3 Average and Maximum novelty for Overall and Non-repeated ideas for the combined data (along with the S.E.)

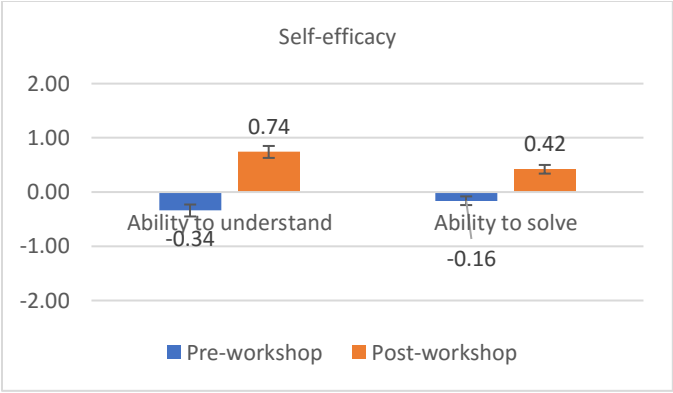

Figure 4 Self-efficacy rated by participants (along with the S.E.)

Results displayed in Table 2 demonstrates that the combined outcome of the workshops show a significant decrease in quantity and variety of ideas while it did not show a

similar effect on novelty. There was decrease in the quantity, variety as well as the average and maximum novelty of ideas shared during post-briefing. In contrast, all four parameters showed a significant increase for the ideas that were shared post-simulation when compared to that of post-briefing. To understand the factors that could have influenced these effects, and to answer the research questions raised earlier, further analysis was carried out on the influence of factors like demography and personal connection, over the participant response. Among the 85 participants, two participants from the visual impairment workshop and one from the hearing impairment workshop had experienced a similar scenario earlier. Three participants is too small a sample size to infer any conclusions hence, their results are separated from remainder of the data and discussed later for future consideration. In addition, one participant did not mention about their previous experience and personal connection to the target population. Therefore, this data from the participant was considered incomplete and not included in further analysis.

Table 2 Statistical significance of combined results

		Overall			Non-repeated
	For α=0.05	Pre-workshop to post-briefing	Post-briefing to post simulation	Pre-workshop to post simulation	Post-briefing to post simulation
Creativity	Quantity				
	Variety				
	Avg Novelty				
	Max Novelty				
Empathy	Ability to understand behavior and mindset	NA	NA		
	Ability to solve issues	NA	NA		
Key	Implies significant decrease between two stages		Implies significant increase between two stages		

Analysis on the factors influencing the result was based on data from the remaining 81 participants. Analysis was carried out by testing the influence of the following factors on quantity, variety and novelty of ideas shared by the participants:

A. Participant demography (factors assessed: gender, age, nationality)
B. Previous connection
C. Self-efficacy:
    1. Interaction effect of participant self-efficacy and demography, and
    2. Interaction effect of participant self-efficacy and previous connection

For the purposes of this paper, the following sections focus on the overall data and do not include the non-repeated data.

A. Participant Demography

Demographic factors considered in this study are gender, age and nationality of the participants. The data was not normally distributed; hence, it was first ranked and then analyzed with a N-Way ANOVA using MATLAB. While there were 49 female and 32 male (excluding 4 participants with previous experience or insufficient data) participants, the distributions in age and nationality were not significantly diverse. The participants' age group ranged between 18 to 52 with 21 as the median. Similarly, among the 81 participants, 75 participants were Singaporeans and the remaining six participants belonged to Malaysia, Taiwan, Philippines and Thailand nationalities. Participant age versus their response did not show any correlation (Spearman Correlation) when analyzed. Hence to simplify the calculation and understand the interaction effects, participant age group was divided into two groups: participants below 21 (median value) were grouped into one category, and participants who were 21 and above were grouped into different age group. Similarly, participants were divided into Singaporeans and Non-Singaporeans based on their nationality.

Results from a N-Way ANOVA showed no significance (*p-value*>0.05) in the effect of gender compared to the quantity, variety and novelty of ideas shared by the participants during all three stages of the workshops. Similar was the effect for age and nationality. But, there was some interaction effects between gender and age on the difference in novelty of ideas shared between pre-workshop and post-briefing (*p-value*= 0.08).

Similarly, there was a certain level of interaction between age and nationality on the difference in quantity of ideas shared between post-simulation and post-briefing (*p-value*=0.06). One reason for the interaction between age and nationality could be that four of the six participants categorized as Non-Singaporeans were above 21. Given the limited diversity of both age and nationality data, a *post hoc* analysis would not be reliable at this point.

B. Personal connection

Personal connection, as mentioned earlier, refers to the participants' exposure/connection to the target population prior to the workshop. Among the shortlisted participants, 51 were connected and 30 were not connected. The N-Way ANOVA between personal connection and the self-efficacy results showed that a participant's connection to the target population had a significant impact (*p-value*=0.05) on the difference in quantity of ideas shared between pre-workshop and post-simulation as well as between pre-workshop and post-briefing. There was also a significant impact (*p-value*=0.02) of participant's connection on the difference in average novelty of ideas shared between pre-workshop and post-briefing stages. The impact based on self-efficacy and interaction effects are discussed under the section on self-efficacy.

With a N-Way ANOVA showing significant impact of personal connection, a *post hoc* analysis was carried out to compare the impact of connection to the target population using

a Wilcoxon signed-rank test. For this analysis, the participant data was grouped into two categories 1) Connected to target population, and 2) Not connected to target population. The difference in quantity, variety and novelty of ideas along with the self-efficacy value reported by the participants was analyzed for each category. Wilcoxon signed-rank test was used to compare the different stages for each category. The results in Table 3 supports the previous interpretation made based on the ANOVA analysis, showing that a participant's personal connection does have a significant impact on the ideas shared by the participants. The response of participants with personal connections could be associated with the effect of design fixation [19-21] where, the participants tend to adhere to a preconceived set of ideas due to their previous knowledge about the population. Whereas, both briefing and simulation had a better impact on participants without any such preconceived ideas (not connected). Nevertheless, simulated scenarios had a significantly higher impact than briefing among all participants irrespective of their personal connections. Table 4 lists few exemplar ideas listed by the participants with and without any previous personal connections, during different stages of the workshop.

Table 3 Statistical significance between different stages of the workshop for Connected and Non-connected participants

		Overall					
	For α=0.05	Pre-workshop to post-briefing		Post-briefing to post simulation		Pre-workshop to post simulation	
		C	NC	C	NC	C	NC
Creativity	Quantity						
	Variety						
	Avg Novelty						
	Max Novelty						
Empathy	Ability to understand behavior and mindset	NA		NA			
	Ability to solve issues	NA		NA			
Key	Implies significant decrease between two stages			Implies significant increase between two stages			
	C- Connected (n=51)			NC- Not Connected (n=30)			

Table 4 Ideas shared by participants with (connected) and without personal connections (not connected)

		Ideas
Pre-workshop	**Connected**	1. Some app that lets them know there are any dangers around them: something like GPS 2. Implement a speaker at the top of the vehicle in public transport near the grab pole- South Korea implemented that in trains
	Not connected	1. Visually handicapped friendly structures & gadgets/ applications- E.g. Applications designed that read out information, walking sticks with different functions 2. Communication devices
Post-briefing	**Connected**	1. Consistent layout of -stairs, lift buttons, restaurants 2. Get hearing aids that are more accustomed to lower sound frequency
	Not connected	1. Gadgets/applications designed specially for the visually handicapped (apps that read out information, devices that aid them in schools- magnifying of words/ images) 2. Vibrations can be used to notify them
Post-simulation	**Connected**	1. Driverless cars 2. A speech to text app which is accurate (good for lectures)
	Not connected	1. Longer time for them to cross 2. Fire alarms/alerts that produce lights as well as sounds

C. Self-efficacy

Self-efficacy values were recorded to analyze the difference in participants' self-evaluated level of empathy towards the end of the workshop. Self-efficacy rating was collected only during the pre-workshop and post-simulation stages. Hence the effect of self-efficacy was calculated only between the pre-workshop and post-simulation questionnaires. Recorded self-efficacy values were divided into three categories based on the pattern observed between pre-workshop and post-simulation: i) Increased self-efficacy: responses that showed an increase in self-efficacy post-simulation, ii) Constant self-efficacy: responses that did not show any difference in self-efficacy post-simulation, and iii) Decreased self-efficacy: responses that showed a decrease in self-efficacy post-simulation.

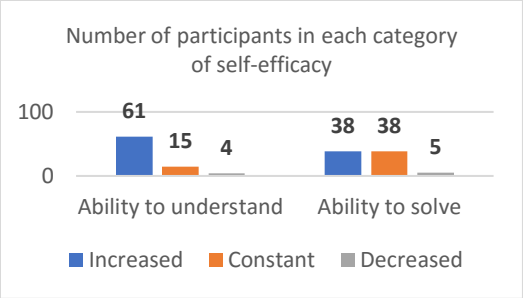

Figure 5 Number of participants in each category of self-efficacy

Figure 5 shows that very few participants indicated a decrease while self-evaluating their ability to understand and provide solution. This pattern was observed irrespective of their personal connection or demography. Hence, the impact of decreased self-efficacy is not included in further analysis. Earlier results (Table 1& 2) from the study showed a significant increase in self-efficacy for both individual and overall analysis, hence further analysis was done to understand the interaction effect of the self-efficacy and other influencing factors. The following sections analyze the interaction effect of self-efficacy and demography, self-efficacy and personal connection, on the quantity, variety and novelty of ideas.

1. *Interaction effect of participant self-efficacy and demography:*

N-Way ANOVA on participant self-efficacy and demography showed that a participant's self-evaluation on their ability to understand the issues faced by the target population, had a significant (*p-value*=0.04) effect on participants' response. The effect was significant as a difference in all parameters except for the maximum novelty between pre-workshop and post-simulation stages. Other than this outcome, there was no significant interaction observed between self-efficacy and demography. A *post hoc* analysis was carried out using Wilcoxon signed-rank test to analyze if the self-efficacy response for understanding the issues had an impact on ideas, based on the demography of the participants. One point where there was significance in results obtained was the increase in average novelty (*p-value*< 0.05) of ideas when the female participants expressed an increased or constant understanding.

Table 5 Statistical significance of combined impact of participant self-evaluation (understanding) and gender, on average novelty of ideas

Ability to understand	Male	Female
Increased	↑	↑
constant	↓	↑
Key	Significant decrease	
	Significant increase	

2. *Interaction effect of participant self-efficacy and personal connection:*

Results from ANOVA showed a significant (*p-value<0.05*) interaction between a participant's self-efficacy rating on their ability to solve the design issues and their personal connection. This result was observed for the difference in quantity of ideas between pre-workshop and post-simulation stages.

Hence, a *post hoc* analysis was carried out using Wilcoxon signed-rank test to have a better understanding of this interaction between the recorded self-efficacy and personal connection on the quantity, variety and novelty of ideas. Interaction effect on variety showed results similar to that of the quantity hence, following two sections will be based on the quantity and novelty of ideas.

2.1 Self-efficacy, Personal connection and Quantity: Table 6 illustrates the significance of the impact obtained, with arrows implying an increase or decrease in number of ideas, towards the end of the workshop (post-simulation). A significant increase (Ability to understand: *p-value*=0.015, Ability to solve: *p-value*=0.013) in the number of ideas was observed among participants who expressed an increase in self-efficacy and did not have any personal connections. The cells with an arrow but not shaded imply an increase or decrease in quantity that was not significant (*p-value*>0.05). Therefore, among the participants without any personal connection, participants who expressed an increase in self-evaluated empathy were also able to provide significantly higher number of solutions.

Table 6 Statistical significance for quantity of ideas between pre-workshop and post-simulation stages

Ability to understand	C	NC		Ability to solve	C	NC
Increased	↑	↑		**Increase**	↓	↑
Constant	↓	↓		**Constant**	↓	↑
Key	Significant decrease					
	Significant increase					
	C-Connected					
	NC-Not connected					

2.2 Self-efficacy, Previous connection and Novelty: Table 7 shows the impact of previous connection and increased/ constant self-efficacy on the novelty of ideas shared by the participants. Two significant outcomes can be observed in Table 7. First, there was a significant increase (*p-value*=0.04) in the novelty of solutions among participants who had no previous connections and expressed an increase in their ability to solve. Second, there was a significant increase (*p-value*=0.04) in the novelty of solutions among participants without any previous connection and expressed no change in their ability to provide solutions. The up-arrows here represent an increase in average novelty post-simulation and the down-arrows imply a decrease in average novelty. The cells with an arrow but not shaded imply an increase or decrease in novelty that was not

significant (*p-value*>0.05). Results obtained also show a contradiction in the novelty of the ideas shared by participants with personal connection versus their reported self-evaluated empathy values.

Table 7 Statistical significance for average novelty of ideas between pre-workshop and post-simulation stages

Ability to understand	C	NC		Ability to solve	C	NC
Increase	↓	↑		Increase	↓	↑
Constant	↓	↑		Constant	↓	↑
Key	Significant decrease					
	Significant increase					
	C-Connected					
	NC-Not connected					

DISCUSSION

The overall study results support and greatly extend the findings from a previous study [14] that showed that experiencing a simulated scenario has a significant impact on creativity when compared to only briefings. The impact of the simulated scenarios on a participant's increased level of empathy observed in this study, can be inferred from the significant increase in the self-efficacy results obtained based on the participants' self-evaluated level of empathy.

The primary focus of this paper is to understand the impact of participant background and knowledge on their response to experiencing a briefing and simulated scenarios. Hence, a deeper analysis on the impact on empathy is considered beyond the scope of this paper. This research study intended to understand the impact of certain demographic factors and personal connections on the quantity, variety and novelty of ideas shared by the participants, by answering the following questions:

1) To what extent does the factors below influence the impact of a simulated scenario on participant creativity and empathy?

a. Participant demography:

Three factors were considered under demography: gender, age and nationality. Results from this study shows the minimum influence of gender on participant creativity and empathy. A potential interaction between age and gender and age and nationality on impacting participant creativity is observed. A higher sample size would help understand if such demographic factors could be significant in impacting the results. Hence, further analysis will be needed to develop conclusion complete model of the impact of other demographic factors like age and nationality on participant response.

b. Personal connection:

The study results were evident in illustrating the influence of participant's personal connections with creativity and empathy evoked through simulated and briefing scenarios. Participants without any personal connections to the target population showed a better response to briefing and simulated scenarios when compared to the participants with personal connections. The effect was observed for both quantity and novelty of the ideas shared by the participants. This could be due to the prior knowledge (design fixation) incurred in participants due to personal connections, thereby making the information shared through briefing or simulated scenarios less effective. Despite the impending design fixation due to their personal connections, participants could still generate new ideas after experiencing briefing and simulated scenarios. This effect on creativity was significantly higher for the simulated scenarios when compared to that of briefing. Such high impact of simulated scenarios could be due to the immersion experience obtained from the scenarios when compared to the knowledge gained through briefing.

With briefing and simulated scenarios being the design methods considered and analyzed, obtained results demonstrate the importance of considering a designer's personal connection as an influencing factor while choosing an ideal design method for ideation.

2) How does empathic self-efficacy influence the effect of personal connection and demography on participant creativity?

With a deeper analysis on the interaction between self-efficacy recorded and participant's demography and personal connection, we could analyze the effect of the influence on the ideas. The *post hoc* analysis in section 1 illustrates that the female participants could have associated their increase in self-efficacy (ability to understand), based on the increased novelty in their ideas; hence showing a better interaction. Similarly, based on results from sections 2.1 and 2.2, participants without any personal connections could have associated their increased self-efficacy (ability to understand and ability to solve), based on the ideas generated. Whereas, this interaction between the self-efficacy and the ideas was not significant among the male participants and the participants with personal connections. What was more interesting among the reported self-efficacy was the outcomes of participants who felt no change in their level of self-efficacy. For example, a participant with no personal connection could still show a significant increase in the average novelty of their solutions, even when they felt there was no change in their ability to solve the design issues. Therefore, due to the variations observed in the interaction between self-efficacy and other influencing factors, it might not be reliable to associate a participant's self-evaluated empathy with their creativity.

LIMITATIONS

Certain compromise on the demographic distribution had to be accepted since the workshop participation was self-selected. Another limitation to this approach is that the order of the workshop was not randomized, this might have influenced the level of immersion among participants for different stages of the workshop.

CONCLUSION AND FUTURE WORK

1. This is a very important study that shows the benefits of briefings and simulations of targeted populations in increasing the creativity and empathy of participants in solving design issues.
2. While participants with personal connection do not show the same increase in the effect of briefings and simulations in increased creativity and empathy, such briefings and simulations do not show any negative effects.
3. When comparing briefings and simulations, simulations are much more effective than just briefings in improving creativity and empathy in participants.
4. Selecting a design method by considering the designer's previous exposure would maximize the benefit obtained from that method.

For future research, potential interactions between age and gender, age and nationality with a higher sample size could be possible areas to explore. Results from the three participants who had a personal experience of the simulated scenario couldn't be included in this study due to the small sample size. This could also be an influencing factor to consider in future. Also, a self-efficacy survey is alone not sufficient to validate the empathy evoked. Hence, a deeper qualitative analysis on empathy should be considered in future works to measure empathy.

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