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USER EXTREME CONDITIONS TO ENHANCE DESIGNER EMPATHY AND CREATIVITY: APPLICATIONS USING VISUAL IMPAIRMENT

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ABSTRACT

Designers often design for people unlike themselves. Many design tools and methods have been developed to support the designers in this task. One area is empathic design, where, simulated scenarios allow the designers to experience a situation that is less likely to be accessed otherwise. These simulated scenarios are widely used and past studies have shown these methods enhance designer creativity or evoke designer empathy. In this paper we investigate to what extent these simulated scenarios help increase designer empathy and creativity and how it compares to only being briefed about the target population. In this study 36 subjects took part in a workshop that included a briefing about the life of people with visual impairments as well as a simulation of such scenarios. Participants' levels of creativity and empathy were assessed at three different stages during the workshop: (i) Pre-workshop, (ii) Post-briefing and (iii) Post-simulation. The results show that, the participants' creativity in terms of novelty, quantity and breadth of the ideas was significantly high after the simulation when compared to only being briefed about the situation. There were no differences in the idea feasibility. All ideas were technically feasible. Also participant empathy increased significantly from before the workshop to post-simulation. A further comparison of the workshop reflections from both participants and volunteers with visual impairments were used to understand the extent to which the participants were able to empathize with people with visual impairments. We find the simulated scenario improved the participants' ability to understand the simulated population compared to the before workshop state, but nevertheless, the participants were unable to match the level of detail given by the people with actual visual impairments.

INTRODUCTION

Need finding is a central part of user centred design. Many need finding techniques such as contextual need analysis, journey maps and personas, either directly or indirectly guide designers to empathize with the users. It is well recognized that though investing time in close interactions with the users can provide rich data on user needs, it can be a time and resource consuming task [1]. In addition to this, lack of technical knowledge among the users might result in ideas that are technically not feasible to implement [2]. Consequently, simulated conditions and tools have been developed to emulate user interaction in a more resource efficient way to communicate certain perspectives of the user to the designer [3-5]. In the past decades, different simulation tools and scenarios have been designed and implemented for designers to empathize with their users. In the early 1990s, a third age suit that simulated the challenges faced by elderly was used by Ford to design a car that was inclusive of the design needs of elderly [6]. Similarly, a group of designers at the MIT age lab have developed an empathy suit called AGNES (Age Gain Now Empathy System), to simulate limitations in physical abilities faced by a 75 year old [7].

Another concept that complements this is the 'lead user' approach. 'Lead user', a term introduced by Von Hippel in 1986 [8], refers to the user population who are well ahead of rest of the population in realizing a need and in some cases they might even find a solution for it [9]. Finding these lead users can be a difficult task. Accordingly, methods have been developed to help identify these lead users [10, 11] Rather than finding these unique people, increasing amount of work has shown that also people with limited abilities [12] or living in special situations [13, 14] may be as useful as lead users in identifying latent needs for not just themselves but the entire population. In particular Hannukainen and Hölttä-Otto [15] showed that extraordinary users who experience a loss of ability, including people with visual impartments, are capable of being lead users. These developments have led to design methods to help support designers to both empathize with the users as well as to create novel innovations to meet the not yet articulated needs. For example, Empathic Experience Design (EED) [16] and Empathic Lead User (ELU) [17] methods were introduced to empathize with the extraordinary lead user population to help generate novel design concepts (EED) and design needs (ELU). These methods impose physical restrictions that simulate the challenges experienced by a lead user population, enabling the designers to experience needs from their perspective. In another study by Conradie et al. [18], lead users to design assistive tools that supported users with low vision were selected from a group of users with visual impairments. The lead users was shortlisted based on interviews and focus groups that evaluated the lead user characteristic of participants. This approach was specifically proposed to increase the accessibility of assistive systems based on needs of the end-users.

Such simulation tools that restrict physical abilities, or create so called situational disabilities, have been tested and proven to be effective with both practitioners [19] as well as design students in identifying contextual needs [17] of a target population. Though a study by Conradie et al., showed that the result of a empathic lead user study with blindfolds on students, did not show a significant effect on participant's attitude towards their design [20]; works of Clarkson et al. has proved that simulation tools do help designers perceive needs that weren't realized otherwise [19].

Empathic Experience Design (EED) demonstrated to be an effective way to generate concepts that are more creative than those generated using a more traditional ideation method [16, 21]. However, what was not tested was if a full experience of the situational disability was needed to evoke creativity or if only thinking about it would have been sufficient. Therefore, in this paper we build on the previous work on Empathic Experience Design (EED), by answering the following research questions based on the results of a visual impairment simulation workshop:

1) *Does briefing about a situation increase creativity?*

2) *How effective is experiencing a simulation in increasing creativity?*

3) *How effective is experiencing a simulation in evoking empathy?*

APPROACH

Figure 1 shows the flowchart of the research approach. Following sections will explain further regarding the workshop, methods and metrics used for analysis. All procedures were approved by the SUTD Institutional Review Board (IRB).

Workshop

The workshop started with 36 workshop participants giving their consent to take part in the study. Participant age group ranged from 18 to 55 with an average of 24. Duration of the entire workshop was three hours. The workshop consisted of two major segments: briefing and simulation. The pre-workshop questionnaires were given for the participants to answer before the workshop segments commenced. First segment was a 15 minute briefing on visual impairment and the second was a one hour visual impairment simulation experience. Both of these are detailed below.

Figure 2 A workshop participant trying to see the computer screen using the visual impairment simulation glasses

Briefing: During the briefing, participants were asked about their current knowledge about visual impairments. They were then explained about different types of visual impairments [22] and challenges faced by people with visual impairments. To understand the different types of impairment, the participants were given glasses that simulated those visual impairments (Figure 2). The participants were not given enough time to interact with the simulation tools hence, they were used only to

FIGURE 1 BLOCK DIAGRAM OF STUDY APPROACH

help them learn about the different types of visual impairments. Later the participants were introduced to CCTV (closed-circuit television) systems that are also known as video magnifiers, a technology used by people with visual impairments for magnified viewing. Participants were also shown how to use the white cane that is commonly used by people with visual impairments. Towards end of the briefing, the participants learnt about how people with visual impairments manage with their loss of sight, how they navigate around, different types of impairments that exist, challenges associated with reading with those conditions and few assistive devices that are currently in use.

Simulated Scenario: For the simulated scenario, the 36 participants were split into five groups with six to eight participants per group. Once the simulation started, participants entered into a dark room where their visual abilities were completely inhibited. Participants were guided by volunteers with actual visual impairments throughout the workshop. Participants were exposed to four different scenarios, 1) a bus stop- where they were asked to get into a particular bus 2) a garden- where the participants tried to identify an artificial lavender smell, 3) a fruit market- where they were asked to differentiate different fruits by taste and 4) a house- where they navigate through the entrance, living room and dining space. Ultimately, the goal was to make the participants realize the challenges faced while navigating around. For example, during the first scenario at the bus stop, participants were asked to board a specific bus and they eventually ended missing the bus without being able to identify the bus number. They were also made to test their other senses such as, taste, smell and touch so that they could relate themselves to how those senses are used by people with visual impairment. The participants also got to interact with the volunteers with visual impairments, to learn about their lifestyle and how they face such situations. Later the workshop ended with participants sharing their experience with rest of the participants.

Questionnaires

Following the consent, a handout with both open and closed ended questions and tasks were given to the participants. Workshop commenced only after answering the first questionnaire (pre-workshop), second questionnaire was provided immediately after the briefing (post-briefing) and the third was given towards the end of the workshop (post-simulation).

The pre-workshop questionnaire included questions about demographic information along with a 5-point scale self-assessment on participant's own ability to understand people with visual impairments and to solve their issues. These two questions on 'ability to understand and solve' were used to gauge the participant's level of empathy. It was also checked if the participants had any past exposure to people with visual impairments. In addition, the participants were asked to list or sketch as many ideas as possible to solve issues they identified. The ideas were used to measure the participants' level of creativity. Questionnaires were given during three stages of the workshop with participants being asked to list the issues and ideas during all three stages. Each participant was given a folder along with the first questionnaire and they were directed to store each of their questionnaires into that same folder; this was done to link the three questionnaires without linking them with the participants.

Pre-workshop questionnaires were used to capture the participant's mind-set and knowledge about people with visual impairments before the commencement of the workshop. A post- briefing questionnaire was used to capture the difference in participant's opinion over people with visual impairments after they were given a brief presentation about the population. Following the briefing, participants went through a series of scenarios during which their visual abilities were restricted. Finally, the post-workshop questionnaire was used to capture participant reflections after experiencing the simulated scenario. Post-briefing and post- workshop questionnaires intended to differentiate the level of influence a simulated scenario has over evoking creativity and empathy, when compared to that of a brief presentation. Similarly, the difference between pre- and post- workshop questionnaires could display the influence of a simulated scenario over participants' overall perceptions.

Creativity and Feasibility evaluation metrics

Creativity was measured following the approach by Shah et al [23] and Moreno et al [24] with minor modifications that are explained below.

To assess the influence of workshop on participant's creativity, the ideas were scored in terms of the quantity of ideas, idea novelty, feasibility as well as the breadth of ideas.

Quantity: Quantity denotes the total number of ideas that the users were able to provide for people with visual impairments during different stages of the workshop. The increase in quantity of the ideas was calculated to assess increase in participant creativity. Overall and unique number of ideas were calculated for second and third stage of the workshop. This was done to differentiate the ideas influenced by the workshop, from that of the ones that were not influenced by the workshop. Equation (1), from work by Moreno et al., [24] explains the relationship between overall (Q_{Total}) and unique ideas (Q_{NR}).

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

Novelty: Novelty was evaluated based on the procedure introduced by Shah et al. [23] to measure the uniqueness of an idea. In order to calculate novelty, the ideas were binned by two independent raters. Raters grouped a set of ideas into bins based on the similarity between them. The ideas in a single bin were deemed to be the same idea. Bins were finalized upon agreement between both raters as part of the rater training. Another set of ideas were grouped according to the bins agreed by both raters. The rater agreement was calculated as the correlation of the independent novelty values. An r^2 value of

0.94 was achieved after the second round. After this a single rater continued to rate the rest of the ideas. Following the binning, average and maximum novelty for every idea was calculated based on each bin or idea. Similar to a work by Moreno et al. [24], average and maximum novelty of ideas were calculated for both overall (total) and unique (non-repeated) ideas.

The novelty value of ideas in each bin was calculated based on (2), where S is the novelty score assigned for each idea in a particular bin. T is the total number of ideas across every bin, C is the number of ideas in each bin. The value is brought to vary between 0-10 once multiplied by ten [23].

$$S = (T - C)/ T \times 10 \quad (2)$$

Breadth of ideas: Similar to the variety metric by Shah et al [23], the variety or breadth of ideas were also captured. Breath of ideas depends on different bins created based on the binning technique mentioned earlier. This is to cluster the ideas based on higher level categories they belong to. For example, for an idea that says 'public education' and 'public awareness on helping the population' will be grouped into one category. Similarly, if the same participant mentions two ideas related to assistive tools and technology, those two ideas will be grouped into the same category for the breadth analysis. A percent agreement of 81% was achieved after the rater training.

Feasibility: The feasibility of the ideas was assessed following a 4 scale feasibility chart (Figure 3) by Linsey et al. [25]. Two independent raters were involved to rate the feasibility as well. To make the rating more appropriate, the first rater was a design researcher and the second one was a rater with visual impairment. A percent agreement of 88% was achieved. Similar to the binning technique, the first rater continued to rate rest of the ideas.

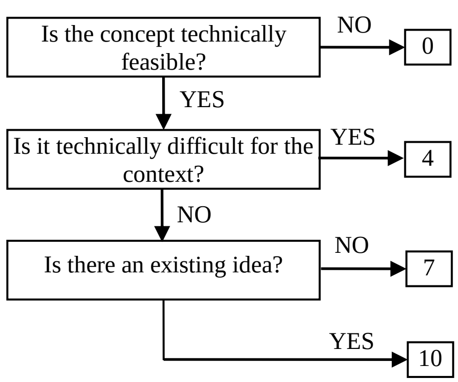

Figure 3 Feasibility Metric

ANALYSIS AND RESULTS

The data for all metrics failed the initial test for normality thus, a non-parametric test was used for further analysis. Wilcoxon Signed Rank test, a non-parametric test to analyze two related samples, was used to test the significance of the number and novelty of ideas as well as the number of bins perceived by the participants. The same test was used to test the self-evaluation by the participants on their understanding and ability to solve possible issues faced by people with visual impairments.

Figure 4 displays the overall (O) quantity as well as the unique (U) quantity of ideas listed at each stage with 'n' mentioned within brackets next to each stage. The increase in quantity when compared to pre-workshop *(O: n=30; 1.83 ±1.16)*, shows that the participants were able to formulate more ideas as they progressed through the workshop. The graph also shows that experiencing a simulated scenario helps visualize more ideas *(O: n=36; 2.36 ±1.07, U: n= 34; 1.67 ±0.89)* when compared to learning it through a brief presentation *(O: n=24; 1.31 ± 1.26, U: n= 24; 1.03 ±1.06).*

Wilcoxon signed rank test on SPSS was used to test the significance of the workshop results. Results indicated that the difference in quantity observed between pre-workshop and post-briefing *(p-value = 0.026)*, pre-workshop and post-simulation *(p-value= 0.025)*, post-briefing and post-simulation *(p-value= 0.00)* were all statistically significant for overall ideas. Whereas, the difference observed between unique number of ideas is significant only between pre-workshop and post-briefing *(p-value= 0.001)* and between post-briefing and post-simulation *(p-value= 0.002).* The difference was not significant between unique ideas listed post-simulation and pre-workshop *(p-value= 0.54)*, this implies that the decrease in quantity of unique ideas post-simulation is not significant enough to accept the difference.

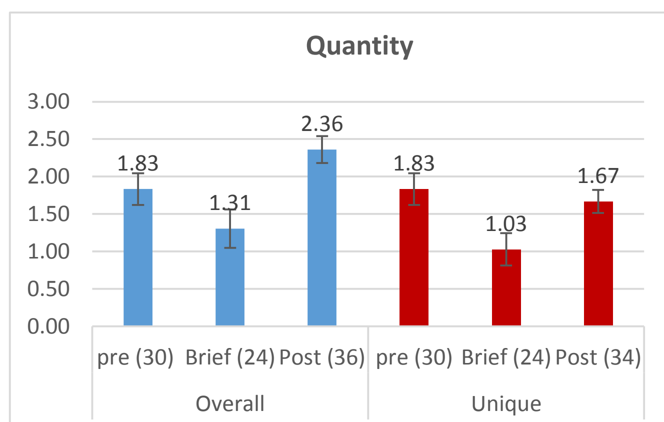

Figure 4 Overall and Unique average number of ideas (and standard error) at 3 different stages of the workshop

Average and Maximum Novelty of Ideas

Novelty values were used to rate the originality of the ideas generated by the participants. The novelty values complemented the increase in number of ideas listed by the participants. Figures 5 and 6 displays the average (Avg) and average maximum (Avg Max) novelty obtained at each stage of the workshop with 'n' mentioned within brackets next to each stage. It can be observed from the results that the average and maximum novelty of ideas are significantly higher for the post-workshop *(O-Avg: n=35; 8.68 ±1.63, U-Avg: n= 31; 7.91 ±3.29) (O-Avg Max: n=36; 9.47 ±0.56, U-Avg Max: n= 36; 8.93 ±2.27)* stage when compared to that of the pre-workshop *(O-Avg: n=27; 6.62 ±3.91) (O-Avg Max: n=36; 7.88 ±3.61)* and post-briefing *(O-Avg: n=18; 4.64 ±4.71, U-Avg: n=17; 4.42 ±4.75) (O-Avg Max: n=24; 6.04 ±4.38, U-Avg Max: n= 24; 5.94 ±4.32)* stages. The displayed increase in novelty even among the unique ideas shows that the participants were able to articulate more novel ideas after experiencing the simulated scenario.

Analysis done on average novelty of overall ideas using Wilcoxon signed rank test show that the difference was statistically significant between pre-workshop and post-simulation *(p-value= 0.002)*, post-briefing and post-simulation *(p-value= 0.001)* whereas, the increase in quantity observed between pre-workshop and post-briefing *(p-value= 0.198)* were not significant enough to accept the difference. Analysis of unique ideas also gave similar results with the difference not being significant between pre-workshop and post-briefing *(p-value=0.17)* while being significant between pre-workshop and post-simulation *(p-value= 0.024)* and between, post-briefing and post-simulation *(p-value= 0.002)*.

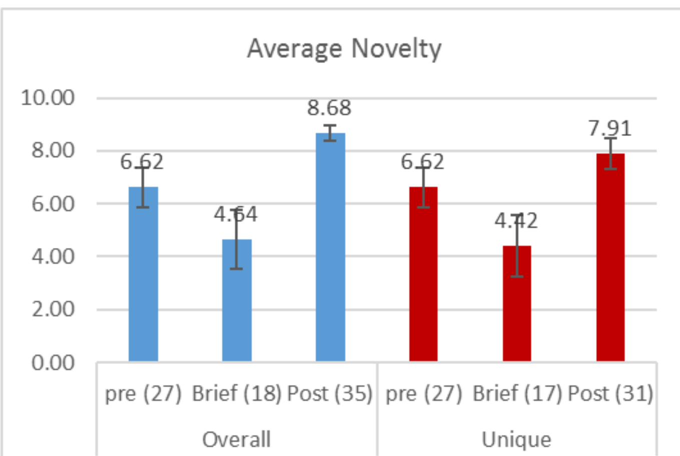

Figure 5 Overall and Unique average novelty of ideas (and standard error) at 3 different stages of the workshop

Wilcoxon signed rank test results on maximum novelty values observed at each stage shows that the difference in maximum novelty observed between pre-workshop and post-briefing *(p-value = 0.024)*, pre-workshop and post-simulation *(p-value= 0.043)*, post-briefing and post-simulation *(p-value= 0.00)* were all statistically significant for overall ideas. While the difference observed between unique maximum novelty of ideas was significant between pre-workshop and post-briefing *(p-value= 0.012)* and between post-briefing and post-simulation *(p-value= 0.00)*, they were not significant between pre-workshop and post-simulation *(p-value= 0.182)*.

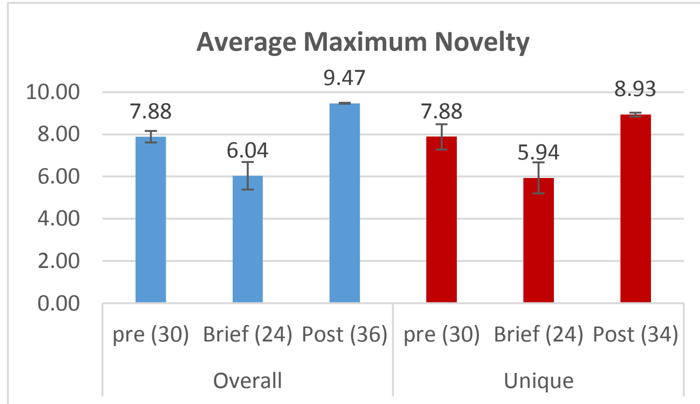

Figure 6 Overall and Unique average maximum novelty of ideas (and standard error) at 3 different stages of the workshop

Breadth of ideas

The amount of idea categories was used as a measure of breath of ideas. This was to analyze the increase in categories that the participants perceive at different stages of the workshop when compared to the categories they listed before the workshop commenced *(O: n=30; 1.69 ±1.04)*. Results were as displayed in Figure 7 with 'n' mentioned within brackets next to each stage. Results show that the participants could relate to more categories of ideas after the simulation experience *(O: n=36; 2.33 ±1.07, U: n= 34; 1.64 ±0.87)* when compared to that of post-briefing *(O: n=24; 1.19 ±1.19, U: n= 24; 0.92 ±0.97)*. This shows that the participants formulated unique ideas and well as unique number of categories at each stage of the workshop and this was significantly high after the simulation experience.

Wilcoxon signed rank test results for number of bins observed at each stage shows that the difference observed between pre-workshop and post-briefing *(p-value = 0.023)*, pre-workshop and post-simulation *(p-value= 0.010)*, post-briefing and post-simulation *(p-value= 0.00)* were all statistically significant for overall ideas. Whereas, the difference observed between unique number of bins was significant only between pre-workshop and post-briefing *(p-value= 0.001)* and between post-briefing and post-simulation *(p-value= 0.00)*, they were not significant between pre-workshop and post-simulation *(p-value= 0.729)*.

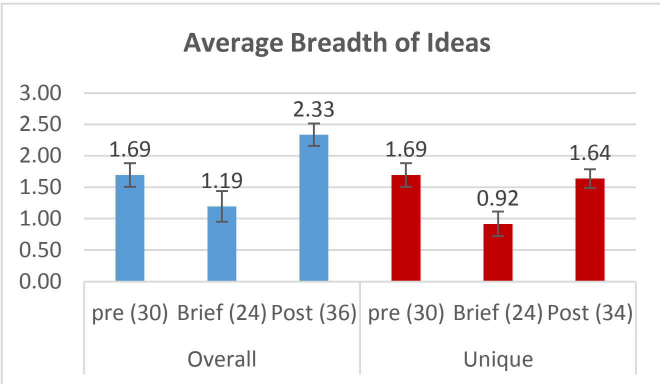

Figure 7 Overall and Unique average breadth of Ideas (and standard error) at 3 different stages of the workshop

Feasibility of Ideas

The feasibility of the ideas was generally high. The average values were 9.32±*0.17* pre-workshop, 9.66±*0.23* post-briefing and 9.78±*0.09* post-simulation. Overall only one idea was infeasible. There was no statistical difference between the values.

Empathy Self-evaluation

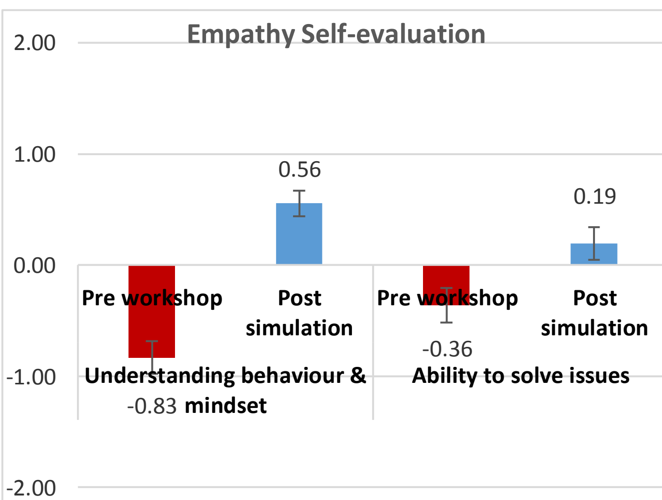

Figure 8 Empathy Self-evaluation (and standard error) by participants

In addition to listing the ideas, participants were also asked to evaluate their understanding towards the people with visual impairments and their ability to provide ideas on a five-level Likert scale. The Likert scale ranged from -2 to 2 with 0 referring to neutral response. Figure 8 shows that there was a significant increase in the participants' perceptions over their ability to understand and provide ideas. The results also proved to be statistically significant for both understanding (n=36; p-value= 0.000) and idea providing ability (n=36; p-value =0.002) when tested using a Wilcoxon Signed Rank test.

Ideas and categories listed by the participants were compared with ideas listed by the volunteers with visual impairments. This was done to understand the extent to which the ideas listed by the participants were related to those of the ideas anticipated by people with visual impairments. We noticed similarity in the ideas, but there was a lack of detail associated with the ideas generated by the participants when compared to those generated by the volunteers with visual impairments.

Table 1 lists few examples of the ideas listed by the workshop participants and volunteers with visual impairments. From the ideas listed, it can be seen that the participants were able to make more specific comments on the ideas as they proceeded through the workshop. Though the ideas were not exactly similar to that of the ones listed by volunteers with visual impairments, workshop participants were able to perceive similar issues.

Table 1 Ideas listed by workshop participants and volunteers with visual impairment

		Ideas
Workshop Participants	**Pre-workshop**	1. Infrastructural enhancements, making them more friendly for visually handicapped 2. Modification of important infrastructure 3. Education
	Post-briefing	1. Infrastructural elements in homes, transport hubs and public places, just to name a few
	Post-simulation	1. Help them at bus stops/train stations to lookout for the transport and board the bus/train 2. Longer time for them to cross 3. Education on visually impaired issues and assets- in community- in school- in job place 4. Inclusion in workplace 5. Inclusiveness awareness
Volunteers with visual impairments		1. Bus company should alert drivers to stop and inform the bus number to the person if the person is with a cane 2. Divide road for people and cyclists 3. All schools to have a special needs office rather than having a separate physically challenged school 4. Would like to see inclusive designs as technology enhances- personally believe in inclusive design

Discussion

We aimed to answer three research questions to assess what impact briefing about a disability and actually experiencing a disability simulation have on designer creativity as well as designer empathy. We recall the research questions below.

1) *Does briefing about a situation increase creativity?*

Participants did generate ideas including unique ideas after the briefing but, the quantity was significantly less when compared to the ideas listed after experiencing the simulation. Based on the lack of significance in quantity, novelty and breadth of ideas expressed after briefing, it could be concluded that briefing alone might not have an impact on creativity among ideas. This can be related to the work by Seepersad et al. [19], where they differentiate the influence of academic training and a simulated lead user experience.

2) *How effective is experiencing a simulation in increasing creativity?*

The increase in number of ideas provided by the participants at the end of the workshop shows that the simulation did have a significant impact on creativity. The increase in quantity, novelty and breath of ideas after the simulation shows that, the participants were not only able to generate more ideas but were also able to provide ideas to issues they did not realize earlier.

Thus, the results obtained show that creativity when evaluated in terms of novelty, quantity and breadth of ideas, increased significantly among the participants after experiencing the simulation. All ideas expressed by the participants were technically feasible hence, feasibility couldn't be taken into consideration.

3) *How effective is experiencing a simulation in evoking empathy?*

The participant's self-reported ability to understand issues and solve problems faced by people with visual impairments increased significantly from before the workshop to after the simulation. This implies that it is also possible to increase self-efficacy, or perceived ability to solve these types of problems, through a simulated experience.

In addition, a preliminary comparison was made between ideas from workshop participants to those listed by the volunteers with visual impairments (Table 1). As demonstrated in Table 1, it appears that the simulation increased the similarity of ideas between participants and volunteers. This indicates an increase in empathy after experiencing the workshop. In addition,

Table 2 illustrates the overall effect of the briefing and simulation on all metrics measured. The regions shaded in dark red denote the cases where the decrease in quantity, novelty and breadth were significant while, the regions shaded in light green denote cases where the increase in quantity, novelty and breadth were significant. It is also notable that a simple briefing on a situation could have a negative effect on creativity. This was true for all cases except when measuring the average novelty of the ideas generated whether looking at the overall ideas or only the unique ones. However, in order to achieve a significant increase in the average novelty of ideas as well as in all the other measures, or a general improvement in the level of creativity, a full simulation is needed. This thus further supports Empathic Experience Design and other experience or simulation based empathic design methods and provides further insight into how to develop them further.

Table 2 Statistical significance between different stages of the workshop

		Pre-workshop to post-briefing	Post-briefing to post simulation	Pre-workshop to post simulation
Creativity	Quantity (Overall)	Significant decrease	Significant increase	Significant increase
	Ave Novelty (Overall)		Significant increase	Significant increase
	Max Novelty (Overall)	Significant decrease	Significant increase	Significant increase
	Breadth (Overall)	Significant decrease	Significant increase	Significant increase
	Quantity (Unique)	Significant decrease		Significant increase
	Ave Novelty (Unique)		Significant increase	Significant increase
	Max Novelty (Unique)	Significant decrease	Significant increase	
	Breadth (Unique)	Significant decrease	Significant increase	
Empathy	Ability to understand behavior and mindset	NA	NA	Significant increase
	Ability to solve issues	NA	NA	Significant increase
Key	Significant decrease		Significant increase	

Limitations

Limitations of the study include the influence of previous experience of workshop participants. Thirteen participants who took part in the workshop were connected to someone who experienced vision loss and two of them had themselves experienced it earlier. This difference when tested did not show a significant effect on the answers provided by the participants but, there are chances that this difference in population could have had an influence on the ideas shared by the participants. Also, only a self-assessment on empathy was used. Similar to research in self-efficacy, self-evaluation may be indicative of the actual state being evaluated or not. Another limitation is that only one impairment type was targeted. And thus one cannot readily generalize these findings to all situational disability simulations. Also, during the workshop, the order in which the participants experienced the workshop was not randomized. The order might have had an effect on the level of immersion in both the briefing and the experience but this was not explored in this study.

Conclusion and Future work

In this work we sought to gain deeper understanding of empathic design methods, in particular simulating extraordinary conditions as means to increase designer creativity and empathy. A visual impairment simulation workshop was analyzed at three different stages of the workshop. First stage was to assess the initial knowledge of the participants, second was to look at the influence of a brief introduction and the final stage was to evaluate a simulated scenario with target user intervention. At each stage, workshop participants were asked to list a set of ideas for the issues faced by people with visual impairments. The total number of ideas listed at second and final stage of the workshop were grouped into overall (repeated) and unique (non-repeated) ideas. Novelty and feasibility of the ideas listed were used to measure the originality and quality of ideas listed. Results showed that experiencing a simulated scenario had a desired influence compared to that of only briefing about the scenario.

The results strongly support the use of visual impartment simulation as part of need finding conceptual design. This opens avenues for further design tool and methodology development in this area, including generalizing the findings to simulating extreme conditions in general.

Future work could include repeating the study with a wider population under different simulated scenarios. A study with a larger sample size could enable the analysis of the influence of age and previous experience on the creativity and empathy. Another possible work could be a mixed methods approach including a qualitative analysis of the similarity between ideas shared by the participants with that of the ideas from the target population. This could help measure the extent to which the participants are able to empathize with a target population as well as provide further insight into when a simulated condition may be good enough and when a more participatory process is appropriate as part of a design process.

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