The Unconscious Workspace:

How designers can use shared virtual spaces for creative problem solving.

By

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Key words: Creative problem solving, design process, incubation effect, immersive reality, virtual teams

Note to Reader

The overall goal of a master's level thesis is to display and disseminate the student's research findings and design conclusions. For this reason, I have structured this thesis in a way which will be of most benefit and reach to its intended target audience. The thesis is separated into chapters which will ultimately be published as a series of online articles, submitted to the Medium website. Due to the ever-changing landscape of the thesis's content, i.e. immersive virtual environments, the information and knowledge generated will need to evolve with the technology discussed. The information has therefore been presented as a part of a larger, dynamic conversation in which other designers can comment and discuss, instead of being used as a static, isolated source.

Abstract

Design teams use online digital spaces to communicate when working remotely, varying from email to chat to video collaboration tools. Often, these spaces stifle the team's creative problem-solving abilities. The opportunity space is explored through two focused explorations: Creativity in 3D virtual spaces, and collaboration and communication in 3D virtual spaces.

The first focused exploration between virtual workflows and the creative model described by Mihaly Csikszentmihalyi revealed a noteworthy difference between the two - the incubation phase. The incubation effect is described as a process of allowing the unconscious mind to process ideas indirectly while an individual participates in an unrelated task. These incubation periods often occur in physical spaces through play and discovery for a creative team before they can achieve a sense of creative flow. However, there is no clear emphasis to include a space in virtual team environments for incubation to occur.

Creativity is heavily influenced by our surroundings. Immersive virtual environments create an atmosphere that welcomes play and experimentation, as well as allowing developers to control sensory information given to the user. The flexibility of virtual spaces allows us to create an individual's ideal creative space.

Secondly, complex design problems often require novel ideas generated from the knowledge of more than one area of expertise. George de Mestral, a Swiss electrical engineer, had studied the unique form of cockleburs when he noticed they had gotten stuck in his dog's fur during a hunting trip. This had led to the invention of the hook and loop fastener. People from different fields tend to interpret information differently due to learned convergent thinking methods, leading to different perspectives. Working in isolation can lead to misinterpretation of information or the problem space, which can misdirect what the team is solving for.

Chapter 1: Virtual Teams

Virtual-based teams, working collaboratively across great distances, have become crucial to the success of global businesses. This brings many positive factors to both companies and employees. Companies are able to access a larger recruitment pool allowing them to find specific talent at the lower cost to company. Companies also see a significant reduction in office space, real estate and its associated expenses. Employees benefit from virtual teams through flexible work times and being able to work from any physical location (Ferrazzi, 2014). As virtual teams do not require employees to travel, businesses have reported a significant decrease in their carbon footprint. In a 2014 report, Xerox stated that they had reduced their greenhouse gas emissions by over 40000 metric tons, translating to a reduction of 4.6 million gallons of gas (Fell, 2015).

One of the motivating purposes behind recruiting diverse, multinational talent to work on a specific problem is to use their collective knowledge to bring innovation and creativity into their solutions. Employees are now expected to adapt their creative process into more and more modes of communication outside of face-to-face human interaction (Nemiro, 2004). In order for virtual teams to communicate, many different types of virtual spaces are being developed and experimented with in attempts to bridge the gaps in human interaction across physical space. Some virtual spaces are asynchronous channels (e.g. email, text

messaging), some are synchronous channels (e.g. voice and video chat), and there are many successful and some not-so-successful recent developments in collaborative team workspaces (Slack, Trello, Google Wave).

Despite the growing popularity of virtual workspaces as organizational structures, a virtual teams survey conducted by RW³ CultureWizard (2016), reported on the limits of these online collaborations:

> *"Lack of face-to-face contact has the greatest impact on productivity in the following areas: understanding the full context of what people communicate (51%), managing conflict (48%), and establishing trust and building relationships (45%) ... Regular face-to-face meetings were cited as the most beneficial by 92% of respondents, followed by conference calls (93%), video-conferencing (84%), and group emails/email discussion groups (83%)."*

In other words, the richness of working together in-person has not yet been replaced. It is important to note, before secondary research of this nature can be considered, one must understand the purpose of these studies. CultureWizard, owned by RW³ Technologies, sells business solutions which aim to increase productivity of cross-cultural and virtual teams in global companies. The survey was conducted with the aim to make their target audience aware of a problem space (challenges of maintaining a "high performing" global team) which subsequently creates a need for their service solution. With this in mind, the facts and figures of the survey are directed towards productivity and efficiency of global teams in order to increase profitability margins of corporations rather than how virtual spaces impact the purpose, planning and intention of collaborate creative problem solving.

Nevertheless, empirical data such as this holds beneficial insight into the communication of virtual teams. I propose that introducing 3D virtual environments provides opportunities for creative workers to collaborate in new and playful ways, bringing both greater avenues for idea generation to the company, and even more radically, new opportunities for agency and creative self-determination for the creative workers.

Chapter 2: Creativity and Play in Literature

2.1 What constitutes creative thought?

Creativity is a quality that carries multiple definitions, exists in many different forms and is perceived across multiple disciplines. Because of this, there are several overlapping academic definitions of the term. This paper follows Mihaly Csikszentmihalyi's creative model (2013) due to its emphasis on flow and elements which affect creative environments. Csikszentmihalyi loosely defines creativity as "*any act, idea, or product that changes an existing domain, or that transforms an existing domain into a new one...what counts is whether the novelty he or she produces is accepted for inclusion in the domain.*" (Csikszentmihalyi, 2013). Csikszentmihalyi's key features of creativity, in particular the act of creating something that is novel and has value to society, shares common traits with other definitions of the term. (May, 1994 & H.H., 1963 & Rogers, 1954 & Torrance & Oech, 1990 & Kaufman, 2006).

Fig. 1. McIntyre, P (2008) Csikszentmihalyi's model of creativity. [Online image] Retrieved from http://arpjournal.com/the-systems-model-of-creativity-analyzing-the-distribution-of-power-in-the-studio/

2.2 Creative flow + play

In Csikszentmihalyi's seminal book, *Creativity: The Psychology of Discovery and Invention* (1996) a state of creative flow is the "optimal state of consciousness where we feel our best and perform our best." In a state of flow an individual's ability to focus on a task is intensely heightened yet was not a factor in increasing short term creativity. Rather, flow was seen to increase overall creativity over long periods of time.

In order to achieve a state of flow, an individual would need to balance their task with the appropriate amount of challenge to their level of capability. For example, a relatively easy task given to a highly skilled person may cause them to lose motivation while a task too challenging may cause high levels of stress or anxiety. We can easily apply this theory to interactive activities that have seen to affect creativity, i.e. play. A game which challenges a player just the right amount can cause an immersive experience in which they may perform a task. Christina Wodtke, associate professor at the California College of the Arts and the author of *Information Architecture: Blueprints for the Web*, expands on the state of fun by incorporating the concept of flow.

Fig. 2. Wodtke, C (2016) State of flow vs State of fun. [Online image] Retrieved from https://medium.com/@cwodtke/teaching-game-design-in-non-game-design-programs-c1ddae83208c

Tim Brown, CEO of IDEO, advocates the strong relationship between serious play and creativity (2008). In virtual environments, interactivity forms the basis of communication, navigation and engagement with the

space. A developer is able to create a space that allows for play, and in turn can control the variables, rules and criteria of serious play. It is for this reason that exploration into the relationship between play and creativity is an ideal space to observe play without the fear of judgement from peers and the fear of failure whilst striving towards a state of creative flow. In this paper, the method of serious play used is of low fidelity prototyping. The sessions of play are semi structured and facilitated yet are open enough to allow for new directions of knowledge to be pursued. For more details on low fidelity prototyping, please see (Schulz et al., 2015) (Sanders & Stappers, 2008) (Von Hippel, 2006).

2.3 The purpose of creativity

A 2010 survey conducted by IBM of over 1500 CEOs across different industry sectors reports that the most crucial factor to the future success of a business, according to the perspective of their CEOs, is instilling 'creativity' throughout an organization. Creative thinking may reveal perceptually unrelated connections in a way that has never been seen before (Weinberger, Iyer, & Green, 2016). Because of this, creativity is seen as a catalyst for the innovation and transformation needed for successful leadership competency in an increasingly volatile and interconnected marketplace (Kern, 2010). Industry leaders such as Buckminster Fuller who was an American author, designer, and inventor are internationally recognized in their fields due to their "unique way of thinking that allows [them] to identify unmet needs" (Cowie, 2015).

2.4 An argument against the quantified measurement of creative ability

J.P Guilford and E. Paul Torrance were two of the most influential philosophers on the topic of creativity in western academia. Both Guilford and Torrance proposed that creativity could be validated through empirical testing, a theory which has influenced research into modern models of creativity. In 1966, Torrance created the Torrance Tests of Creative Thinking (TTCT), which has become the most widely recognized and recommended form of measuring an individual's creative ability. These numeric test results are sometimes used in isolation to determine base creative ability of individuals. Torrance has stressed that the outcomes of the TTCT should be used as an indicator to assist in nurturing creativity in the individual (Kyung Hee Kim, 2006).

Fig. 3. IDEO design studio showing typical/exemplary face to face collaboration opportunities in open floor plan, low dividing walls, shared project walls and customizable spaces. (November 16, 2017). [Online image] Retrieved from https://designthinking.ideo.com/wp-content/uploads/2017/11/toy_lab_dt.jpg

As seen in the figure 3 above, IDEO, an industry leading design and consulting firm, configures physical workspaces to allow for experimentation and cross-disciplinary collaboration. IDEO measures the "effectiveness and creative capacity of their teams" (Brown, 2009) using a tool called *Creative Difference* which collects, and analyses data taken from creative teams.

Fig. 4. IDEO (n. d). Screenshot of IDEO's Creative Difference interactive dashboard. Retrieved 5 April. 2018, from https://www.ideo.com/post/creative-difference. Screenshot by author.

In order for an organization to use this tool, they must first complete a 15-20-minute questionnaire that is shared across business units and teams. The information is compiled and interpreted into IDEO's 6 'creative quality' measurements, cultural snapshots. These measurements (as well as cultural snapshots are reflected as numerical values on an interactive dashboard for the organization to view and compare to competing organization.

Torrance states that quantitative scores should not be used in isolation for measuring creativity, yet the Creative Difference tool has gamified these traits in a way that suggests that they can be numerically quantifiable on a predefined scale, as well as independently increased. Furthermore, these scores are then compared to other companies. The claim that specific creative qualities can be tracked, compared and manipulated is problematic because the measurement of creativity and innovation becomes distorted to reflect profitability and success of a company rather than an indication of how to nurture an individual's creativity and talent for the benefit of society.

Chapter 3: VR in Literature

3.1 Origins

The term of "virtual reality" can be traced back as far as the 1930s with the Antonin Artaud who described theater as *la réalite virtuelle* in his *Théâtre et son double (1938; The Theatre and Its Double, 1958).* (Meinhold, 2016). Although early iterations of Virtual Reality technology date to the 1960s, VR has failed to gain traction until recently, and experienced many failed launches. The launches in of the Oculus Rift saw the reemergence of the technology and has once again gained interest on a global scale.

The definition of VR, often shifting, has evolved and will be used in this paper as:

> *"a human-to-computer interface and immerses its user in a computer-generated three-dimensional environment. Although the term "virtual" implies that this simulated world does not actually exist, the term "reality" refers to the user's experience of the simulated environment as being real." (Meinhold, 2016)*

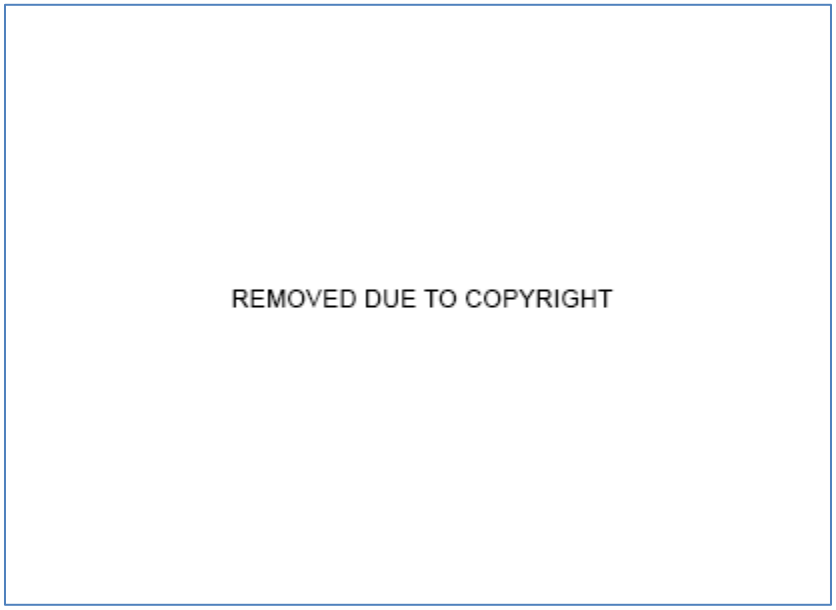

Fig. 5. (n.d) Paul Milgram's Reality-Virtuality continuum Retrieved 5 April. 2018, from http://etclab.mie.utoronto.ca/publication/1994/Milgram_Takemura_SPIE1994.pdf

Paul Milgram introduced the concept of the reality-virtuality continuum/spectrum (Figure 5) in the composition of real and virtual objects. The scale ranges from completely real reality to completely virtual (1994). According to Milgram, Takemura, Utsumi, & Kishino (1994) Mixed Reality exists on linear spectrum starting with physical spaces and ending with 3D virtual spaces. For the purpose of this research, the study will be focusing purely on the complete immersion of the participant within a 3D virtual space.

3.2 Collaboration in virtual environments

This paper uses "*Seriously Playing: Introducing Communication Students to Axecorp's Virtuality*", written by Carmichael, et. al., as precedent for its findings into the relationship of serious play and communication in virtual team environments. Carmichael, et. al. developed a fictional consulting company which allowed students to experience the business world in a controlled virtual learning platform to study the impact of roleplaying on student behavior. The paper argues that the innovative technology of virtual spaces drove the success of the experiment. Students were enthusiastic to participate in the program, and notable positive behavioral changes in the students were observed in terms of professionalism and motivation, and communication.

The results of this case study indicate that serious play coupled with virtual environments may result in a noticeable improvement in the level of communication (Carmichael, et. al, 2010). This finding is a significant indication to incorporate serious play into the practice-based work of this paper as the communication levels of virtual teams suffer in quality compared to in-person communication (as detailed in Chapter 1: Virtual Teams).

3.3 Virtuality and Gamification

Another significant precedent is Shih, et. al., who created a role-playing digital game designed to enhance cultural awareness of late nineteenth century Southern Taiwan. As described in their essay; "*A simulated learning environment of history games for enhancing player's cultural awareness*", Ju-Ling Shih, Shun-Cian Jheng and Jia-Jiun Tseng were successful in generating a significant increase in cultural awareness within the participants. The participants described the experience as immersive, and the post-tests that the researchers conducted showed that they had "better cognitive growth and sense of existence with respect to the locations and environments, local cultures, folk arts, faith and festivals, as well as architectural

characteristics". (Shih, J., Jheng, S., & Tseng, J., 2015). It is important to note that some participants displayed characteristics of exploration and experimentation in the virtual environment which cannot be experienced through conventional learning methods, i.e. literary books and videos. J.-L Shih found that these players "preferred to roam around, touch and trigger events, and discover the internal rules of the game to fulfill their curiosity and sense of achievements." (Shih, J., Jheng, S., & Tseng, J., 2015). The team concluded that the new technology used (digital role-playing games) added "new vitality to the mechanism of cultural transmission" (Shih, J., Jheng, S., & Tseng, J., 2015) and that "3D simulated learning environments [...] could successfully merge 'reality' and 'virtuality'" (Shih, J., Jheng, S., & Tseng, J., 2015).

Another example of the potential relationship between learning educational skills such as critical thinking and games, and how gaming can serve as a platform to develop these valued skills can be found in *"Gamers and gaming context: Relationships to critical thinking"* (Gerber, Scott, 2011). Sue Gerber and Logan Scott explain how 21st century skills involve developing a new kind of education system which employs the use of knowledge and not just the retention of it. Their research was conducted using commercial games rather than educational games, and their sample size was limited. They found no significant difference in the level of critical thinking between participants who played commercial games and those who did not. However, their research found that in the context of critical thinking and playing strategy games in short sessions showed "that strategy gamers have a greater propensity for actively open-minded thinking than non-strategy gamers" (Gerber, S., & Scott, L., 2011). In other words, individuals who participate in activities that involve analytical reasoning have a greater chance of thinking in an open-minded fashion, which can benefit in creative thinking and problem solving. For this reason, entry level puzzles have been incorporated in early prototype phases of my practice work as discussed in chapter 5.

3.5 Research avenues into VR

In addition to the above-mentioned examples of VR in the context of collaboration, play, and education, there has been a growing academic interest in the psychological applications of virtual reality (VR) within recent years. VR exposure therapy has already made a significant impact on emotional wellness of participants who suffer from acute PTSD. A study conducted in 2002 on virtual reality exposure therapy

for world trade center PTSD reported "a large (83%) reduction in depression, and large (90%) reduction in PTSD symptoms after completing VR exposure therapy." (Difede & Hoffman, 2002). A case study conducted in 2016 used VR as an enhancement to mindfulness training for a participant who suffers from borderline personality disorder. The case study revealed that the participant showed an "improved emotional state after the VR sessions." (Nararro-Haro et al., 2016). Strong preliminary results of recent studies such as these indicate VR as a promising medium for psychological research interest in directions that are still in the early exploration phase.

3.6 Social spaces in VR

Currently, there are only a handful of virtual reality social networks available to the general public. One of the most notable examples are Microsoft's AltspaceVR, also known as AltVR, which currently uses both mobile and high-end VR headsets. AltspaceVR allows people to use the social space for group interactions such as meetings, watch videos and play games. VR social spaces will be explored in more detail in chapter 5 of this paper.

Chapter 4: Studio Explorations

4.1 Connections between Creativity and Design

The first stage of research on this thesis topic began with unpacking Csikszentmihalyi's phases of creativity, highlighting how virtual spaces may be used for the purposes of creating an incubation space for can be included in. This exploration has guided the research into a topic that would benefit the design community in some way. The earliest key reference texts that served as touchpoints for the early design activities were, as mentioned above, Mihaly Csikszentmihalyi's book, Creativity: Flow and the Psychology of Discovery and Invention (2013), as well as James C. Kaufman & Robert Sternberg's book, The International Handbook of Creativity (2006).

The International Handbook of Creativity revealed that defining creativity would not be a simple matter of finding a universally accepted academic definition as specific aspects and versions of creativity vary by culture and geographic region. As mentioned in chapter 2, common attributes to creativity across cultures are novelty or innovation and value to a community. Some nationalities found creativity to be a personality

trait of geniuses and even go as far as to see creativity as a trait of the divine. The definition of creativity for my thesis has been narrowed to cater to North American standards as this is the area of focus that my intended target audience would most benefit from.

The creativity process, per Csikszentmihalyi's Creativity: Flow and the Psychology of Discovery and Invention, can be mapped out into five phases: Preparation, Elaboration, Insight, Evaluation and Incubation. These phases can aid in understanding where roadblocks in the creative process occur. For example, a moment of insight, also known as 'the AHA' moment or a moment of realization often occurs after an incubation phase. Thus, a person might pursue incubating activities to reach a moment of insight. Of course, while the reality of being creative is not so simple as being able to follow a well-planned and linear roadmap, and celebrated for its unexpected breakthroughs, enumeration of typical moments of creative process and sequence can help elicit more insights and aha moments.

Phase 1: Preparation

Csikszentmihalyi describes preparation in the creative process as a possible starting phase of any creative process. This is where the individual becomes completely immersed in the field. Curiosity becomes a leading motivation to explore the intricacies of the area to discover possible problem issues that are interesting. Through this exploration, the problem statement is defined, the purpose of the project is established and the context and framing of the problem is fleshed out. Secondary research is explored in this phase, allowing the individual to lay a foundation of academically reviewed information for their knowledge into the problem. For this reason, preparation is vital to the success of the entire project as this is the defining direction that the explorations and solving will follow.

Fig. 6. British Design Council (2005) Double Diamond Design Process Model. Retrieved 5 April 2018 from: https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond

If we compare Csikszentmihalyi's preparation phase to the double diamond design process model (Figure #), we can relate this to the 'Define' phase. In most cases, designers are given a visible problem area in which they are meant to define the underlying issue whereas Csikszentmihalyi encourages creative individuals to explore what they feel is interesting and find issues within. As this process has been well documented in both creative and design research, no further investigation into preparation was conducted.

Phase 2: Incubation

According to Csikszentmihalyi, the incubation phase is a period given for information gathered on a focused problem to develop into seeds of ideas by allowing them time to mature in your subconscious (Csikszentmihalyi, 2013). In a study conducted by Simone M. Ritter* and Ap Dijksterhuis (2015) participants were given a common TTCT task to perform to measure their creative ability. In this case the study used the Unusual Uses task in which an individual is asked to iterate as many uses for a common item as they can think of in an allocated amount of time. The task was done in two sessions. One without an incubation period to determine the base creative ability and once again with the inclusion of an incubation period. The study reported a significant increase in creative ability for the participants who had experienced an incubation period in between creative tasks (Ritter S. M., Dijksterhuis A., 2014). There is much academic interest into the topic of incubation, yet is curiously separated from popular design thinking

processes. In comparison, the design process skips incubation and dives into idea generation which can lead to lower levels of creative ability as seen in studies such as above.

According to Benjamin Baird, a psychologist at the University of California, has conducted research on mind-wandering and its effects on an individual's creative problem-solving ability. A study conducted in 2012 on 145 undergraduate students on the effects of taking a break between mental tasks reported that simple breaks without preparation into a problem would not yield any creative insight as "mind-wandering was only helpful for problems that were already being mentally chewed on. It didn't seem to lead to a general increase in creative problem-solving ability," (Baird, B., et al, 2012). In other words, a designer would need to have completed their preparation phase of a design problem before attempting to obtain any benefits from mind wandering. There has been much interesting research lately on the importance of daydreaming and boredom for generating creative insights, and the effects of omnipresent entertainment in the form of smartphones and internet in inhibiting such creative thought. (for more reading c.f. "*Inspired by distraction: mind wandering facilitates creative incubation*"). This mental wandering is an important incubation activity only if preceded by a preparation phase.

To better understand what a space intended for group mind-wandering would look like, I created several virtual and physical spaces for participants to use and reflect on (detailed in Chapter 5). The 3 virtual spaces were developed in the Unity Game Engine and was developed for the mobile Google VR cardboard headset (see Appendix A, B, C). Each VR space ran through a series of group participatory user tests to determine the potential benefit of using a virtual space for the incubation period of generating creative flow. The purpose of these VR spaces was to assess what key activities and reactions an individual would participate in during these sessions. The virtual spaces differed in the levels of interaction available to the participant and whether the participant was able to see a visual representation of other participants within the space. The key insights obtained from the preliminary prototypes saw that participants would become easily distracted by the limitations of the technology used, in this case the Google cardboard device. Personal observations have shown that although the technology used was rudimentary, participants were fully encapsulated by the virtual experience and would focus completely on the virtual space or task within the VR experience. According to the RW^3 CultureWizard 2016 report, 85% of virtual teams admitted to being distracted by unrelated tasks while communicating in a virtual space.

Fig. 7. Design students participating in paper (low fidelity) prototype. 4 Dec. 2017.

The physical space was created as a group participatory observation exercise in which two participants wore non-functional headsets that could been worn without impairing vision to the physical world. This was to imitate the visual limitations (field of view) that was present in VR simulations. The participants were given brightly colored objects such as sponge balls and plastic toys and were asked to interact with the objects and each other. The exercise was similar to an improv performance as they were asked to imagine what these objects might do in a virtual world. The exercise was observed by another group of designers and once the exercise was over, it was discussed and reflected upon. The parameters from the virtual spaces and physical spaces were used as variables needed to create a successful incubation space.

Fig. 8. Paper prototype set up. 4 Dec. 2017.

Key takeaways from this participatory exercise were:

- Without direction, play does not lead to new ideas or explorations.
- There must be established rulesets before the exercise begins.
- A timeframe helps control the focus of the play in the sessions.

Virtual Reality in Design

In order to determine whether the technology of Virtual Reality was accessible to its target audience, my studio research expanded into workshops, lectures and exhibitions surrounding the mixed reality spectrum. With the help of my advisor, Eugenia Bertulis, I created a series of workshops to introduce interaction and communication designers to developing and understanding VR and AR technology and its use in the design industry. Through the facilitation and instructing these workshops, my observations showed that these technologies are within the technical capabilities of young designers and are seen to be a topic of interest for them. The students were able to develop working prototypes of both AR and VR projects by the end of the workshops. They were also able to explore making 3D type form in a virtual space (these were exhibited in a

virtual gallery for the IxD 'Consensual Hallucinations' exhibit) as well as creating multi-disciplinary projects that covered communication design and interaction design (these were in the form of printed zines which had augmented reality components). These observations and activities alluded to the potential of integrating VR into the design process space. By using inexpensive hardware and celebrating low-fidelity glitchy precedents in design history such as zine culture, WebVR as a medium provides an avenue to resisting the drive toward measurement and profitability.

Fig. 9. Legros, C (Photographer). (2 December 2017) IxD *Mixed Reality exhibit 'Consensual Hallucinations'* [Photograph]. Retrieved from https://medium.com/@catherinelegros/ux-design-for-social-change-8d17c576925b

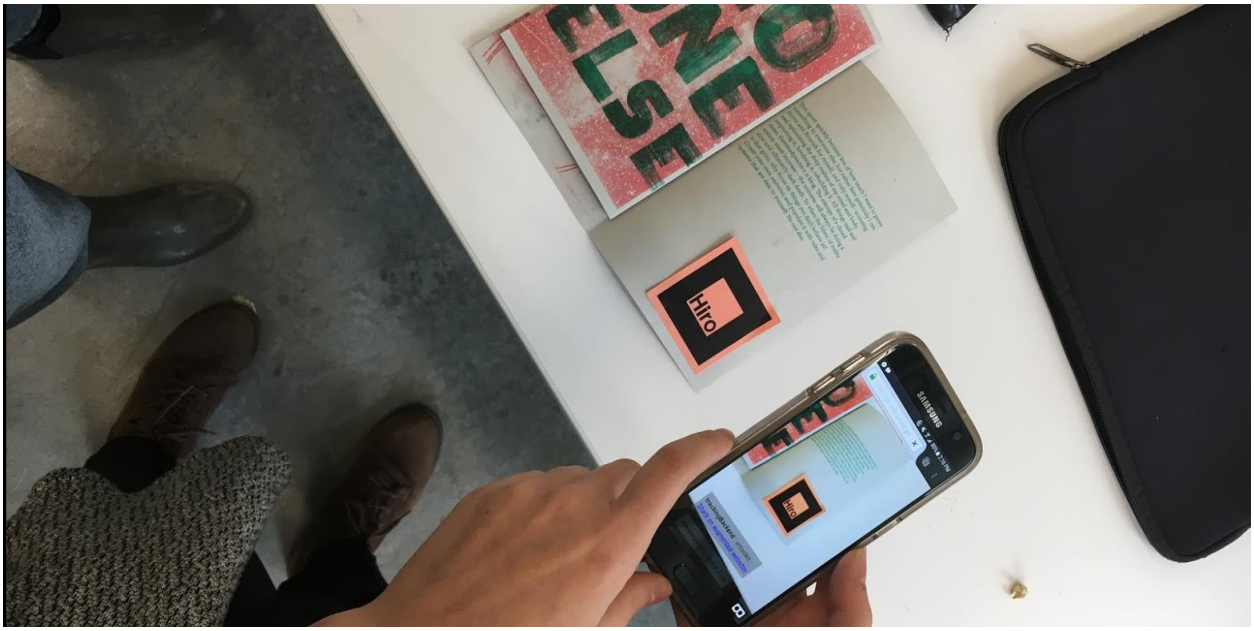

Fig. 10. Legros, C (Photographer). (2 December 2017) IxD *Mixed Reality exhibit 'Consensual Hallucinations'* AR participation [Photograph]. Retrieved from https://medium.com/@catherinelegros/ux-design-for-social-change-8d17c576925b

Chapter 5: Virtual environment case studies

5.1 AltVR case study

AltVR was a start-up virtual social space in which people could gather as avatars, interact, communicate, play games and watch videos together in 3D virtual environment. The purpose of this case study was to observe the relationship between the interactions of people in AltVR's virtual space. The case study took place over a 1-hour timeframe within AltVR's social app. Since AltVR relies strongly visual and audio perceptions, the observations recorded concentrated on the visual and audio interactions between people during the experience. The environmental appearance was pre-created by the Microsoft development team and thus could not be altered for the sake of this case study. The observations were conducted by myself as a non-participant in the social interactions in order to observe both parties during the interaction without the influence of my own personal bias in the knowledge that I was observing my own interactions. All participants enter AltVR under pseudonyms and no potential breach of personal identity would be risked in these observations, as well as not knowing the identity of the participants myself.

5.1.1 Set up

Fig. 11. Screenshot of a VR campsite scene from the social platform *AltVR,* Microsoft, 2017.

The social space was developed to resemble a low fidelity campsite space consisting of an animated campfire, rocks, trees, and a signboard. The ambient atmosphere was warm, dim and comfortable, almost nostalgic. and as my avatar approached the center of the scene, I passed interactable objects which could be picked up, such as fireworks and candy. The campsite could hold approximately 30 people and during this session it was occupied by around 15 people.

5.1.2 Group formations

While the general campsite area was the most used location, people opted to form groups just outside the campfire on the rocks which overlooked the mountain pass. The most vocal members in the scene would stand on elevated ground while speaking to the group in general. Often, 3 or 4 people could be seen wandering the location in isolation, yet it is unclear if this was a deliberate attempt to isolate themselves from conversation, or simply because they had taken off their VR headsets without exiting the scene. A small group of 3 people had isolated themselves from the rest of the campsite and travelled into the edge of the scene behind trees. This group huddled close together while talking about the custom avatar models that they had created for the VR experience.

These group formations had an interesting beneficial side-effect. Because people group together with the people they want to interact with, communication become directed towards the desired audience, unlike conventional Voice over IP (VOIP) communications such as Skype. In conventional VOIP, each voice is given equal weight in loudness and audience, making it difficult to identify who the speaker is talking to and limits all communication to a form of broadcasting. In AltVR, sounds exist in a 3d space, which means people that are closer to each other sound louder than those afar. Combining these two elements, it is easier to identify who is speaking to you or a group simply from their location.

5.1.3 World interactions

The signboard was interactive for all people and would display an 'ice breaker' type question that could be changed by interacting with the arrow icons situated on each side of the question. This was, in my opinion, added to the space to encourage initiating conversations between players. In the hour-long observation season, no person interacted with the billboard and no conversations began using the selected ice-breaker.

This reaction draws relations to the physical world experiment discussed in Chapter 4: Studio Explorations. Giving open ended tasks is difficult for participants to take hold of when the purpose is not clear. A billboard dictating the topic in which people should talk about is perhaps too aggressive and controlling for a task for people to accept and adopt as this goes against natural casual social behaviour. With this in mind, it would be interesting for further research to experiment with this concept in a work environment where agendas are used to direct discussions.

Fig. 12. Screenshot of interactive billboard from the social platform *AltVR,* Microsoft, 2017.

5.2 VRChat

(needs intro to VRChat) The observations in VRChat were set up in the same manner as the AltVR case study. This was to observe the participation and play in a controlled space with minimal unexpected variability. Each observation took place over a 1-hour timeframe and I, the observer, took on both a participatory and non-participatory role. All participants enter VRChat under pseudonyms and no potential breach of personal identity would be risked in these observations, as well as not knowing the identity of the participants myself.

5.2.1 Insight: Presence

Fig. 13. Screenshot of body presence inside the social platform *VRChat,* VRChat Inc, 2017.

Unlike the AltVR case study, I found that body presence pulled me into the space through projected images of the body that I controlled. The shadow cast from my virtual body onto a nearby wall cemented a sense of 'being there' that was unlike traditional virtual spaces. When asked about this feeling to a participant inside the space, they commented that "It feels like an open world, I feel very free here." and felt excited to explore the space further. Clearly, work related incubation spaces would need to elicit similar feelings of excitement.

5.2.2 Insight: Serious Play

The presentation room is a virtually constructed world in which only one room exists. In this room there are several white boards that line the walls with color markers placed with the white boards. In the center of the room is a rectangular table with bar chairs, the style resembles that of brutalist architecture. Upon joining the space, participants were able to pick up markers and draw in the 3d space surrounding them. While they were, presumably, familiar with the intention that the markers were meant to be used on the whiteboards, the technology of the space allowed lines to be drawn freely in any open space (seen below in figure 12). People opted to instead embrace the unfamiliar and explore the limitation of the new space. However, because there were no known rules of play, purpose or direction, the lines were drawn randomly

with no feedback from the system. People would abandon this task once they became aware that their actions had minimal on the environment. This indirectly confirms the observations of the physical reality exercise discussed Chapter 4.

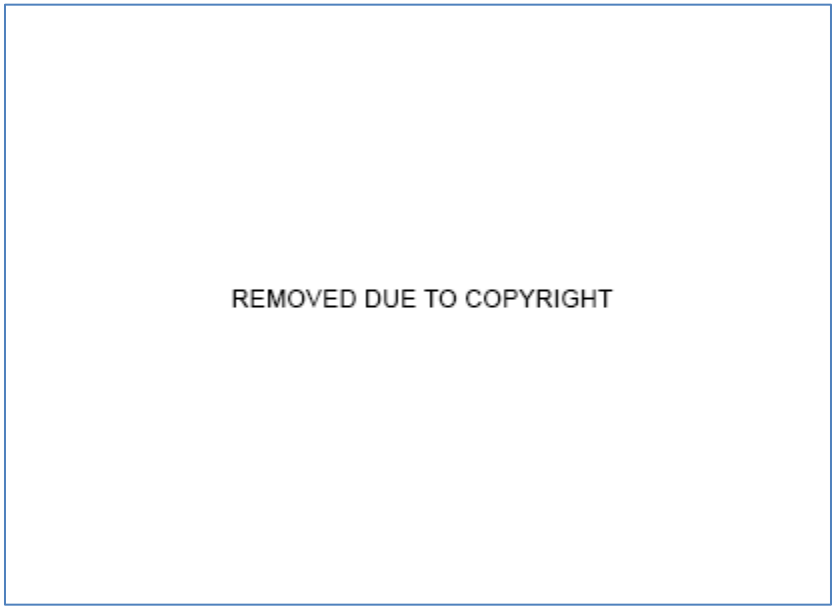

Fig. 14. Screenshot of presentation room inside the social platform *VRChat,* VRChat Inc, 2017.

In contrast to the presentation room, another room which was designed to be a bowling rink (figure 13) showed conformity in the rules of play. The bowling rink, in stark contrast to the presentation room, is constructed using vivid and warm tones which express a more casual atmosphere. Those who participated in the bowling activity followed learned rules of physical bowling rinks and adapted it to play in the new environment. In addition to those who tried to adapt to the goals of the room (hitting the pins of the bowling alley with a bowling ball) there were players who experimented on the limitations of the space, such as throwing bowling balls in the air or at other players. Those who followed the rules also displayed basic group participation as they would wait in line for players in front to bowl first.

Fig. 15. Screenshot of bowling rink inside the social platform *VRChat,* VRChat Inc, 2017.

5.3 Cardboard VR - Practice-based research

5.3.1 Mobile VR

Fig. 16. VR equipment used for mobile VR experiences (Connections, Create Together, Stars and Visualizer), 2017.

Mobile VR is a form of virtual reality that utilizes the computational power of a smartphone with an untethered VR headset (Figure #). The mobile is place inside the headset which becomes the screen for the VR headset. One benefit of mobile VR is that it is not connected to a high-end computer, lowering its entry cost for those who want to experience virtual reality without a large initial investment. Because the headset is untethered, this lets the individual to move more freely when experiencing VR as well as allowing the headset to be taken to any location without needing installation.

For the advantages of using mobile VR stated above, I developed a series of VR environments intended for mobile VR. Participants would be able to view the environments through an installed application on their respective mobile devices which would then be placed inside a VR headset. Each participant was asked to observe and interact with the immersive virtual space in 5-minute sessions and to discuss the experience afterwards. Participant information and identities were not recorded.

5.3.2 VR Space - Connections

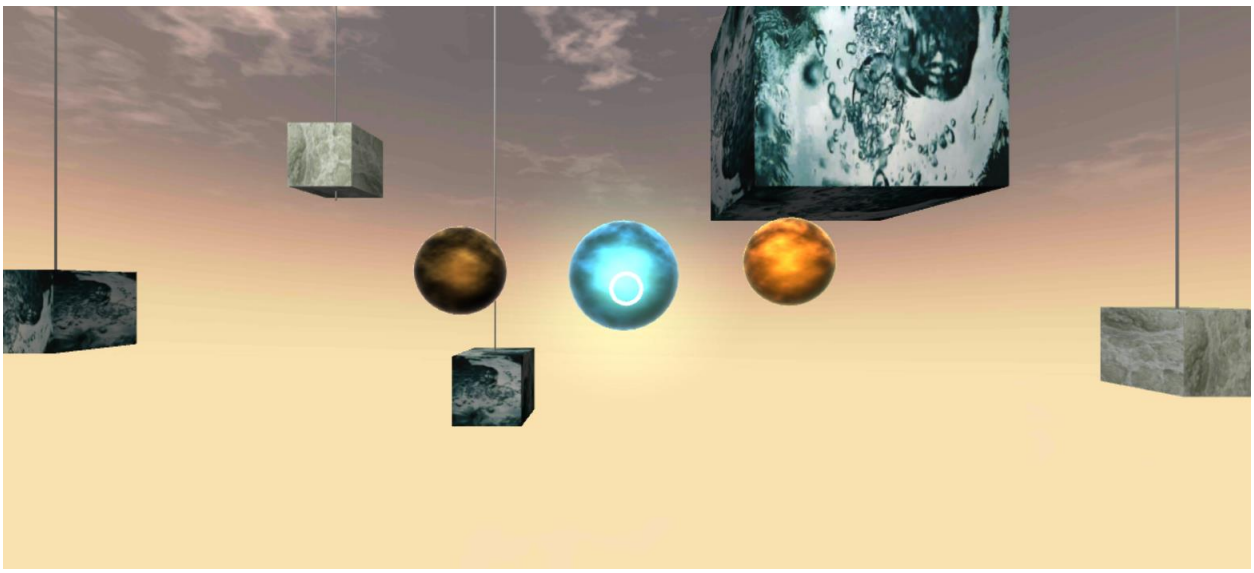

Fig. 17. Screenshot of VR experience *Connections,* 2017.

Following the explorations into structured play, the first experience centered around simple visual creative problem-solving exercises. The play space had to designed to create the illusion of a 3-dimensional infinity, with no floors, walls or ceilings. The participant is situated floating in the sky, colored spheres floating in front of them. Blank 3D cubes, which hang from a string that stretches up to the sky, surround the participant. When they activate a ball, animated images are painted onto the cubes and an accompanied audio-track plays. Each cube shows a different set of animations and sounds. When the participant combines two cubes a new and unique sphere is created. The individual must which combination of spheres will create something new by clicking and testing combinations.

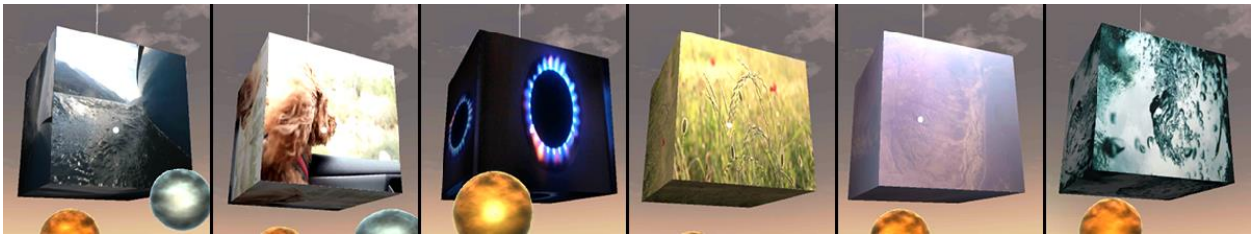

Fig. 18. Screenshot of artifacts in the VR experience *Connections,* 2017.

The participant was instructed to interact with these cubes, combining them in an undisclosed order in order to generate new and different projections. Figure 16 shows an example of one of these digital artifacts.

When the participant gazes at the artifact, a corresponding sound would emanate from it. In this example the projections display a flowing river with the sound of continuously running water. If this artifact would be combined with the artifact resembling the essence of fire, the essence of steam would be created.

5.3.3 Presence

Participants noted a sense of disorientation within the space due to the unnatural perspective of floating in an infinite space. Because of this, participants would very seldomly look downwards. Participants were also not able to see their body or hands and felt detached from the space. References to a physical self as discussed in the VRChat case study has seen to impact the adjustment period in which participants are willing to interact with the space.

5.3.4 Experimentation

As the combination order of the artifacts was left to the participant to discover on their own, there was an increase in the experimentation and curiosity displayed during sessions. Participants would interact with any objects within their vision but would ignore object which did not provide feedback when touched. This leads to the question of whether agency over the interactivity of a virtual space in VR affects the level of curiosity and experimentation.

5.4 VR space 2 - Create together

5.4.1 Set up

This space was set up in a similar manner to VR space 1 but was designed to accommodate multiple people (up to 4) in a single session. The virtual space was set in an infinitely large snowy mountain area with a table set in the center of the space. On the table lay vividly colored object which a participant could pick up, move around and throw.

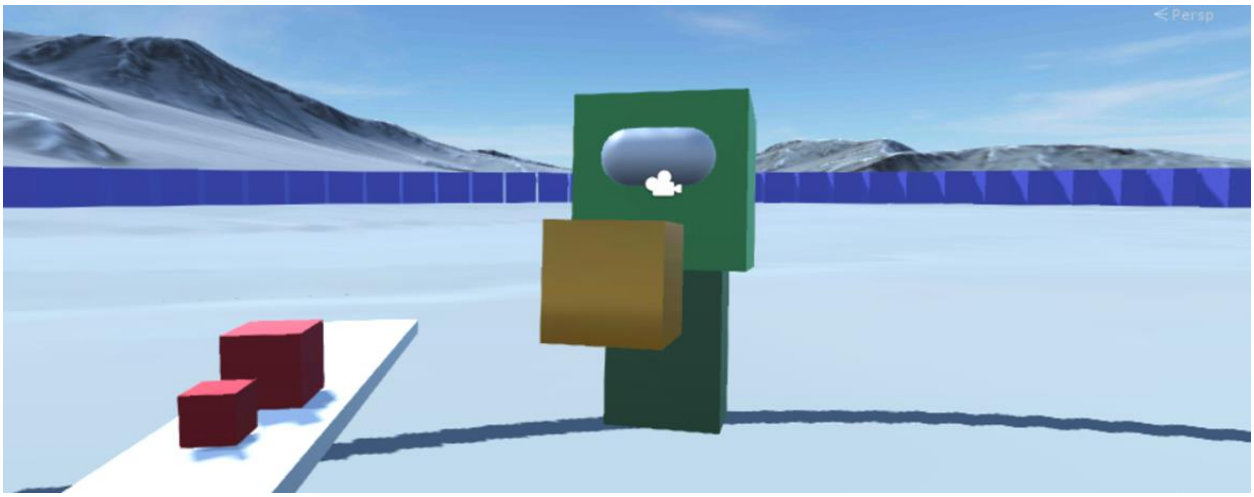

Fig.19. Screenshot of the VR experience *Create Together,* 2017.

The participants would be able to see other participants in the virtual space through a simplistic avatar (figure 17) who's head movements were synced to their avatar's head movements. When more than one participant picked up an object, a song would begin playing. The song was determined to the combination of which objects each person was holding. However, if a person decides to drop or throw away the object that they are holding, the music would stop playing.

5.4.2 Presence

Although the participant could not see their body, a shadow of themselves would be projected on the floor below them. As mobile VR technology being used did not incorporate hand of body movement aside from head rotation, this technique helped in creating an elementary level of body presence. However, participants still reported a level of disconnection to their avatars, but to a lesser extend of the previous case study.

5.4.3 Co-presence

Interaction with other participants was restricted due to the technology of the VR setup, and for this reason communication between participants were observed as stunted. Participants expressed frustration as they were not able to communicate their intention within the VR space without bringing themselves out of the experience to verbally talk with other participants in the room.

5.4.4 Interaction

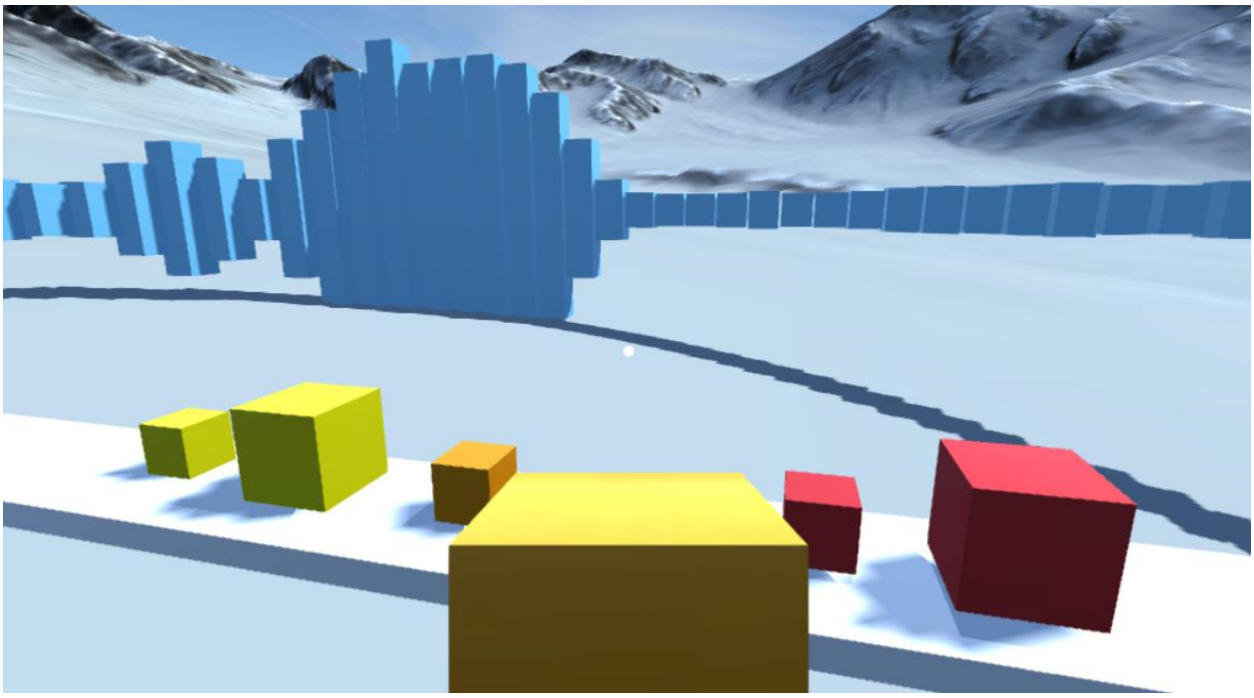

Fig. 20. Screenshot of interactive objects in VR experience *Create Together,* 2017.

Participants reported that the vivid color of the objects, especially the warm toned objects instinctively triggered an understanding that these objects were interactive, as opposed to the table which was a cold blue. Experimentation which changing the colors of these objects displayed varying level of interactivity of the participants. Warm toned object showed higher levels of interaction than cooler toned objects. Changing the shape of the objects did not show significant differences in interactivity.

Conclusion / Discussion

The secondary research and studio examples generated for this thesis project show several principles that can be used to elicit a creative incubation phase in 3D virtual environments by teammates working in different geographical locations. These principles include the importance of direction in the phase prior to incubation, the preparation phase. We discuss the value of presence, using design elements such as atmosphere, having the avatar cast shadow, and game rules, both appropriately guiding while not overly determined to allow for discovery. Examples are given of designing for optimal co-presence which helps with communication in the virtual environments. Furthermore, the research and practical examples show the opportunity for building both glossy corporate VR collaborative environments, and "outside of the office" postmodern glitchy spaces. Virtual reality enables an individual to communicate affectively through

the use of natural body and hand gestures in a virtual world, allowing a richer source of communication methods to express their ideas to their teammates. These malleable environments allow people to adjust subtle elements of their space in order to obtain a state of flow and find beautiful insights through collaborative incubation time together.

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LIST OF FIGURES

GLOSSARY OF TERMS

Virtual Reality

"The applied science of virtual reality (VR) engages in the design and engineering of and research related to special immersive interactive computer systems. These virtual reality systems synthesize environments, or worlds, which are simulations of reality that are usually rendered using three-dimensional computer images, sounds, and force feedbacks." (Meinhold, 2016)

Augmented Reality

"Augmented reality (AR) refers to any technology that inserts digital interfaces into the real world." (Mohn, 2015)

Mixed Reality / Hybrid Reality

"Mixed Reality (MR) visual displays, a particular subset of Virtual Reality (VR) related technologies that involve the merging of real and virtual worlds somewhere along the 'virtuality continuum' which connects completely real environments to completely virtual ones." (Milgram & Kishino, 1994)

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This paper explores the usefulness of using Serious Games as a collaborative tool for ideation. It also explores the effectiveness of role-play and the simulation of reality to evaluate knowledge exchange between participants and collaboration.

Carmichael, K. (2011). AxeCorp's Team Challenge: Teaching Teamwork Via 3D Social Networking Platforms. ***Business Communication Quarterly*****, *74*(4), 479–485. https://doi.org/10.1177/1080569911423962**

Carmichael conducted an exercise to establish the impact of virtual teams and role-playing as a device to prepare students for the work world and to integrate skill development and knowledge of communication concepts. (Carmichael, K., 2011)

Carmichael, K., Feltmate, I., & Campbell, J. (2010). Seriously Playing: Introducing Communication Students to AxeCorp's Virtuality. ***Business Communication Quarterly*****, *73*(4), 460–463. https://doi.org/10.1177/1080569910385386**

This article explores the creation and implementation of a fictional company in order to improve student learning in the field of communication. It describes the technology used to operate the company, student's responses to the exercise and its inclusion into a first-year business communication course.

Gerber, S., & Scott, L. (2011). Gamers and gaming context: Relationships to critical thinking. ***British Journal of Educational Technology*****, *42*(5), 842–849. https://doi.org/10.1111/j.1467-8535.2010.01106**

This paper describes the findings and analysis of surveys in which 121 adults were investigated to establish a relationship between gaming with skillsets that are desirable in modern day culture such as critical thinking and problem solving.

Shih, J.-L., Jheng, S.-C., & Tseng, J.-J. (2015). A simulated learning environment of history games for enhancing players' cultural awareness. ***Interactive Learning Environments*****,** ***23*****(2), 191–211. https://doi.org/10.1080/10494820.2014.997249**

In this paper, the authors created and developed a virtual roleplaying game to educate individuals on the historical experiences and enhancing the individual's cultural awareness. Players were evaluated on their improvements in these areas using questionnaires.

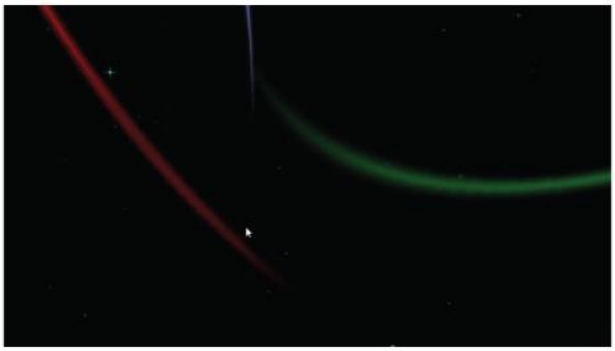
Tsun-Ju Lin, & Yu-Ju Lan. (2015). Language Learning in Virtual Reality Environments: Past, Present, and Future. ***Journal of Educational Technology & Society*****, (4), 486.**

This journal cross-analyzed 29 articles on the subject of language learning in a virtual reality environment by investigating trends in topics, technologies used, language learning settings, sample groups and methodological approaches.

APPENDICES

Appendix A

ROXANNE ALBUTT



The participant is situated in the center of a starfield, darkness surrounding them with visible glittering stars in the distance. Coloured lights begin to arc around the screen in a simple pattern, leaving a glowing trail behind. Pressing the activation button on the headset creates a distance explosion of a star accompanied by the sound of a meditation bell. In the background plays a soft binaural audio track.

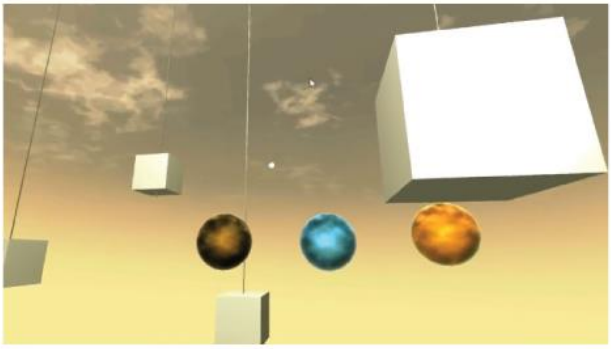
Key insights

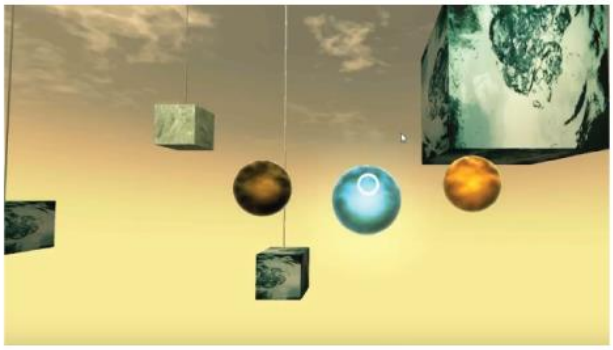
- Participants felt a sense of ease due to the visuals and audio.
- They did not know how long the experience was and led to confusion.
- When the participant pressed the button, the visuals were not always in immediate sight and caused a disconnection between the visual and audio.
- No feelings of inspiration or creative impulses were mentioned.

VR CARDBOARD - PROTOTYPE TWO - CONNECT

Appendix B

ROXANNE ALBUTT





The participant is situated floating in the sky, colored spheres floating in front of them. Blank 3D cubes, which hang from a string that stretches up to the sky, surround the participant. When they activate a ball, animated images are painted onto the cubes and an accompanied audio-track plays. Each cube shows a different set of animations and sound. When the participant combines two cubes a new unique sphere is created. The participant must find which combination of spheres will create something new by clicking and testing combinations.

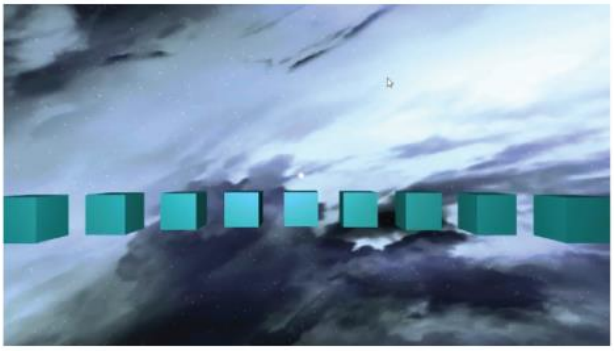
Key insights

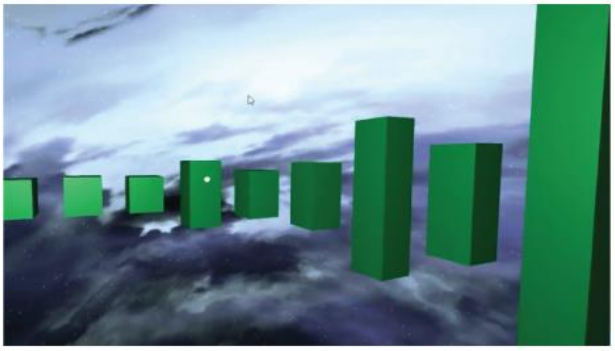
- Immediate feedback connected gestural action with object.
- They did not know how long the experience was and led to confusion.
- Gazing over an object changed the size of the reticle which helped Distinguish interactive objects from non-interactive objects.
- Mental activity put the participant into a problem solving and curious mindset.

VR CARDBOARD - PROTOTYPE TWO - CONNECT

Appendix C

ROXANNE ALBUTT





The participant is once again floating in space, surrounded by cyan cubes that are arranged in a ring around them. A audio-track is chosen by the application at random.

Key insights

- No interaction, participants felt no agency in this space
- Absorbed into the visuals and audio that they felt disorientated when taking off the headset, possibly a sign of over stimulation.
- Showed a lack on concentration after the experience.

VR CARDBOARD - PROTOTYPE THREE - VISUALIZER