"Should We Meet IRL": Gauging Matches in Virtual Reality

Tejaswini Yeleswarapu, Pranav Nair, Nimmi Rangaswamy
International Institute of Information Technology (IIIT-H), Hyderabad
Contact Author: t.yeleswarapu@research.iiit.ac.in

Abstract. Virtual Reality has evolved as a powerful, embedded and immersive technology medium to transform dating experiences. However, there is no rigorous CSCW research examining 'dating' in VR, despite social interaction being a serious topic of exploration. We aim to push the CSCW discourse on social interaction further by analyzing the dynamics of romantic reciprocality in a *fully immersive* VR application. Through a qualitative study of 30 participants in 15 pairs, we examine a customizable VR application *'RecRoom'* as a dating technology medium to analyze how dimensions of interaction - including but not limited to voice, haptics and spatiality - influence dynamics of dating experiences. We employ Tinder as a contrasting chat based medium to situate and deepen our learnings about dating in VR. Our study finds VR allowing users to efficiently and effectively 'gauge' matches resulting in well informed decisions to meet (or not) virtual partners 'IRL' or in real life than existing chat based mediums like Tinder. We believe this leads to improved experience of first dates.

Introduction

As new technologies are introduced, innovators, enthusiasts and entrepreneurs adapt them to a variety of use cases to exploit and amplify new affordances and experiences. Dating is no stranger to the above statement and dating technology has evolved to expand deeper into virtual matchmaking. With the advent of print and mass media came matchmaking newspaper advertisements; with videotaping came VHS dating; and with the web came Match.com. Now, with the mobile phone - we have Tinder. Not only has technology adapted to suit dating, dating cultures in turn adapted to the 'technology of the era' (Sales and Bishop, 2018). In India, dating is a fairly recent phenomenon gaining momentum with the rise of mobile phone adoption since the 2000s as mobile interactions afforded privacy to dating practices. Tinder brought favourable shifts to a culture obsessing over commitment in viewing temporary hookups favourably due to the non-judgemental characteristic and comfort of the online space (Newett et al., 2017). With the advent of Virtual Reality (henceforth VR) new affordances, features and public appeal are imminent in the domain of dating technologies - and VR as technology disrupting the 'right swipe' (David and Cambre, 2016). What started out, for the authors of this paper, as a study focused on VR practices for matchmaking and disrupting traditional digital dating, transformed into a research opportunity to study the specific structuring of romantic interaction in fully immersive VR platforms. The latter was carried out specifically in contrast to chat based mediums like Tinder to appraise consequences for striking romantic relationships. The authors believe this paper to be a pioneering attempt in the critical evaluation of a *fully immersive* (Castronovo et al., 2013) VR dating experience.

Numerous CSCW focused studies have examined romantic interaction in *non-immersive* virtual multiplayer games (Zytko et al., 2015; Pace et al., 2010; Zhang, 2014; Huynh et al., 2013) and intimacy in virtual worlds like 'Second Life' (Boellstorff, 2015). However, social interaction in *fully immersive* virtual environments has been investigated mainly as avatar-based systems (Bente et al., 2008; Blanchard et al., 1990; Latoschik et al., 2017; Roth et al., 2016) and social channels such as gaze behavior, non verbal behaviours and their impact on communication quality (Garau et al., 2003; Bailenson et al., 2005). While 'Second Life' (Boellstorff, 2015) provides an understanding of intimacy in *non-immersive* (Castronovo et al., 2013) collaborative social virtual environments, our study investigates added dimensions of *complete bodily immersion* driving romantic interaction in VR and its role in the evolution of dating technologies enriching interactive possibilities. The authors view VR as a stage to set the dating experience as our findings primarily revolve around interactions that are a result of introducing VR into online dating. The latter parts of the paper further build on the findings and literature to critically examine if and how VR as a rich, immersive and interactive platform supporting dating experiences, enhances and enriches the experience of 'gauging' or screening potential partners or 'matches' (David and Cambre, 2016) prior to a first date- especially in contrast to existing chat-based

multimedia platforms like Tinder that are weaker (Marcus, 2016; Daft and Wiginton, 1979) in supporting rich social interaction. It is important to note that we investigate the efficacy of VR and Tinder as standalone mediums, only focusing on interaction and not the matchmaking process.

We set up a study with 30 heterosexual participants in 15 pairs, who were made to use both Tinder and a custom VR platform from an existing social VR game called *RecRoom*. We interviewed participants on various aspects of both environments and built a comparison based on findings. Some of our findings push the boundaries of human - VR interaction by examining them in the context of dating; VR allowed for more efficient and effective gauging of matches due to:

1. More unfettered interactions by diffusing focus from the person to the environment, alleviating social tensions inherent in a dating context.

2. Engaging interpersonal and spontaneous interactions augmenting intimacy.

3. Interaction in real time, accentuating intricacies of body language and conversational nuance

4. Better 'Avenues of attraction' through bodily immersion.

5. Security of the virtual while mirroring the perspicacity of a real life date.

The above characteristics of VR aid dating partners make well informed decisions on whether or not to meet in real life, thereby improving the quality of 'first (real) dates'. However, participants reported aspects of temporality like dedicated time commitment, inability to multi task and the animated design of *RecRoom* depleting some of the experiences of immersive VR. Our paper employs an inductive approach, deriving themes from a close reading and analysis of primary data from participant interviews and serves as a preliminary step to initiate further research on the potential of fully immersive VR as a dating technology,

Related Work

Introduction to Virtual Reality

A nuanced understanding of VR systems includes an important factor known as 'immersion' that divides all modern VR systems on the basis of their ability to 'immerse' users into more real experiences. Immersion is formally defined as "the extent to which the senses are engaged by the mediated environment" and is determined by system affordances. Ivan Suthermland first introduced key concepts of immersion and sensory input and output in a simulated world - the basis of current VR research. Most VR configurations fall into three main categories with each category being ranked by its degree of immersion. *Non Immersive* VR is the simplest form of virtual reality where users interact with the environment using a conventional monitor without being immersed; *Semi Immersive* systems include

large, multiple screens or monitors that provide a medium to high level of immersion. These systems are improved versions of desktop (non immersive) VR, supporting head tracking thereby improving the feeling of 'being there'; and *Fully Immersive* systems such as head-mounted displays (HMD) or CAVE TM systems with full bodily immersion; three or four walls, a projected floor, a projected ceiling which significantly or fully cover the users' field of view (Castronovo et al., 2013). These systems are in essence, the ultimate version of VR systems enhanced by audio, visual, sensory and haptic interfaces (Mandal, 2013). 'Second Life', 'Flight Simulator' and 'RecRoom' are examples of non-immersive, semi-immersive and fully immersive VR applications respectively.

Fully immersive VR also affords 'Avatars' or digital alter egos (Latoschik et al., 2017) that may act as physical representations of users and typically mimic their expressions and body language through sensors, further differentiating fully immersive VR from chat-based mediums and non immersive VR. Non-immersive VR also affords avatars, however, without the bodily immersion and is typically navigated only through voice. Avatars play a significant role in enhancing the realism in fully immersive VR.

Social Interaction in Fully Immersive VR

The main difference separating fully immersive VR systems from other traditional digital mediums is its 'three dimensionality'- a factor that brings together fully bodily immersion, interactivity and virtual presence all under one medium. Fully immersive virtual reality, a fairly recent technology that enables full bodily (three dimensional) immersion, has already made waves in the healthcare, gaming and tourism industries and only lately has made noise in the dating industry. While there are no exclusive fully immersive VR dating apps yet, it has shown immense potential in transforming dating experiences due to providing life-like experiences, emulating FtF interactions. Just like virtual worlds offering social games, many gaming companies have launched 'social VR' apps, where players around the world meet in a three dimensional virtual space for the sole purpose of socializing and conducting leisure activities with minimal gaming. Social VR apps have gained massive popularity in the last few years for providing realistic, immersive social experiences with high customizability. As an emerging technology, rigorous research on the full scope of social interaction in fully immersive VR has only recently gained traction with little to no focus dating and romantic interaction.

Fully Immersive VR vs Chat-Based CMC: What Makes VR an Enriching Medium for Interaction

Media Richness Theory

"Media Richness" refers to the range of audio, visual, verbal, and contextual information sources (Burgoon et al., 2002). The media richness of a medium depends on its capacity to process information and varies based on information

such as "immediate feedback, range and volume of cues, channels, usage, personalization and language variety" (Lee et al., 2011; Daft and Wiginton, 1979). Ramirez et. al (Ramirez Jr and Burgoon, 2004) classified three distinct forms of "computer mediated communication" (CMC) or modalities, namely, "text-based CMC, audio-based CMC and visual-based CMC". Lee et. al (Lee et al., 2011) further elaborates that text-based CMC has the lowest capacity to process information as it lacks "environmental, spatial, visual, auditory and other sensory information". Audio-based CMC (audio calls or audio messages) adds "aural" information but lacks visual cues and visual-based CMC provides visual information in addition to audio sources. It is important to note that in our paper, we refer to current online dating mediums as 'chat-based' and not 'text-based' as many incorporate audio-visual features like photos, gifs, emojis, bitmojis, audio call and so on, thereby differing from traditional text-based mediums like IM. Although existing chat-based mediums have brought text, audio and visual CMCs under a single modality, they still lack in "environmental, spatial and other sensory information" (Lee et al., 2011). We believe immersive VR bridges these important gaps that chat-based dating mediums are not built to address. As (Sundar et al., 2008) argue, enriching modalities, from chat based CMC to virtual reality, offer a powerful approximation of "real, non-mediated interaction".

Information Cues and Social Presence

As mentioned above, the capacity to process information determines a medium's richness and therefore "information cues" play an important role. Lee et. al and Daft et. al (Lee et al., 2011; Daft and Wiginton, 1979) define cues as the "communication of information through various channels such as text (spoken or written words), verbal cues (tone of voice), or nonverbal cues (physical gestures, body language)".The lack of cues depletes a crucial factor known as "social presence" wherein the "realness" of communication is diminished and the person communicating is reduced to a mere "object" (Short et al., 1976). In order to experience greater social presence, the media richness of a medium and communication must be close to FtF interactions. Rich interactions facilitated by "immersive" modalities make for a significantly more engaging experiences (Pedersen and Liu, 2003) as common themes of frustration with the experience of online dating on chat based mediums like Tinder and OKCupid are the lack of social presence and spontaneity in conversation (Masden and Edwards, 2015). To this end, initial impressions developed through chat-based CMCs are less evolved than FtF interactions and therefore less enriching and uni-dimensional (Lee et al., 2011; Ramirez Jr and Burgoon, 2004). We extend this argument to VR as a rich immersive medium employing body language, tonal voice modulation and expressive verbal and non verbal language as cues achieving wide range and depth of social interaction.

Non-verbal Cues and Body Language

This work builds upon and extend Jeremy Bailenson's research on the effect of non-verbal cues and body language on social interaction in immersive virtual environments to dating and romantic interaction. Bailenson suggests that non verbal cues and gestures are often correlates of specific mental states- we smile when pleased, nod when we agree and touch when we are interested in someone. Intuitively tabulating and assessing non verbal behaviour is something humans do constantly in FtF conversations. With fully immersive virtual environments, interactants can assess these behaviours with greater precision to augment normal intuitions about body language and non verbal cues occurring during social interactions (Bailenson et al., 2005). The unavailability of non-verbal cues and body language in chat based mediums diminishes the quality of interaction in a dating context as romantic interaction involves indirect cues [such as physical touch, gaze and so on] that, as mentioned above, aid in assessing or gauging crucial factors such as interest, chemistry and reciprocation [or lack thereof].

Background

The following sections offer a background on the general affordances of mobile dating apps, mechanisms of Tinder matchmaking and insights into the unique setting the study was conducted in.

Affordances of Mobile Dating

Mobile dating apps such as Tinder include "communicative affordances" (Lutz and Ranzini, 2017) that differ from traditional online dating mediums such as Match.com (Marcus, 2016). Shrock et. al (Schrock, 2015) propose four key communicative affordances - "portability", "availability", "locatability", "multimediality" - that mobile dating apps rely on. "Portability" or mobility is the key difference between mobile dating apps like Tinder and desktop-based dating apps like Match.com; Tinder can be used "on the move" in different locations in both public and private spaces while the latter can only be used in private spaces.

"Availability" of mobile media enables easy access, leading to higher frequency of usage, "Locatability" allows for easy matching, texting and meeting with users that are in the same vicinity (physical proximity) (Lutz and Ranzini, 2017; Marcus, 2016), and "Multimediality" includes three modes of communication - text, emojis, gifs, memes, audio and video calls (Lutz and Ranzini, 2017; Marcus, 2016). Tinder also relies on an additional visual affordance of photos. According to Marcus et. al (Marcus, 2016), users rely on "limited" information while swiping due to the "heavy reliance" on photos. Another important factor known as "synchronicity" or "the short amount of time in which messages are sent" (Marcus, 2016) calls for "spontaneity" and "availability" from users to make a quick decision on their potential partners' self presentation through

photos as well as their own (Lutz and Ranzini, 2017). Lutz et. al and Marcus et. al (Lutz and Ranzini, 2017; Marcus, 2016) argue that the affordance of "synchronicity" in addition to the limited information available on Tinder are constrictive, leading to issues such as "loss of interest"," information overload", inability to gauge potential partners properly.

Matchmaking Mechanisms of Tinder

First launched in September 2012, Tinder paved the way for mobile dating apps by introducing the "swiping" motion to anonymously "like" or "dislike" potential matches. Users can "swipe right" (like) or "swipe left" (dislike) other users based on their respective locations [1].

Tinder requires a Facebook login to create a profile and automatically extracts information like photos, name, age and gender. Users can then choose to manually change the information along with writing a short "bio" or biography to introduce themselves and optionally link an Instagram or Spotify account. Factors such geographical location, mutual friends and common interests play a crucial role in adding the most compatible candidates to a list of potential matches. Users can then anonymously "swipe right" or "swipe left" on other users to indicate (dis)interest [2]. A 'match' is formed when two users 'swipe right' on one another to indicate interest (David and Cambre, 2016; LeFebvre, 2018). A mutual right swipe then results in a "match", enabling the two interested parties chat through private messaging within the app to help determine or 'gauge' if one or both partners desire further communication.

As a chat based CMC, Tinder offers various affordances in addition to texting in the form of photos, emojis, gifs and memes to further enhance interactivity and make the dating experience engaging. We chose Tinder as a dating technology medium in the study for its specific messenger-like capabilities and popularity as a dating/romance seeking technology unlike other chat based mediums like IM. (Its important to mention that we did not choose Tinder for its reputation as a 'hook-up' or casual dating app)

Dating in India

The Indian dating culture underwent a sudden and drastic change in 2011, with the launch of Tinder into the Indian market. Tinder marketed as a 'hook-up' app quickly became popular among the younger demographic, making dating and particularly hook-ups open and widespread. Apart from a few articles [3], there is no rigorous research examining dating in India. Accordingly, our references suggest that the norms of finding a partner are slowly changing; from a culture vehemently set on arranged marriages to gradually adopting and accepting 'dating' among the

---

[1]   shorturl.at/lBCH3
[2]   shorturl.at/lBCH3
[3]   http://tiny.cc/ja62cz, http://tiny.cc/42kwtz

younger demographic. The shift in culture is resulting in the emergence of new practices, from serious to casual dating and even hook-ups. The agency to choose a partner is increasingly shifting from parents to the individuals themselves with the rise in popularity of online dating platforms like OkCupid and Tinder. This shift in agency is still fairly recent, with online dating being embraced the fastest by college students and young working professionals [4]. In lieu of this, we deliberately chose college students in the age group 18-23 as our target demographic.

Methods

The VR Environment

After a thorough investigation of various cross-platform VR social applications like 'vTime' and 'Facebook Spaces' and considering the potential for customization we chose *RecRoom* for the experiment. *RecRoom* is highly customizable, offers a personal lounge, and several in-built games in a VR environment. The room designed for the study was one among the default in-game templates that was customized to befit a romantic setting reminiscent of a typical bar-room scenario. We chose this specific setting based on the results (89%) of a poll sent out on our college forum, querying for a comfortable yet romantic space for a date.

As shown in Figure 1, the room had a personal lounge area furnished with comfortable couches surrounding a coffee table, a ping pong table and a dart board, a dim lit bar furnished with a bar table, stools and ample empty space and a stage with a functioning mike and speakers for karaoke. A 'choose your own game' cabinet with several games from paintball to charades cards to disk throw was also added.

Figure 1. A lounge area furnished with dartboards and a ping pong table (left) and a bar table with two bar stools (right) in *RecRoom.*.

Additionally, Zytko el al.'s (Zytko et al., 2015) research on collaborative games was incorporated to enhance dating experiences in our VR space. The research

---
4   http://tiny.cc/df92cz, http://tiny.cc/ja62cz

suggests that collaborative multiplayer games allow for indirect evaluation of game partners as potential romantic partners. Collaborative games or "Multiplayer Online Games" (MOGs) like World of Warcraft and MapleStory are posited as "inherently social environments" as the games allow multiple geographically separated users to interact with one another in real time. Romantic intimacy in MOGs have been investigated in several studies (Huynh et al., 2013; Pace et al., 2010; Zytko et al., 2015) that portray MOGs as "collaborative virtual environments where a player's actual self (versus their ideal self) naturally emerge through collaboration, coordination, and teamwork". Zytko et. al (Zytko et al., 2015) further elucidates that "in-game, non-competitive" collaborative activities like a picnic in a castle or building a virtual garden together create opportunities to explore "budding" romantic feelings. Accordingly, inspiration was drawn from Zytko et al.'s research to add the aforementioned collaborative activities to enhance the process of gauging dates. For this study, the VR environment was customized in a manner that afforded the ability to implement and explore the following factors:

1. **Immersion:** We study VR as twinning the intimacy of a real life date with the affordance of a chat like conversation. To do this we ensured users were made aware of interacting over a virtual medium accessible to each other, not only for verbal conversations but for physical interactions in *virtual 'real' time*.

2. **Security:** Due to the real time dimensionality of voice and avatars, disconnecting from the room was designed to be easy in case the dating experience became uncomfortable.

3. **Interactivity:** The technology of virtual reality affords a multiplicity of new and potential features in a dating experience. For example, a spatial expansion with activities, voice, haptic touch, avatar customisations, real time verbal cues, body language and haptics are new features that we decided to focus on. Our goal here was to observe how the new affordances are deployed by our participants in the context of virtual dating.

There are two main system features that work as affordances for a VR dating experience:

1. **Avatar:** The avatar in *RecRoom* is a virtual representation of the person that goes beyond the basic 'name-picture' representation. As shown in Figure 2, the avatar in *RecRoom* is simple - a long elongated torso, squarish cell-shaded palms and wrists with the ability to extend and contract the forefinger and thumb, and a fun ovalish face with eyes and a mouth that dynamically change. The facial and body expressions are a result of the participants' body language and voice. We decided to use default avatars that load up in Rec Room and minimized customizability to height, skin color, hair color and hairstyle to mimic participants' idea of their projected physical appearance.

9

2. **Haptic Feedback:** Haptic feedback is essentially the 'vibration' of VR controllers due to virtual touch. Vibrations are triggered in the controllers when one avatar 'touches' another avatar in the virtual space as a form of feedback, and any touch produces the same vibrations. It is also important to note that while the vibrations do not determine the area of touch for an avatar, the three dimensional nature of a fully immersive shared virtual space helps with connecting the vibrations to the intended area of touch by affording witnessing the actions of the other avatar in real time- for instance, touching an avatar's hand produces the same vibration as touching its face but witnessing the second avatar move their hand towards the face helps registering that the vibration is meant for the face.

While courting in person, touch is a very important dimension to show one's interest in the courtship ritual. VR affords the ability to physically move towards and virtually 'touch' the partner in the form of 'haptic feedback' while coming into contact.*RecRoom* also gives haptic feedback on touch and while picking up/dropping things or when inanimate objects are thrown at an avatar.
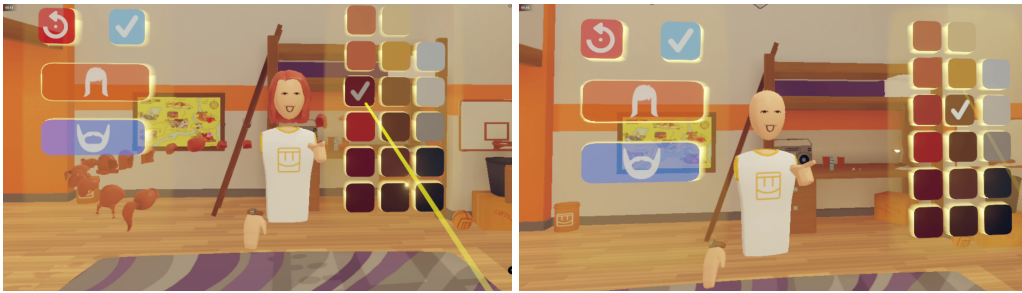

Figure 2. A female (left) and male (right) participant's avatar choosing their hairstyle and haircolour in *RecRoom*..

The Qualitative Study

A qualitative study of 30 (15 male and 15 female) heterosexual participants interacting with a fully immersive VR application *RecRoom* and Tinder was undertaken. Since there is no 'standard' way of designing dating in VR, we built and customised the virtual 'dating' environment to the study. The participants were aged between 18-23 and belonged to an academically highly ranked engineering institute in Hyderabad, India. The study was conducted strictly on heterosexual couples made up of Indian college students. With the older demographic still bearing a 'lingering mindset' of dating being taboo and homosexuality being illegal in India (at the time of the study) methodological adjustments were made by including only college students in the aforementioned age group and heterosexual couples; the skewed sex ratio of 1:7 females to males in the institute made selection of women more complicated.

We conducted the study in two phases - the first on Tinder and the second on the customized VR app *RecRoom*, followed by semi structured interviews covering

participant experiences in both mediums. Tinder was used as a base to further ground our learnings about VR. Our aim was to create and customize a VR environment with the end goal of dating (as in Tinder) exploiting the affordances of VR technology. We endeavored to echo the matchmaking mechanisms of Tinder for pairing participants while simultaneously controlling aspects of the study to suit VR.

Participant Recruitment and Pairing

A google form asking for basic details - name, age, contact number, email, branch of study, relationship status and availability - was sent out to all students in the institute to recruit participants. Due to a skewed sex ratio, we received 72 entries from men and 31 from women to participate in the study. Since the student cohort consisted of students between the age group 17-23, entries were filtered out based on age (since the age of consent is 18 in India), availability and relationship status (only single respondents seriously looking to date were recruited). The pairing for Tinder was done manually through preference forms sent out to all prospective participants who volunteered for the study. Two sets of preference forms were sent out - one for the female participants and one for the male participants.

Figure 3. An empty classroom converted into the VR room..

The forms included the name, picture and short bio of every participant along with a 'familiarity' option to filter out partners that were known or familiar to the participant. Unfamiliar partners were deliberately chosen to make the dating process as organic as possible. Due the aforementioned skewed sex ratio we gave

every woman an option of three-five men to pair from in a follow-up individualised preference form as the number of men were chosen based on their preferences and the familiarity option of the previous preference form. The men were asked for their preferences (preferences were filtered out based on the familiarity option) but the final choice to 'match' rested with the women - much like how the dating app Bumble (Bivens and Hoque, 2018) works - leaving us with a total of 15 pairs (30 participants) in the study. The final pairing was done by mapping the first preference of female participants to the first three preferences of the male participants. A pair was formed when the first preference of the female participant overlapped with either of the first three preferences of a male participant. Although a total of 25 pairs (50 participants) were initially matched through this process, 10 of 30 women dropped out due to scheduling issues, leaving us with a total of 15 pairs. The manual matchmaking process took great care to ensure every participant was matched with an unfamiliar partner.

Procedure

The participants were informed to download Tinder and 'swipe right' on the person they were matched with and asked to chat for three days, a typical duration for pairs on Tinder (Shatto, 2018). Our intention was to retain the VR pairing as the one on Tinder, while keeping this fact hidden from the participants. All pairs were instructed to not meet in person or talk over phone to ensure their voices would not be a 'give away'. We designed the study to retain the same pairs in both VR and Tinder in order to focus on exploring 'platform' specific variations in dating experiences. Participant anonymity was a critical factor in the VR study to ensure removal of bias, thereby guaranteeing a fresh start for pairs in both mediums - evaluating both medium as independent experiences.

TINDER
Manual Pairing through Preference Forms

RECROOM
Same Pairs - Unaware to Participants
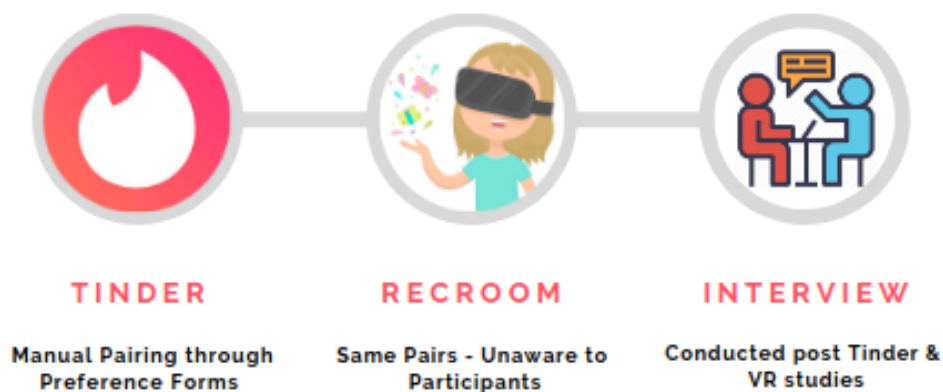
INTERVIEW
Conducted post Tinder & VR studies

Figure 4. Chronology of the Study.

For the VR study, the pairs came in on the fourth day post the three day chat on Tinder, unaware the partner they had chatted with for the last three days will be

paired in VR too (the pairs were asked, during the interviews, if they indeed recognized their partners were identical in both mediums - only two pairs had realized that the pairing was identical). The pairs were sent to separate rooms - each of which were equipped with a VR ready PC and a VR headset - namely a HTC VIVE and an Oculus Rift. As shown in Figure 3, we used two empty classrooms, arranging sensors atop a stack of chairs and desks to capture the physical space of the room and the body of the participants. Participants were given sixty minutes [5] of in-VR time followed by a 75-90 minute detailed interview covering their dating experiences on both mediums incorporating a range of questions. To better probe into the structuring of romantic interaction affecting gauging potential, and impact of both mediums on dating experiences, we focused our interviews on the following parameters:

1. Dimensions of interactivity among paired partners - the range and depth of interaction as articulated by participants.

2. Degrees of self projection - range and richness of self articulation as expressed by participants

3. Degree of Expressiveness - how voice, haptics, touch and bodily immersion compare with emojis, gif and memes.

4. Strength of Attraction as articulated by participants.

5. Miscellaneous issues like 'security', 'control' and 'novelty' in participant experiences.

   The pairs were interviewed separately by two researchers - the first and second authors of the paper. Interviews of the 30 participants and subsequent transcription were equally divided between the two researchers and the audio was recorded and transcribed with the explicit consent of the participants. Each participant received a 500 rupee (8 USD) amazon gift voucher for participation.

Data Analysis

All three authors carried out a structured, qualitative analysis to summarize and interpret interview data. Interview data was coded and analyzed using a general inductive approach (Thomas, 2006). From a careful reading of transcripts, we developed categories and and clustered excerpts together, conveying key themes from the data. Post-interviews, we transcribed the recordings and grouped qualitative opinions of every participant, based on their experiences from the study on the two modalities of dating (Tinder and VR). In the interviews, we probed the agency and intensity afforded for the five aforementioned parameters.
   We then noted the qualitative opinions of participants for each of these categories under five subcategories - Supports VR, Against VR, Supports Tinder,

---

[5]   http://tiny.cc/gy52cz

Against Tinder and Neutral and tallied the number of opinions under each of these 5 sections, for each of the five main parameters. Our qualitative interviews fleshed out the significance of the above opinions in more depth. The findings were analyzed and written from a close reading of the rich open ended interview data combined with the assessment via ratings on a 5 point Likert scale on the efficacy of gauging matches (1 being the lowest and 5 being the highest), preference (1 being strongly does not prefer and 5 being strongly prefers) and overall dating experience our participants offered about each of the two platforms.

Results

In this section, we lay out key findings from qualitative interviews about the salient features of VR influencing romantic interactions. It is important to note data pertinent to Tinder was analyzed and integrated in the findings to compare a predominantly chat based medium to VR as an immersive dating medium. Our primary focus remained VR. For quotes, we will refer to Participants as P1 to P30 while mentioning their age and gender.

The VR environment for our study offered a multi-dimensional self representation that goes beyond a picture - a full blown avatar embodying bodily presence; factors like motion controls and spatial movement adding mobility to this representation. The inclusion of voice inserted this physical representation into the social realm and the ability to communicate through various channels, including voice and touch adding an immersive layer of interaction.

Our findings demonstrate VR as a powerful preference over Tinder in terms of pure 'gauging potential' and overall 'dating experience'. A majority of participants (28/30) felt the immersive nature of VR enhanced additional opportunities to gauge matches heavily impacting the decision to schedule a first (real) date. Participants found VR to be a 'self-sufficient' and 'wholesome' medium compared to Tinder, where additional mediums like phone or video chat are often used to gauge a match before deciding to meet in real life. Of the 19 participants who wanted to schedule a date, 15 initially did not want to after the Tinder chat but changed their minds post the VR experience. Only 4 participants' decision to schedule a date did not change post the VR experience. Similarly, of the remaining 11 participants who did not want to schedule a date, 7 wanted to post the Tinder experience but changed their minds post the VR experience. Only 4 participants' decision to not schedule a date remained the same post the VR experience. As the above data explains, participants drastically modified their assessment of the same partner after the VR experience; the same partner who was deemed unworthy of a meeting after Tinder, was deemed worthy after VR and vice versa. As P15(Male, 19) succinctly puts,

> 'I do not want to meet my Tinder partner because she seemed quite
> distant and judgemental, which frankly was a put off and I stopped
> making an effort. On the other hand, I got along so well with my VR

partner; she was intelligent, funny and our mutual love for pranks further piqued my interest in her. I'm so excited to meet for real.'

A majority of participants (26/30) did not realize (when asked) that the pairing was identical in both mediums. In extension to the previous quote, P15(Male, 19) said, 'I don't think I could've guessed my VR partner was the same as my Tinder partner - they seemed like two entirely different people!'

Participant responses are strong pointers to the constraining and abstract nature of chat to judge 'if a match on a platform is worth the effort to convert into a real life date'. As participant P27(Female, 20) put it,

> 'Meeting someone after chatting on Tinder is always dicey - you don't know if you'll hit it off for sure until you actually meet them and it's too much effort when you've matched with multiple people. VR solves this problem without having to leave one's home! It made it possible to have a life-like date which made it easier to judge if I want to take the effort to meet my match for real.'

Overall, we found participants relied and trusted the VR experience more in their decision to meet their partners due to its 'life like nature' and similarity to a real life date. The following subsections serve as further evidence to the aforementioned meta findings:

Diffusion of Focus

VR and Tinder environments bring core differences to the dating context - Tinder consists of only the screen as real estate, the chat box, the person's photos and details, and two options - check out or chat. The center of focus is the user and the pressure to keep the conversation afloat and interesting is entirely on the 'matched' (David and Cambre, 2016) pair. In VR, the environment is not restricted to a two dimensional mobile screen but extends to a three dimensional space allowing for user generated spatial quality and an environment shaped to replicate a real life scenario.

Interestingly, the spatial context in VR shifts and diffuses the focus from the person to the environment. This, we believe, afforded the alleviation of social tensions inherent in a dating environment, as the users no longer the only 'active' elements- the VR environment allowed for effective 'interaction driven props' to diffuse tensions making way for more unfettered interactions. 'Conversations (in chat) would often revolve around the participant's interests and hobbies and this unfortunately retained a sense of formalness.' - P27(Female, 20).

Participants found themselves beginning with a quick casual 'Hi' and veering headlong exploring the VR space. Indulging in virtual activities resulted not just in comfort and an air of ease but organically germinated conversations. The pairs were now provided with an immersive virtual context they mutually shared and lived in for a certain amount of time, unlike in Tinder where context had to be forged in

15

terms of common interests, hobbies and other related information. 21 participants found the conversation on Tinder to be 'awkwardly initiated' and the task of keeping the conversation going 'somewhat of a chore'. As participant P27(Female, 20) mentioned,

> '..as Tinder is a hit-and-miss scenario where either parties would keep introducing topics of conversation that interest them, in hopes that the other party gets hooked on to the same.'

However, 8 participants admitted that the virtual environment may have 'diffused focus on their partners than required', which led to them 'being distracted and learning less about the partner'.

Spontaneity

While chat based mediums like Tinder allow for a discontinuous, discrete messaging/ communication style, VR affords a more continuous and real time interaction. On Tinder, this discontinuity allowed participants to read messages, take time and think out replies to best impress their match and project themselves with deliberation.

> '(On Tinder)..can easily not be me, can think of replies, somebody else could be chatting, can google up facts for discussion, can even take my own sweet time..' - P9(Female, 18).

One of our participants, P15(Male, 19) compared the two dating styles to the

> 'difference between a VIVA and a written assignment.. One can rephrase in an written assignment like on Tinder, while VR was like giving a live oral examination.'

Tinder chats were 'like the take-home assignments' where the participant was allowed time to read messages, think and respond with some amount of premeditation. VR was the 'live oral exam' where participants did not get this time advantage and the interaction was 'impromptu'.

Twenty-two participants articulated the loss of spontaneity on Tinder made conversations more impersonal, nudging a waning of interest to invest in the conversation - especially when replies were temporally apart. Only seven pairs continued their Tinder conversation for the entirety of 3 days with the Tinder chats taking up not more than a total of ten minutes on any given day. On the VR platform, real time spontaneity made conversations more casual, personal and comfortable. Even when 4 out of the 15 pairs did not 'click' romantically they continued interacting in the VR environment for the entire period of 60 minutes (9 pairs had to be prodded out of the experience post the allotted time).

Immediate Feedback and Extra Linguistic Cues

Virtual Reality afforded partners the ability to give as well as receive immediate feedback on events inside of the dating experience through verbal and non verbal cues and body language expanding interactive possibilities to respond to a partner. As one participant, P4(Male, 21) put it,

> '...The combination of voice with a three dimensional representation of your partner through an avatar, touch through haptics, body language and real time interaction made the the experience intimate and wonderfully personal; conversations felt natural and life-like and doing activities like paintball and karaoke made me feel a kind of closeness and intimacy'.

18 participants voiced emotions expressed on Tinder as 'one-dimensional' and the 'props' for expression, like emojis, gifs and acronyms as 'boringly normalizing' chat in the context of texting. As P21(Male,18) said about a Tinder text,'people texting "lol" were actually not even chuckling'. In VR, participants felt their partner could not fake reactions,

> 'You can insert a facile laugh emoji on chat, but more difficult to fake a real, hearty laugh in VR' - P21(Male, 18).

While voice affords the ability to convey content, non verbal cues such as inflections and tones provide linguistic cues to elicit diverse interactions. For example, the way a word is inflected decides if it is being said with seriousness or sarcasm. However, digital forms of inflection such as emojis are not as nuanced and flexible in their use to convey emotions. Three participants alluded to 'emojis' being 'cumbersome in conveying intent and laborious in being cool and casual'. Due to the time lapse and higher probability of misunderstanding of emotions or content conveyed over chat, our participants were alert in wording messages on Tinder due to the fear of being 'immediately unmatched'. The real time conversational affordance of tenor and tone on the VR platform 'allowed for the speaker to make an immediate recovery and clear the misunderstanding before a possible unmatch.' - P4(Male, 21); 'If I use innuendo I have to put appropriate emojis to give it that tone..not required in VR' - P12(Male, 23). 29 out of 30 participants agreed that this factor of immediate feedback was a 'killer bonding' technique, as this quote highlights,

> '..Saw her shrug when I drew something disgusting, saw her shake when she laughed - could pick brilliant cues from these bodily movements. It was like I was really in the same room as her.' - P4(Male, 21)

Avenues of Attraction

Avenues of attraction are affordances to facilitate mutual attraction between the interacting partners. For Tinder - these are text, emojis, stickers, even the right-swiping experience. For VR, participants pointed out voice, chat, spatiality, mobility, avatar customisation and expressive behaviour as strong affordances.The difference in avenues of attraction in VR and Tinder stem from specific attributes of the two platforms. All 30 participants unanimously agreed VR provided more avenues for them to gauge 'partner desirability' as a date. As one of the women put it,

> 'When chatting, the person is only an idea in your head, can't gather what he's thinking' - P6(Female, 21).

Voice combined with an avatar that mimics movements and body language (smiling, talking, gestures) in real time and haptics catapulted the participants' mental conception of their match - from an abstract representation formed from a chat text to that of a 'breathing, living' person. Two of the following quotes illumine the above statement;

> 'A person's voice, her tone, her manner of speaking, her body language through her avatar, along with her intuitive response is way more attractive than an emoji- to convey the same thought' - P12(Male, 23)

> 'When the other person laughs or responds to your jokes and you can actually see them doing so, it's effective, more attractive than a chat text - P12(Male, 23).

VR also afforded an efficient way to gauge the lack of chemistry. 'Cues to connote desirability can also become cues to turn off' said, P11(Female, 19) who had noticed her match reluctant to shift from their 'joint activity' at the beginning of the 'date' or move on to some 'cosy banter'. The above 'kinds of social interactions' on the VR platform seemed to suggest to P11 '..that he was the kind to stick to his comfort zone, which could in fact be a put off'.

However, for the purpose of dating, the VR situation seemingly 'gave a lot away' as mentioned by 3 participants, P27(Female, 20) and P10(Female, 21) who did not like that 'VR was helping too much in figuring out the partner'- and preferred the control Tinder allowed to mould their 'projecting' and retained an element of mystery'. One of them articulated:

> 'Certain degree of obscurity where you can't see a lot of the other person and this degree of mystery keeps you hooked. The fact you don't know how they talk, look, react..introduces a mystery keeping you attracted in a weird way' - P4(Male, 21).

Haptic feedback allowed participants to high five, bump fists, throw things at each other and especially touch - a feature adding the touch of intimacy enhancing the dating experience as an instrument of flirting.

> 'Though this isn't as real as actual physical touch, haptic touch makes flirting much more intimate and exciting, especially to subtly indicate that you're into your partner. It also made activities like paintball more fun and interactive as you actually feel the paint being thrown at you.' -P11(Female, 19)

All of the above factors afford VR an element of 'bodily immersion'. All 30 participants unanimously agreed that 'VR made them appear more attractive' because it not only changed the setting of the conversation, but also made them 'more real and fun' as the following quote illumed,

> 'On Tinder, you see my picture and my bio. In VR, you see ME' - P10(Female, 21)

Control of Experience

By control, we refer to the extent of power a user of a match making platform has over the dating experience - specifically with the ability to control conversations and the agency to be able to quit the experience at will. Tinder offered the security of 'a safe zone' - of not actually meeting a stranger in the real world and with the control to block/unmatch if the experience turned unpleasant. Participants unanimously 'upvoted' Tinder on the 'control' scale. As a participant said,

> '..On Tinder, you can immediately unmatch the person.. In VR, however, it's uneasy to remove the headset since my partner was interacting with me right there, in real time - it's more personal. If I quit my partner sees me quit..Like shutting the door on someone's face' - P12(Male, 23)

However, P18(Male, 19) provided a contrasting view,

> 'VR has the intensity of a real date and the security of virtual.'

The additional security and comfort of having a choice to leave at any stage cut both ways! A third of our participants did appreciate that VR was like a 'live stream', where something said before cannot be revisited,

> 'Chats on Tinder, as long as you haven't been unmatched, are permanent' - P5(Male, 20).

Control over 'time commitment' is also critical as interaction in VR required setting aside a dedicated amount of time- 'something to be put up with'- in contrast to Tinder, where the ability to multi-task while chatting was assumed advantageous. Participant views were divided on the above; 6 did not take to the increased commitment and would rather deal with the more casual, time-discontinuous Tinder. 20 participants commented that since Tinder 'eventually leads to a first date' where both partners have to commit some time, they would prefer 'cutting the redundant texting' and go for increased time commitment in a VR environment. There were yet a few, 4 of them, who believed if they were really serious about finding a partner, they would not mind dedicating some fixed amount of time. The 6 participants who were only looking for a casual fling said, 'they would rather not spend as much time and use Tinder instead'. The fact that Tinder afforded courtship of multiple potential dates (chat as a medium allowed users to communicate with multiple potential matches at the same time) furthered the advantage of this temporal separation in 'chat-only' dating technologies.

Discussion

Gauging Potential: Deciding to Meet IRL

Prior work on *non-immersive* virtual worlds like 'Second Life' examined the nature of intimacy and sex as 'just another part of virtual life'. For 'residents' of Second life, romantic engagements or finding partners and relationships were part of a larger engagement with the game- and a vast majority of romantic relationships remained virtual, with no intention to extend them to real life relationships (Boellstorff, 2015). While Boellstroff explored romance and intimacy in a collaborative *non-immersive* virtual world limited to chat and '2-D avatars' (Boellstorff, 2015), our study pushes the boundaries of his research analyzing complete bodily immersion on a VR platform with a purposive goal of extending relationships to the real world.

The goal of any dating platform, chat based or VR, is to facilitate an environment that would promote 'gauging' potential partners eventually leading to meeting IRL (in real life) or a real life meet. 'Environment' in this case speaks to the efficacy and affordances of the user interface - on chat based mediums(text, emojis, etc) and virtual space in VR (voice, avatars, haptics, etc) - augmenting the process of 'gauging' potential partners. Our observations illustrate the immersive and interactive nature in VR environments play a pivotal role in shaping romantic interactions that ultimately leave users with a more enriched and holistic impression of their partners compared to chat-based mediums.

We offer two interrelated ideas to further situate our observations; 'hyper-awareness' and 'social waning' to suggest a temporary release from social impulses typical of a dating context. Hyper-awareness suggests a loosening up of self-grooming and projection behaviours due to environment induced alleviation of

social pressures; Social waning suggests 'letting go' of learnt norms and defensive behaviours due to the spontaneous nature of VR combined with paired collaborative activities. The last subsection, 'Assessing Socio Romantic Behaviours', discusses the effectual assessment of socio-romantic behaviors for better of gauging matches. All three ideas aid in contextualizing and connoting the structuring of romantic interactions in VR.

Hyper-awareness and Social Waning

Hyper-awareness forms a major component in the development of romantic or sexual interactions as it engenders the need to be constantly vigilant and in control of one's appearance, words and actions in projecting the best possible version of oneself. This is present in chat based mediums like Tinder in the form of carefully curated photos and tailored conversations - an online 'performance' of self as a series of signals to convey a particular impression' (Donath, 2002). Although VR enables similar props and capabilities in the form of avatar customization, the obsessive need for impression management seemed to decrease. The real time interaction in the form of collaborative activities and games organically sparked romantic attraction between pairs by developing trust, inter-dependence, elucidating the ability to work as a team (Huynh et al., 2013; Zhang, 2014) while providing segues into the partner's personality. This shift in attention from the paired partner to the activity dissipated hyper awareness in VR as the "pressure to impress" receded, allowing for a more congenial, free-flowing interaction.

Access to the aforementioned games and activities coupled with spontaneity due to real time interaction gave rise to another key observation we call 'social waning'. The spontaneous nature of VR, with respect to conversations and participation in activities enabled participants to become less socially conscious. The multitude of activities allowed pairs to explore one another in different settings, without the hyper-awareness of a real date. The ever stubborn *"social gatekeepers of the mind"* loosened as participants reported partaking in activities showcasing facets of their personality, *"sometimes surprising themselves"*! Social waning not only enabled multi-dimensional exploration and understanding of a potential partner, but inadvertently led to the exploration and understanding of *"one's own social dimensions in a safe virtual space"*, rendering the dating experience on VR more holistic in nature. As most first dates are 'awkward' and 'unsettling' (Goodman and Churchill, 2007), the multidimensional understanding of a potential partner offers a sense of familiarity rendering the 'VR date' a valuable precursor to a 'first date'. Furthermore, the socially awkward amongst participants concurred about a VR date being more exciting than an actual date by overcoming inhibitions that accompany "the meeting of partners on a first date".

Assessing Socio-Romantic Behaviours

The addition of non verbal or extra linguistic cues and body language alongside verbal cues have proved advantageous, augmenting the quality of social interaction

in IVE's (Bailenson et al., 2005). Non verbal cues and gestures are often correlates of mental states. The intuitive tabulating and assessing of non verbal behaviour is a common human practice in FtF conversations (Bailenson et al., 2005). With fully immersive VR, our participants reported a higher degree of confidence in the assessment of the partner's socio-romantic behaviours than on Tinder. In a dating environment, the VR platform and accompanying immersive experience aided participants infer their date's social and romantic 'state of mind' and accordingly mould mutual response. The emphasis on inferring a romantic partner's engagement levels calls for an important observation in terms of 'fulfilment of expectations', as P25 (Male,18) elucidates

> 'The likelihood of hitting it off in real life, on an actual date is much higher after a VR conversation than a Tinder conversation, because in terms of personality, you'll more or less get what you expect. The same cannot be said about Tinder because chat conversations can be unreliable.'

Tinder, due to its limitations as a chat based medium, does not afford a chance to explore multiple aspects of a potential romantic partner and often leads to a commonly believed misconception that the 'match' deliberately misrepresented themselves when expectations of the person on chat don't align with the person in real life. On the other hand, the many affordances of VR, discussed in the previous section, offer an expansive experience with a potential match increasing the probability of 'expectations being met' on a first date.

As discussed above, VR structures and manipulates romantic interactions making people considerably less socially conscious, constrained, hence, withdrawn, in a first dating experience. The above coupled with insights gained about personality and non verbal behavioural traits amplifies the process of gauging matches in immersive VR. The latter seemingly and successfully augments understanding of 'how a match on VR would respond in a life-like setting and get along' leading to a well-informed decision on whether or not to take the VR date to the next level of meeting in an actual social context. We observe that immersive VR deflates the gap between chat based mediums and FtF interactions by increasing the efficiency and efficacy of gauging matches. This, we believe would lead to improved quality of subsequent first (real) dates.

Limitations

Though our work offers a unique qualitative understanding of dating in VR, we recognize limitations to our findings. First, our study was conducted in a restricted social environment limiting selection of participants to one college. Second, all our participants were heterosexual as the study was held in the metropolis of Hyderabad, South India, where dating culture is still heteronormative and restrictive with little credence given to gender fluid sexualities. Third, there is no

way gauge if our interview data would stay the same once VR has normalised and situated as 'everyday' technology. Also, the fact that VR headsets are still in between the 'enthusiast' and 'industrial' design stage (Norman, 2013), their transition into a market friendly commercially viable product may engender aspects that our study could not explore.

Study Design Challenges

We are aware the study design has implications on our data analysis and discuss four study design challenges in this section:

Controlled Study. Dating is a complex social behaviour contingent on contextual cues. Dating in controlled environment can lead to a loss of these context cues. While our study was 'controlled' with respect to time (typical 3 days on Tinder and 60 minutes in VR), none of the conversations on Tinder or interactions in VR were recorded. This was deliberately undertaken to ensure free flowing of interaction on both mediums and attempt to minimize implications of the Hawthorne Effect (Adair, 1984). Partner anonymity in the VR study was also just limited to name and identity, with only two participants reporting its imposition restrictive. Studying human behaviour in a dating context gives rise to privacy concerns, one that we circumvented, to some extent, by controlling the dating environment and sharing details of the study design with our participants. Blascovich et al. and Loomis et al.'s research on social interaction in collaborative virtual environments affirmed research advances in the understanding of the nuances and intricacies of social interaction, requiring a high level of experimental control while allowing for enhanced ecological validity (Blascovich et al., 2002; Loomis et al., 1999).

While there have been ethnographic studies to understand sex and intimacy in *non-immersive* virtual worlds such as 'Second Life' (Boellstorff, 2015), Boellstroff specifically describes his method as *virtual* ethnography - one that entailed virtually observing *online* personas or 'avatars' (Boellstorff, 2015) thereby dealing with privacy concerns to some extent. Another reason for a controlled study is the lack of prior research probing the interrelationship of technologies and dating behaviours in fully immersive VR systems. To begin with a controlled study seemed plausible in offering avenues for future research in diverse dating contexts (Castronovo et al., 2013).

Order of the Study. Tinder was experienced first, followed by VR to mimic the natural progression of romantic interaction in dating technologies- from existing chat based mediums like Tinder to fully immersive VR. Our observations from a pilot session of the study also suggested the implemented order of the study- participants better eased into the dating experience through a familiar dating medium like Tinder [similar to a real life situation] first and were then introduced

to an unfamiliar dating medium like fully immersive VR to maintain an organic flow of the dating process.

Novelty. The possibility of novelty of VR impacting our data was taken into account during the interviews asking participants if they owned/experienced VR before. Fifteen of the 30 participants reported owning VR headsets; 12 were familiar with VR while 3 had never experienced VR. Ten percent of our sample size reporting VR novelty, we deemed reasonable to assume novelty not unduly influencing data analysis. Futhermore, all 30 participants were individually given a brief demonstration of *RecRoom* along with a training session of the VR environment prior to the study to control the impact of novelty. All 30 participants reported having used Tinder prior to the study.

VR Room Design. Since there are no standard 'exclusive' VR dating apps, we had to rely on existing social VR applications for the purpose of this study. Although we chose a highly customizable application, *RecRoom*, to befit a romantic setting, a few (6/30) participants expressed the 'animated' design of the room, style of avatars and the very nature of 'Virtual Reality' made the VR date too 'gamified' and 'cartoonish', depleting the seriousness of gauging a match.

Conclusion

Fully Immersive VR has proved to be a great technological asset for many industries and is now expanding its reach to the dating and matchmaking market. As an emerging technology with the capacity to provide full bodily immersion, fully immersive VR separates itself from existing digital dating mediums, calling for an investigation on the workings of fully immersive VR in a dating context. Employing Tinder, an existing chat-based dating app as a contrasting medium, this paper explored the 'gauging' efficacy and efficiency of fully immersive VR through a controlled qualitative study.

The study offered further opportunities to deduce some of the fundamental differences structuring romantic interaction on the two mediums. Observations on the affordances of VR (especially the interactive space, feedback through verbal and non verbal cues and body language and touch through haptics) are consolidated as incrementally efficient and enriching in gauging matches, thereby improving the quality of subsequent real life dates. Dating in VR familiarized pairs with one another through a shared virtual space, paired collaborative activities in immersive VR and became a precursor to a first date. VR also afforded better avenues of expression, attraction, gauging a match more personal and intimate while offering a suitable platform for the socially anxious. The research analysis is also extended to establish the shortcomings of fully immersive VR - the dedicated time commitment, inability to multitask and animated design serving as negatives for some participants.

This paper aimed to primarily serve as a precursor to more evolved and rigorous research on romantic interaction in fully immersive VR, and encourage further discourse on a fairly novel but under explored facet of a technology capable of producing life-like experiences. Further studies can help extend this initial discourse to a more generalized understanding of socio-romantic interaction in immersive technologies.

Acknowledgments

References

Adair, J. G. (1984): 'The Hawthorne effect: a reconsideration of the methodological artifact.'. *Journal of applied psychology*, vol. 69, no. 2, pp. 334.

Bailenson, J. N., A. C. Beall, J. Loomis, J. Blascovich, and M. Turk (2004): 'Transformed social interaction: Decoupling representation from behavior and form in collaborative virtual environments'. *Presence: Teleoperators & Virtual Environments*, vol. 13, no. 4, pp. 428–441.

Bailenson, J. N., A. C. Beall, J. Loomis, J. Blascovich, and M. Turk (2005): 'Transformed social interaction, augmented gaze, and social influence in immersive virtual environments'. *Human communication research*, vol. 31, no. 4, pp. 511–537.

Bente, G., S. Ruggenberg, N. C. Kramer, and F. Eschenburg (2008): 'Avatar-Mediated Networking: Increasing Social Presence and Interpersonal Trust in Net-Based Collaborations'. *Human Communication Research*, vol. 34, no. 2, pp. 287–318.

Bivens, R. and A. S. Hoque (2018): 'Programming sex, gender, and sexuality: Infrastructural failures in the" feminist" dating app Bumble'. *Canadian Journal of Communication*, vol. 43, no. 3, pp. 441–459.

Blanchard, C., S. Burgess, Y. Harvill, J. Lanier, A. Lasko, M. Oberman, and M. Teitel (1990): 'Reality built for two: a virtual reality tool'. In: *ACM SIGGRAPH Computer Graphics*, Vol. 24. pp. 35–36.

Blascovich, J., J. Loomis, A. C. Beall, K. R. Swinth, C. L. Hoyt, and J. N. Bailenson (2002): 'Immersive virtual environment technology as a methodological tool for social psychology'. *Psychological Inquiry*, vol. 13, no. 2, pp. 103–124.

Bly, S. and E. F. Churchill (1999): 'Design through matchmaking: technology in search of users'. *interactions*, vol. 6, no. 2, pp. 23–31.

Boellstorff, T. (2015): *Coming of age in Second Life: An anthropologist explores the virtually human*. Princeton University Press.

Bowers, J. M. (1991): 'The Janus Faces of Design: Some Critical Questions for CSCW'. In: J. M. Bowers and S. D. Benford (eds.): *Studies in Computer Supported Cooperative Work: Theory, Practice and Design*. Amsterdam, etc., pp. 333–350, North-Holland.

Burgoon, M., V. P. Denning, and L. Roberts (2002): 'Language expectancy theory'. *The persuasion handbook: Developments in theory and practice*, pp. 117–136.

Castronovo, F., D. Nikolic, Y. Liu, and J. Messner (2013): 'An evaluation of immersive virtual reality systems for design reviews'. In: *Proceedings of the 13th international conference on construction applications of virtual reality*, Vol. 47.

Daft, R. L. and J. C. Wiginton (1979): 'Language and organization'. *Academy of Management Review*, vol. 4, no. 2, pp. 179–191.

David, G. and C. Cambre (2016): 'Screened intimacies: Tinder and the swipe logic'. *Social media+ society*, vol. 2, no. 2, pp. 2056305116641976.

Donath, J. S. (2002): 'Identity and deception in the virtual community'. In: *Communities in cyberspace*. Routledge, pp. 37–68.

Garau, M., M. Slater, V. Vinayagamoorthy, A. Brogni, A. Steed, and M. A. Sasse (2003): 'The impact of avatar realism and eye gaze control on perceived quality of communication in a shared immersive virtual environment'. In: *Proceedings of the SIGCHI conference on Human factors in computing systems*. pp. 529–536.

Gerson, E. M. and S. L. Star (1986): 'Analyzing due process in the workplace'. *ACM Transactions on Office Information Systems*, vol. 4, no. 3, pp. 257–270.

Goodman, E. S. and E. F. Churchill (2007): 'After the match: mobility and first dates'. In: *Proceedings of the 2007 conference on Designing for User eXperiences*. p. 23.

Hancock, J. T. and P. J. Dunham (2001): 'Impression formation in computer-mediated communication revisited: An analysis of the breadth and intensity of impressions'. *Communication research*, vol. 28, no. 3, pp. 325–347.

Hancock, J. T., C. Toma, and N. Ellison (2007): 'The truth about lying in online dating profiles'. In: *Proceedings of the SIGCHI conference on Human factors in computing systems*. pp. 449–452.

Hitsch, G. J., A. Hortaçsu, and D. Ariely (2010): 'Matching and sorting in online dating'. *American Economic Review*, vol. 100, no. 1, pp. 130–63.

Huynh, K.-P., S.-W. Lim, and M. M. Skoric (2013): 'Stepping out of the magic circle: Regulation of play/life boundary in MMO-mediated romantic relationship'. *Journal of Computer-Mediated Communication*, vol. 18, no. 3, pp. 251–264.

Johansen, R. (1988): *Groupware. Computer Support for Business Teams*. New York and London: The Free Press.

Latoschik, M. E., D. Roth, D. Gall, J. Achenbach, T. Waltemate, and M. Botsch (2017): 'The effect of avatar realism in immersive social virtual realities'. In: *Proceedings of the 23rd ACM Symposium on Virtual Reality Software and Technology*. p. 39.

Lee, S., Y. Sun, and E. Thiry (2011): 'Do you believe in love at first sight: effects of media richness via modalities on viewers' overall impressions of online dating profiles'. In: *Proceedings of the 2011 iConference*. pp. 332–339.

LeFebvre, L. E. (2018): 'Swiping me off my feet: Explicating relationship initiation on Tinder'. *Journal of Social and Personal Relationships*, vol. 35, no. 9, pp. 1205–1229.

Loomis, J. M., J. J. Blascovich, and A. C. Beall (1999): 'Immersive virtual environment technology as a basic research tool in psychology'. *Behavior research methods, instruments, & computers*, vol. 31, no. 4, pp. 557–564.

Luff, P. and C. Heath (1998): 'Mobility in Collaboration'. In: *Proceedings of the 1998 ACM Conference on Computer Supported Cooperative Work*. New York: ACM Press, pp. 305–314, ACM.

Lutz, C. and G. Ranzini (2017): 'Where dating meets data: Investigating social and institutional privacy concerns on Tinder'. *Social Media+ Society*, vol. 3, no. 1, pp. 2056305117697735.

Mandal, S. (2013): 'Brief introduction of virtual reality & its challenges'. *International Journal of Scientific & Engineering Research*, vol. 4, no. 4, pp. 304–309.

Marcus, S. (2016): 'Swipe to the right: Assessing self-presentation in the context of mobile dating applications'. In: *Annual Conference of the International Communication Association (ICA), Fukuoka, Japan*.

Markowitz, D. and J. Bailenson (2019): 'Virtual reality and communication'. *Human Communication Research*, vol. 34, pp. 287–318.

Masden, C. and W. K. Edwards (2015): 'Understanding the role of community in online dating'. In: *Proceedings of the 33rd annual ACM conference on human factors in computing systems*. pp. 535–544.

McVeigh-Schultz, J., E. Márquez Segura, N. Merrill, and K. Isbister (2018): 'What's It Mean to Be Social in VR?: Mapping the Social VR Design Ecology'. In: *Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility*. pp. 289–294.

Newett, L., B. Churchill, and B. Robards (2017): 'Forming connections in the digital era: Tinder, a new tool in young Australian intimate life'. *Journal of Sociology*, pp. 1440783317728584.

Norman, D. (2013): *The design of everyday things: Revised and expanded edition*. Basic books.

Pace, T., S. Bardzell, and J. Bardzell (2010): 'The rogue in the lovely black dress: intimacy in world of warcraft'. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. pp. 233–242.

Pedersen, S. and M. Liu (2003): 'Teachers' beliefs about issues in the implementation of a student-centered learning environment'. *Educational Technology Research and Development*, vol. 51, no. 2, pp. 57.

Polzenhagen, F. and S. Frey (2017): 'Are marriages made in heaven? A cultural-linguistic case study on Indian-English matrimonials'. In: *Advances in cultural linguistics*. Springer, pp. 573–605.

Ramirez Jr, A. and J. Burgoon (2004): 'The effect of interactivity on initial interactions: the influence of information valence and modality and information richness on computer-mediated interaction'. *Communication Monographs*, vol. 71, no. 4, pp. 422–447.

Rivkin-Fish, M. (2005): *Sex in development: science, sexuality, and morality in global perspective*. Duke University Press.

Roth, D., K. Waldow, F. Stetter, G. Bente, M. E. Latoschik, and A. Fuhrmann (2016): 'SIAMC: a socially immersive avatar mediated communication platform'. In: *Proceedings of the 22nd ACM Conference on Virtual Reality Software and Technology*. pp. 357–358.

Sales, N. J. and J. Bishop (2018): 'Tinder and the Dawn of the Dating Apocalypse'.

Sambasivan, N., A. Batool, N. Ahmed, T. Matthews, K. Thomas, S. Gaytán, D. Nemer, E. Bursztein, E. Churchill, and S. Consolvo (eds.) (2019): '"They Don't Leave Us Alone Anywhere We Go": Gender and Digital Abuse in South Asia'.

Schmidt, K. and L. Bannon (1992): 'Taking CSCW seriously: Supporting articulation work'. *Computer Supported Cooperative Work (CSCW)*, vol. 1, no. 1, pp. 7–40.

Schrock, A. R. (2015): 'Communicative affordances of mobile media: Portability, availability, locatability, and multimediality'. *International Journal of Communication*, vol. 9, pp. 18.

Schuemie, M. J., P. Van Der Straaten, M. Krijn, and C. A. Van Der Mast (2001): 'Research on presence in virtual reality: A survey'. *CyberPsychology & Behavior*, vol. 4, no. 2, pp. 183–201.

Sellen, A. J. and R. H. Harper (2003): *The myth of the paperless office*. MIT press.

Seth, N. (2011): 'Online matrimonial sites and the transformation of arranged marriage in India'. In: *Virtual Communities: Concepts, Methodologies, Tools and Applications*. IGI Global, pp. 951–974.

Sharma, V., B. Nardi, J. Norton, and A. Tsaasan (2019): 'Towards Safe Spaces Online: A Study of Indian Matrimonial Websites'. In: *IFIP Conference on Human-Computer Interaction*. pp. 43–66.

Shatto, R. (2018): 'Here's How Long You Should Text Before Having A First Date, According To Experts'.

Short, J., E. Williams, and B. Christie (1976): *The Social Psychology of Telecommunications*. John Wiley and Sons Ltd.

Slater, M. and S. Wilbur (1997): 'A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments'. *Presence: Teleoperators & Virtual Environments*, vol. 6, no. 6, pp. 603–616.

Smith, H. J. and M. Neff (2018): 'Communication Behavior in Embodied Virtual Reality'. In: *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. p. 289.

Sundar, S. S. (2008): 'The MAIN model: A heuristic approach to understanding technology effects on credibility'. *Digital media, youth, and credibility*, vol. 73100.

Sundar, S. S., A. Oeldorf-Hirsch, and A. Garga (2008): 'A cognitive-heuristics approach to understanding presence in virtual environments'. In: *PRESENCE 2008: Proceedings of the 11th Annual International Workshop on Presence*. pp. 219–228.

Thomas, D. R. (2006): 'A general inductive approach for analyzing qualitative evaluation data'. *American journal of evaluation*, vol. 27, no. 2, pp. 237–246.

Titzmann, F.-M. (2013): 'Changing patterns of matchmaking: The Indian online matrimonial market'. *Asian Journal of Women's Studies*, vol. 19, no. 4, pp. 64–94.

Toma, C. L. (2010): 'Perceptions of trustworthiness online: the role of visual and textual information'. In: *Proceedings of the 2010 ACM conference on Computer supported cooperative work*. pp. 13–22.

Tu, K., B. Ribeiro, D. Jensen, D. Towsley, B. Liu, H. Jiang, and X. Wang (2014): 'Online Dating Recommendations: Matching Markets and Learning Preferences'. In: *Proceedings of the 23rd International Conference on World Wide Web*. New York, NY, USA, p. 787–792, Association for Computing Machinery.

WALTHER, J. (2001): 'Is a Picture Worth a Thousand Words? : Photographic Images in Long-Term and Short-Term Computer-Mediated Communication'. *Communication Research*, vol. 28, no. 1, pp. 105–134.

Walther, J. B. (1993): 'Impression development in computer-mediated interaction'. *Western Journal of Communication (includes Communication Reports)*, vol. 57, no. 4, pp. 381–398.

Williams, E. (1977): 'Experimental comparisons of face-to-face and mediated communication: A review.'. *Psychological Bulletin*, vol. 84, no. 5, pp. 963–976.

Xia, P., B. Liu, Y. Sun, and C. Chen (2015): 'Reciprocal Recommendation System for Online Dating'. In: *Proceedings of the 2015 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining 2015*. New York, NY, USA, p. 234–241, Association for Computing Machinery.

Zhang, G. (2014): 'Can you marry me?: Conceptualizing in-game marriage as intimacy-mediated collaboration'. In: *Proceedings of the companion publication of the 17th ACM conference on Computer supported cooperative work & social computing*. pp. 273–276.

Zytko, D., G. Freeman, S. A. Grandhi, S. C. Herring, and Q. G. Jones (2015): 'Enhancing evaluation of potential dates online through paired collaborative activities'. In: *Proceedings of the 18th ACM conference on computer supported cooperative work & social computing*. pp. 1849–1859.

Zytko, D., S. A. Grandhi, and Q. Jones (2014): 'Impression Management Struggles in Online Dating'. In: *Proceedings of the 18th International Conference on Supporting Group Work*. New York, NY, USA, p. 53–62, Association for Computing Machinery.