Virtual Diagnostic: Using Game Behaviors During Immersive Role-Playing for Clinical Assessment of Fear of Intimacy

Yijun, Qian[1]*

College of Computing and Informatics, Drexel University, sq68@drexel.edu

Luoying, Lin

Southeast University, llyyy@seu.edu.cn

Zhimeng, Wang

Beijing Normal University, 202028061042@mail.bnu.edu.cn

Xin, Tong

Duke Kunshan University, Xt43@duke.edu

RAY LC

School of Creative Media, City University of Hong Kong, LC@raylc.org

Fear of intimacy causes loss of human connections and sabotages relationships, affecting over 2.5% of the population, yet its diagnosis is difficult due to the need for clinicians to get close to the subject emotionally before making valid individualized assessments. These difficulties are particularly daunting in prolonged isolation, due the worsening of anxiety and unavailability of clinicians. To design more comprehensive and feasible strategies for assessing fear of intimacy, we turned to a Virtual Reality (VR) paradigm using role-play scenarios to evaluate the in-game behavior of subjects, including decisions-making, distance-to-a-character, and biometric data. We found that certain behaviors in VR correlated with established fear of intimacy and anxiety scales, providing tools that allow us to identify high risk individuals, and data for more comprehensive individualized analysis. This VR diagnosis paradigm also provides insights about patient populations, and strategies for designing immersive clinical interventions.

CCS CONCEPTS • Human-centered computing • Human computer interaction (HCI) • Virtual Reality

Additional Keywords and Phrases: Fear of Intimacy, Virtual Assessment, Adult, Attachment, Serious Games.

ACM Reference Format:
Yijun Qian, Luoying Lin, Zhimeng Wang, Xin Tong, Ray LC. 2021. Virtual Diagnostic: Using Game Behaviors During Immersive Role-Playing for Clinical Assessment of Fear of Intimacy: ACM Conference Proceedings Manuscript Submission Template. In New Orleans'22: ACM CHI Conference, April 14–15, 2022, New Orleans, LA. ACM, New York, NY, USA, 20 pages.

---

[1]* Place the footnote text for the author (if applicable) here.

1 Introduction

Fear of intimacy is an avoidant personality disorder involving anxiety in intimacy settings. Individuals with fear of intimacy have difficulty in becoming physically or emotionally close to another individual[36]. About 2.5% of the population is affected by fear of intimacy and avoiding closeness in relationships. In Western cultures, the total percentage of adults can reach up to 17%[20]. Studies have revealed that fear of intimacy increases the difficulty for individuals to build and maintain close relationships with others, and this causes further negative consequences, such as chronic pain, physical illnesses, breast cancer, depression, and alcoholism and job failure due to a lack of effective social support [30,31,34,38]. Researchers have found that participants with high-fear levels of intimacy are more likely to have low self-esteem, depression, anxiety, emotional suppression, and psychological disorders and are more vulnerable to injury or disease[26,27].

Assessment prior to intervention treatment is a crucial part of ensuring that the intervention is effective[24]. The advantage of clinical interview diagnosis is that it encourages more self-disclosure and provides an adequate information base subsequent intervention[22]. However, the clinical diagnosis in practice takes couple of sessions, mainly determined by the nature of difficulty of building that relationship with patients with intimate fear [13]. The commonly used Fear of Intimacy Scale[9] has been proven valid by multiple sources but lacks a self-representation component. In the past several years, several works have revealed the approach-avoidance tests(AATs) in VR and showed the potentials of virtual reality (VR) to reenact ecologically valid social encounters in a strictly controlled environment [2,20]. VR also has its ability to control the exposure dose and stimulus presents the opportunity to conduct exquisitely controlled clinical and experimental research[17].AATs mean to stimuli people finish a specific task in an environment where includes hypothesis stressor. High fear-of-intimacy individuals desire intimacy but their fear of rejection keeps them from developing and maintaining close relationship[32], AATs seems an ideal strategy to detect people's fear to closeness but few studies explore the efficiency of using AATs in VR to assess the fear level. Behavioral Assessment Tasks (BATs), the systematic study and evaluation of an individual's behavior, is another frequently mentioned measurement strategies with AATs[11], and there is study approved that experiential avoidance can be predicted by using BATs in a VR social situation[19]. But few VR studies have been conducted to explore the efficacy of BATs in VR to detect fear of closeness in an intimate scenario, there is where our study comes out. Some questions remain to explore, such as whether avoidant behaviors in VR game associate with high level of fear of intimacy? Can a virtual romantic partner encourage participants to self-disclose so clinicians can have more information from those individuals?

Building upon the avoidance theory[3] in the context of intimacy fear, and past work in exploring the potential of VR to detect anxiety by assigning approach-avoidance tasks (AATs), we developed a VR game that assesses fear in simulated intimacy environments (living room and bedroom scenes) with a virtual partner. No specific tasks are offered to participants to complete, but their within-game behavioral responses towards certain interactions, such as their willingness to get closer to the virtual partner, are monitored. Our design aims to explore the possibility of using VR to simulate a natural environment to assess the fear level that patients have in a real intimate scenario as a complement to clinical assessment tools. Our study was guided by the follow research questions:

RQ1. Do participants' behavioral choices, actions in play, physiological indicators, and verbal responses in each VR environment can reflect their level of intimacy fear?

RQ2. How can specific scenarios in VR capture and reflect the participants' fear of intimacy during play?

To investigate these questions, we did the following: We examined past studies that have VR games designed for similar psychological symptoms, such as social anxiety disorder. We generated design concepts and determined the rationality of the scenario design with a clinical counselor. We recruited participants and

scaled their fear of intimacy score by a standard assessment questionnaire, then compared the correlation between participants' propensity to respond to in-game scenarios and their Fear of Intimacy Score (FIS)[8] through a laboratory experiment.

The current behavioral assessment methods showing it is a challenge to assess people's intimate behavior in a natural intimate environment. This study presents VR not as treatment intervention, but rather as a behavioral assessment tool to simulate an intimate environment diagnosing the disorder of fear of intimacy. This provides the clinicians and researchers easier-to-obtain, more comprehensive sources of information to improve and make better treatment decisions for potential patients. We also discuss recommended assessment and treatment strategies based on our interviews with participants using the VR prototype, creating a toolkit for game tasks, evaluation, and treatment strategies for anxiety related disorders.

2 Related Work

2.1 Conventional Measurement Methods

The clinical assessment methods[11] in fear of intimacy include self-report questionnaires, diagnostic interviews, and clinician-administered instruments, and behavioral assessment[1,35]. The Fear of Intimacy Scale(FIS), a self-report measure developed by Descutner and Thelen(1991) is used widely to determine an individual's level of fear of intimacy, and multiple studies have approved the FIS to be a reliable resource to assess the anxiety and fear in close relationships[8,9,12,32].The FIS has its advantage in assessing intimacy in a broader cross-section of participants because it is designed to be used as the instrument regardless of the participant's current relationship status. Nevertheless, indirect evidence shows that the questions asking for reflections on actual behaviors are better predictors than imagined ones[15].

Diagnostic interviews, such as semi-structured and structured clinical interviews, assist with differential diagnosis and evaluation of comorbid elements, important for a comprehensive psychosocial assessment. However, these interviews involve social contact and self-disclosure, which sometimes produces significant anxiety for the patients. One of our interviewers, a clinical psychologist, mentioned that part of the challenge was to build up the relationship with patients and let them disclose their past experiences. She says, "Many patients are sensitive and do not trust people easily. It takes time to build that relationship between patients and us so we can hear the comprehensive story to assess their situation accurately." [14]. In addition, the communication-driven method can hardly quantify the fear level, and psychologists mainly depend on their feelings to categorize the patient into different fear levels. Sometimes the assessment can be up to 4 weeks before they conduct an intervention to patients due to the nature of the process.

Behavioral assessment strategies are increasingly used in clinical practices. McNeil, Ries, and Turk's work[24] have a comprehensive review of Behavioral assessment tests (BATs,) which represent a useful assessment strategy by allowing direct evaluation of body movements and behaviors in using all modes of response using multiple methods. Those include role-play tests, avoidance, and physiological measures, so regard as a comprehensive BAT assessment. As McNeil (1995) mentions in his work, measurement of physiological processes is an extremely important part of the behavioral assessment of social anxiety and subtypes of social phobias, such as fear of intimacy[24]. However, most research has focused on the stimulation or social challenge in the laboratory, with very little attention paid to psychophysiological assessment in the natural environment. This might be due to the difficulty of capturing the data in patient's everyday biases. More work needs to be done to bring the motoric, physiological assessment, and BATs strategies into the mainstream of clinical research and practice[24].

2.2 Attachment Theory and Avoidant Behavior

Hazan & Shaver revealed the adult relationships are relevant to the early attachment experience. As attachment is used here, it refers to an abiding emotional bond between particular individuals[3]. The attachment theory developed by Bowlby, Ainsworth, and other theorists, has been used as the framework to explore the questions, such as how to conceptualize the avoidance of closeness, the different existing forms of avoidance, and the relationships between defensiveness and avoidant behaviors. In Bartholomew's work, she explored the emotional and interpersonal ramifications of two styles of adult avoidance, and the thesis of avoidant attachment in children has been expanded to understand the adult avoidance of intimacy[3]. For example, researchers separated infants from their care provider under the Strange Situation[13]. Upon reunion, children typically display strong avoidance, including physical avoidance and apparent lack of recognition of the attachment figure. Gottman & Levenson (1988) found a similar pattern in men who are in unhappy marriages practicing emotional withdrawal to avoid interpersonal conflict. That strategy of inhibiting the expression of negative affect is called 'stonewalling,' which bears a similarity to the avoidant infants in the Strange Situation. Bartholomew proposes that adult avoidance of intimacy roots in early childhood experiences in which emotional vulnerability comes to be related to the rejection from the primary care provider[3]. Research studies the influence of attachment style on romantic relationships, they found for both men and women the anxious and avoidant styles were associated with less frequent positive emotions and more frequent negative emotions in relationship[33]. Adapted by those, it gives us concepts of observing avoidant behavior in VR game might be helpful in measuring if an association between individual's avoidance level and fear of intimacy exists.

2.3 VR and Game Design for Social Anxiety

VR is a potential diagnostic tool for social anxiety disorder[7,21]. There are several previous studies that have attempted to assess social anxiety in VR environments. In the context of assessing approach, a variety of methods have been used to assess social anxiety in VR, such as self-reporting[19] and behavioral assessment[20]. For example, one study recruited individuals with high anxiety and observed their gaze and head movements when a virtual agent was approaching. The result shows that high socially anxiety performed a complex pattern of avoidance behavior[36]. However, most studies only evaluate the anxiety level from a single dimensional perspective. For example, one study looking at avoidance parameters (movement time and speed, distance to social stimulus, gaze behavior) during whole-body movements in VR environment to reflect participants' approach and avoidance behavior[20]. Most of study were restricted to using self-report for investigate avoidance[28]; some works do focus on behavioral in VR[16,23] but only use behavioral measurement to access social anxiety level[7].

As for scenario designing, the most seen approach is to exposure participants to a scene, which easily motivate their anxiety. For example, one study designed two scenes—— standing at a bus stop and attending a foreign language class to trigger participants' fear of small talk with unknown people and the fear of speaking in front of others[19]. It is worth mention that not only VR scene can trigger social anxiety, 360-Degree Videos in VR can also achieve this goal[40].However, instead of providing a chance for participants to explore the scene by themselves, most studies let participants to perform specific tasks in VR, which may limit their Presence in the environment. For instance, a previous study let participants to see a written instruction explaining what they have to do during the VR environment[19]. But we can still learn from this work that this experiment tries to raise the sense of anxiety and increase the sense of immersion by letting the participants speak in the scene.

In addition to anxiety assessments done in VR, there are also some studies that assess through other digital approaches. Such as the assessment system based on Passive Smartphone Sensors[16] ,and an assessment system based on a 3D game[18].

3 Game Design

3.1 Design Research

We began the design process by speaking with local clinicians about how fear of intimacy is assessed in clinical setting. To our surprise, full assessment requires months of interaction with subjects due to the need to get close to subjects before they would divulge personal info[14]. Ironically fear of intimacy is the inability to get close to others, including psychologists, so the process becomes very labor intensive. One key component in the assessment process involves judging the presence of the subject. Despite initiating the clinical process, subjects would often be absent or fail to speak meaningfully during the interview. Clinicians also use whether the subject would skip appointments to assess their level of anxiety, often taking 3-5 years to get to the meaningful communication stage[14]. Some common problems during the clinical process include:

(1) Subject not saying something because they are afraid of the probing attitude taken by the clinician[25].

(2) Subject not saying something meaningful because the conversations are too casual as opposed to probing.

(3) Lack of safety due to having to divulge personal stories, leading to stagnation.

(4) Frequently switching topics so that no meaningful exchange is fostered.

Based on these findings, we surmised that a VR application would eliminate the need for drawn-out clinical assessment, using in-game behaviors instead to assess difficult to probe questions in a role-play setting. Thus, we designed a VR game that duplicated the core module in Strange Situation Experience[13] from separation to reunite. A quarrel scenario will be shown to players since argument is a pervasive symbolic activity that occurs in many social context[4,29]. In this VR game, participants can walk around the virtual room and pick up certain objects, and participants will hear spatial audio, which clearly indicates a couple is arguing with each other. After the players enter the game, narrator will lead them to imagine they are playing a role in a romantic relationship with their virtual partner. Even if there are no specific tasks for participants, their choices within the game will push the story going in different directions, the ending of the story can either be relationship fixing or deterioration. We designed three scenes with different purposes: a living room to assess the initial intimacy and get participants used to navigate in the game, a quarrel audio[4] scene to activate the fear, and a bedroom to evaluate participants' behavioral responses. We also designed a section to encourage participants to self-disclose and record their verbal responses for further analysis.

We develop two versions, one with female virtual partner, one with male virtual partner, so that participants can choose the gender of their virtual partners.

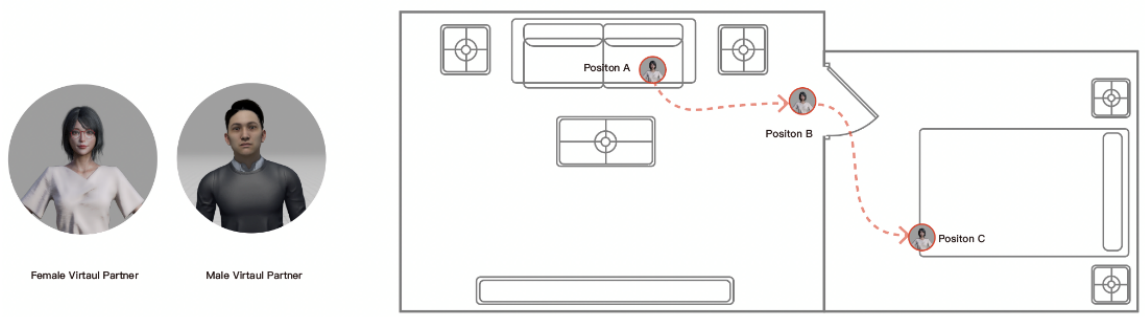


Figure 1: Left Two Virtual Partner Models, female version and male version. Right, the overview of the virtual environment and the virtual partner's trail in the environment (take female virtual partner version for example).

3.2 **Environment Design**

We develop the experimental environment by using the Unity Game Engine and Oculus Quest 2. The models we use are downloaded from the Unity Asset Store. Character animations in the test are generated by Mixamo (a library created by Adobe, which has thousands of full-body character animations, captured from professional motion actors).

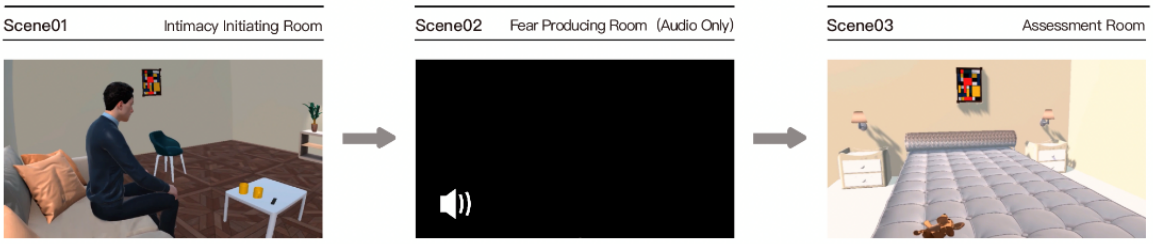


Figure 2: We design three scenes for the this study. The first scene is a living room, to assess the initial intimacy and get participants used to navigate in the game. Then we give participants an all-black environment with quarrel audio only, to activate their fear. The last scene is a bedroom. We design some assessment sections in this scene to evaluate participants' behavioral responses.

3.2.1 *Intimacy Initiating Room*

The participant would be placed in a living room and sitting with a virtual partner when the participant entered the VR game. There are two purposes in this living room scene: First, increasing participant's familiarity with VR operation and the environment. They would be given enough time to use controllers to self-navigate in VR. Second, assigning the role to participants. The background of the story is set up, and a narrator would tell them to imagine they are in a relationship with their virtual partner. Then a user interface will pop up in front of the participants asking them to choose how close they think their psychological distance with the virtual partner is.

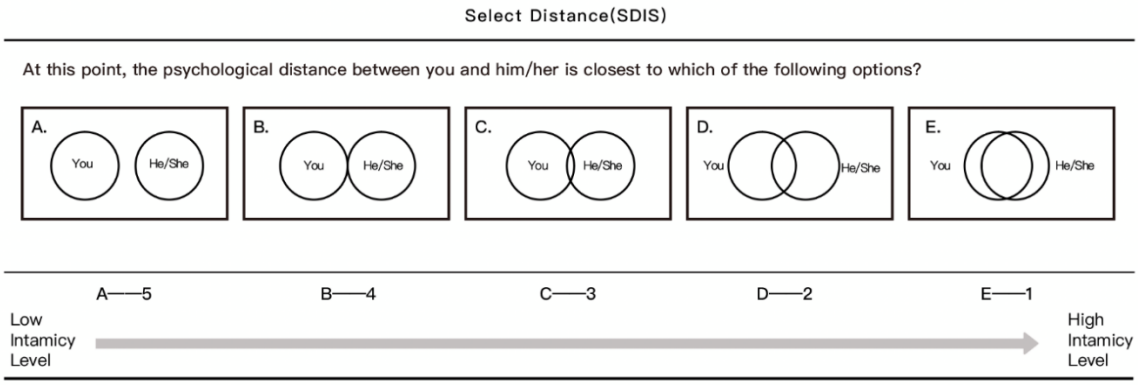
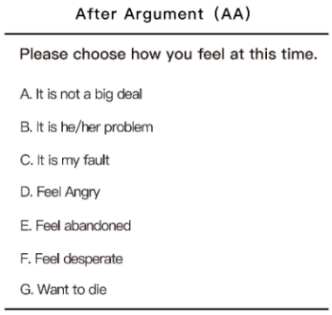


Figure 3: Shows the content of the pop-up asking for the psychological distance between the participant and the virtual partner, with 1 representing high intimacy and 5 representing low intimacy. Reference from the Inclusion of Other in the Self (IOS) Scale (Arthur, et al. 1992).

3.2.2 *Fear Producing Room*

The purpose of the Fear Producing Phase is that we want to examine the participants' fear level and feelings while they are listening to a quarrel, which commonly occurs in any romantic relationship. Participants can hear a couple arguing with each other, and a door closing sound will occur after the argument. A user interface will also pops up asking participants' feelings about the argument.



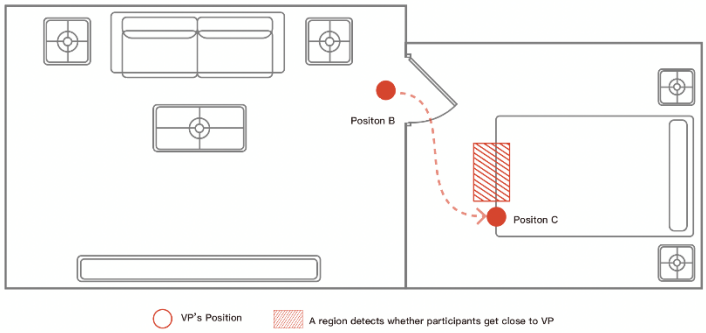


Figure 4(Left): Shows the content of the pop-up asking for participants' feelings about the argument.

Figure 5(Right): In the sitting down section, the virtual partner comes into the room (from Position B to Position C). Then sits down on the bedside (Position C). The stripes area means the region to detect whether participants get close to the virtual partner. If participants enter this region, they can choose whether to sit down beside the virtual partner or not.

3.2.3 *Assessment Room*

Observation of participants' responses in both behavior and verbal responses are our main goals in this Assessment Room. After the quarrel audio, participants will be placed in a real-world scaled bedroom. A door knocking sounds come from behind the door, and participants can go open the door by interacting with the door handle or choosing not to act. After the door opens, the virtual partner will initiate the conversation and participants will be asked to select their response that mostly represents their reaction in the real world to the

virtual partner. After selection is made, the virtual partner will walk toward participants and sit on the bed to talk with participants, then they are encouraged to self-disclose their thoughts about the argument.

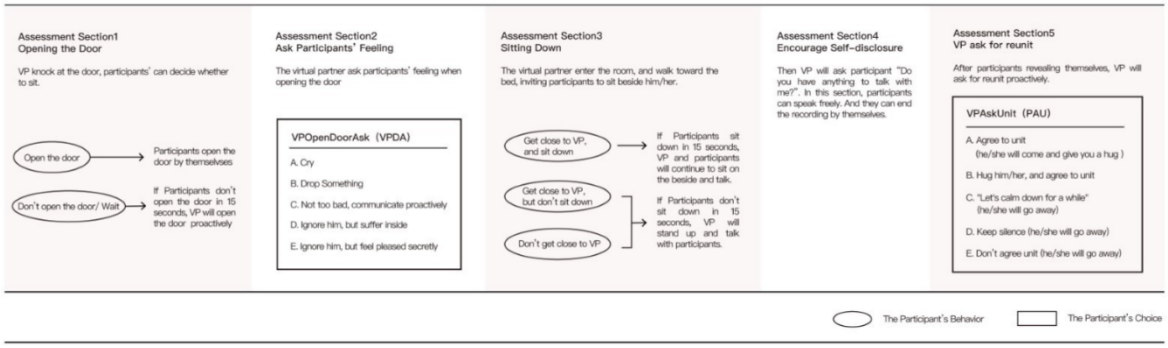


Figure 6: The sequence of assessment sections in scene03. VPDA - the choice after seeing the virtual partner open the door, representing the participant's level of avoidance of the virtual partner's active approach behavior. PUA, the choice after virtual partner seek makeup, representing the participant's level of avoidance of the virtual partner's active approach behavior.

3.3 **Interaction Design**

In the VR environment, participants not only can walk around the virtual space by using the controller, they can also walk by walking in their real physical space. In the experiment, there are some questions need participants to make choices in the VR interface. We pop up the dialog box of the question when the story proceeds to the corresponding episode. Participants can make a choice by controller. The pop-up window disappears after participants complete the selection, and participants' choice will affect the development of the story. What's more, participants can do physical interaction with objects in VR. For example, in the first scene, participants can pick up the TV remote control and cups on the table.

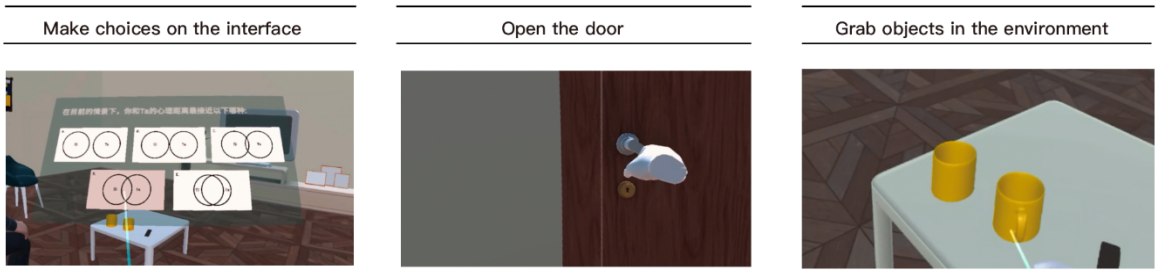


Figure 7: Physical interactions in our VR environment.

In the scene3, we design two special sessions, opening the door and sitting down, in order to explore the correlation between participants' behavior and their intimacy fear level. In the door opening session, when the virtual partner knocks at the door, participants can choose whether to walk toward the door and open it by reaching its handle. In the sitting session, when the virtual partner comes into the bedroom, sits on the bed and invites participants to sit down, we detect whether participants get close to the virtual partner. If participants get close to the virtual partner, they can choose whether to sit or not, and if they choose to sit down, their perspective will switch to the sitting perspective. (Figure 5) We also design a session for

participants to express themselves. Towards the end of the test, we let the virtual partner ask participants "Do you have something to say to me", thus triggering participants to reveal themselves by free-form speaking.

3.4 Measurement

(1) We collect the virtual partner and the participant's world coordinate per second, in order to trace participants' path and analyze the distance between the virtual partner and the participant. (2) We collect whether participants finish the behavior we designed (described in previous paragraph, opening the door and sitting down. We also record the time taken to complete the corresponding action. (3) We record options selected by participants in the VR environment. (4) In the recording session, we record what participants say to the virtual partner.

4 Method

4.1 Participant

A total of 38 university students (26 women, 12 men) aged 19-37(M=23.1, SD=3.17) were recruited. All participants are normal or corrected vision, no major physical or mental illness, and good concentration and execution skills, and provide representative sample of the student population. All participants were paid RMB 20 at the end of the experiment.

4.2 Questionnaire

The Fear of Intimacy Scale (FIS)[9] was used to assess the participants' level of intimacy anxiety. The FIS has no subscales and has only one dimension, and the internal consistency reliability of the scale was 0.93 and the retest reliability was 0.89. The Adult Attachment Scale (AAS)[6] be used to measure adult attachment, particularly for the assessment of adult intimacy and partner relationships. It consists of 18 questions and is divided into two dimensions: Close and Depend (AAS-CD) and Anxiety（AAS-A). The Presence Questionnaire (PQ) [37]was used to assess participants' sense of presence in the VR environment. It has good reliability and validity and consists of 29 items, including involvement, sensory authenticity, adaptation, and interface quality.

4.3 Experimental Setup

We used Unity to build up our game and test game on Oculus Quest 2. A BIOPAC system, Inc MP160 physiological polygraph was used to detect and record the pulse rate by photoplethysmography (PPG) and electrodermal activity (EDA) of the participants before and during the VR experience. One PPGEDA amplifier, one pulse connection cable, one LEAD110S shielded lead, one LEAD100A unshielded lead and two disposable patch electrodes were used.

4.4 Procedure

Participants completed the FIS during the recruitment phase and subsequently completed the informed consent form and AAS once they were in the laboratory. The MP160 physiological polygraph was fitted to the participant: the surface of the fingertip of the left hand was first wiped with alcohol pad. (1) PPG acquisition: fix the pulse connection cable to the participant's left index finger; (2) EDA acquisition: attach disposable patch electrodes to the little and ring fingers of the left hand, with the electrodes connected in such a way that VIN+ and VIN- are the positive and negative signals of the EDA signal. After wearing the physiological apparatus, the physiological data was first collected for 5 min, followed by an explanation of the buttons and operation of

the VR handle, followed by wearing the VR headset, adjusting the tightness of the headset and ensuring that their field of vision was clear and free from blur. The participants experienced the VR scenes for 5-10min. The VR equipment, physiological instruments and patch electrodes are removed for the participants when the experience was complete, they filled in the Presence Questionnaire if they were in good condition, or they had a short break if they were uncomfortable.

4.5 Behavioral Measurement

Our data collections include in-game behavioral and verbal responses data, biometrics, and psychological data. In-game data are used to answer RQ1 to examine the existing correlations between participant's behaviors choices and avoidance tendencies. Pre-measured and post-measured biometrics data are compared to examine if our game design can produce fear in certain game scenarios (RQ2). We use psychological data Pre-FIS score from individuals comparing in-game behavioral data to benchmark the effectivity of assessment tasks in our game. The in-game behavioral data was divided into three categories of data: Behavioral response, Player-agent distance, and in-game audio recoding: (1) Behavioral responses after interacted with virtual partner (VP), those categorical data includes Selecting psychological distance between VP(SDIS), Asking participants' feelings after argument audio(AA), VP asking participants after door open(VPDA), VP asking participant to makeup the relationship(PAU). as shown below, in addition to scenes options that include whether to choose to open the door(Open Door Event), whether to sit near virtual partner (Sit Down Event,) (2) Physical distance: the average distance between the participant and the virtualized partner during the overall VR experience. (3) Audio: Participants' words to virtual partner were recorded, and the time and number of words spoken were counted.

For AA, SDIS, VPDA, PAU, we scaled participant's responses from 1-7(AA), or 1-5(SDIS, VPDA, PAU), which indicates different level of avoidances tendencies, and we use One-way Anova analysis to investigate the differences between individuals' anxiety level (AAS-A), and close & depend level(AAS-CD). Multiple comparison was assessed (Tukey) if significance was found in the Anova. The Kruskal-Wallis test are introduced on analyzing AA, VPDA, PAU and SDIS due to the non-normal distribution of FIS. We applied T-test on Open Door Events and Sit Down Events on AAS-A and AAS-CD because the two measurements are normally distributed (Shapiro-Wilk). For FIS (not normal, Shapiro-Wilk), Wilcoxon test in conducted on these Events.

Other hypothetical avoidance parameters, such as the maximum and minimum distances between individuals and virtual partners are also collected. We used regression analysis to explore the relationships between the movements and their fear of intimacy score (FIS).

4.6 Biometrics

The Electrodermal Activity (EDA) and Wire Photo Plethysmogram (PPG) data were both pre-processed through Acqkowledge 5.0. For EDA, the processes are (1) Comb filtering: select Digital Filters/Com Band Stop option under Transform menu, then input 50HZ at Base Frequency. (2) Low Pass filtering: select Digital Filters/IIR/Low Pass option under the Transform menu and input 35HZ. Secondly, about 3min data were selected as the focus area in the resting state and VR scene experience physiological. The steps in cleaning PPG are similar to EDA: (1) Comb filtering: Select the Digital Filters/Com Band Stop option under the Transform menu, then enter 50HZ in Base Frequency. (2) High Pass Low Pass filtering: Select the Digital Filters/IIR/Band Pass Low and High option under Transform menu, and then input 0.05 and 10HZ in Low Freq and High Freq respectively. Secondly, about 3min data were selected as the focus area in the resting state and VR scene experience physiological. Finally, the physiological data were statistically analyzed using SPSS 25 and met the Kolmogorov-Smirnov criterion for normal distribution.

4.7 Verbal Data

To interpret participant's verbal responses in VR games and participants post-interviews, we interpret the qualitative data by using Ground Theory[5], a systemic methodology analyzing qualitative data. The researchers firstly exported audio-based data into transcripts and imported them to Nvivo 12, a qualitative data analysis software. The results of the data obtained from the participants' in-game recordings or interviews were discussed with the team until all members agreed on the classification and interpretation of the analysis. We categorized participants' responses into two core concepts: positive confrontation, which put fixing the relationship as the main goal; negative confrontation, which the conversation or behaviors potentially push the relationship away. It is worth noting that some of the participants' responses contained both positive and negative tendencies. Our approach to classify the responses is based on our interpretation on the ultimate outcomes of the impact on intimacy whether to be negative or positive. We have the examples from two participants:

> *P2: "And now I feel so wronged… but I don't really want to talk."*
> *P6: "It's ok to lose your temper but walking out of the house is so wrong. I think we should have a talk."*

In the case of P2, this participant expressed her feeling, which could be interpreted as a positive tendency, but the last part of her response shows a strong avoidant behavior in communication. Overall, the response is negative because communication cannot be achieved, and the relationship problem remains. In P6's case, even the participant blamed the virtual partner's behavior, but this participant expressed her desire in communicating, which was generally positive.

4.8 Post-game VR Experience Interview

To further understand the participants' experience in VR and the assessment effect of intimate fear. 39 participants in the experiment filled out the Presence Questionnaire after experiencing VR, and subsequently, we invited four participants to a follow-up semi-structured interview. Since our overall samples are mainly medium level intimacy fear and medium-high level intimacy fear, we took one male and one female from the medium fear sample and one male and one female from the medium-high fear sample. In the interview section, we focus on understanding participants' sense of substitution during the VR experiment. And we further discuss factors affecting their sense of substitution.

5 Results

5.1 Correlations between Fear Level and In-game Behavior

We present the results of our analysis on the whole sample first, and the exact tests we used have been descripted in section 4.5. Table 1 data does not show any relationships between individuals' psychological data (FIS, AAS-CD and AAS-A) and their in-game behaviors or choices. The only significant finding is that people's feelings after hearing the argument video are associate with Close and Depend Score. However, if we break down the results by the gender, two interesting findings emerge (Table 2). Under the scenario of virtual partner is sitting with the player, there is a correlation between the mental distance they report and their anxiety level; in male group, a significant difference has been found between the individuals who select 'agree to make up' and 'hug and agree to make up.'

Table 1. The correlation results for the Fear of Intimacy and In-game Behavioral Data

N=38		**Distance to Virtual Partner (VP)**			**In-game Behavioral Events**				
		Max Distance M=2.91 SD=0.38	**Min Distance** M=0.43 SD=0.20	**Open Door for VP** (Yes/No)	**Sit with VP** (Yes/No)	**AA** M=3.00 SD=1.54	**SDIS** M=3.50 SD=1.13	**VPDA** M=1.53 SD=0.98	**PAU** M=1.87 SD=0.96
All	**FIS** M=113.5 SD=11.21	p=0.1627	p=0.8251	p=0.8897	p=0.7224	p=0.3022	p=0.3071	p=0.06585	p=0.07488
	AAS-CD M=4.16 SD=0.53	p=0.5595	p=0.6099	p=0.3788	p=0.1187	**p=0.0349***	p=0.1668	p=0.9412	p=0.2993
	AAS-A M=4.43 SD=1.29	p=0.5712	p=0.635	p=0.3736	p=0.5519	p=0.0597	p=0.104	p=0.0731	p=0.137

[a] FIS means Fear of Intimacy score based on FIS scale; AAS-CD (Close and Depend) and AAS-A(Anxiety) are two dimensions of the Attachment Anxiety Scale. *p<0.05, **p<0.01, ***p<0.001. AA: the feelings after Argument; VPDA: the choice after seeing the virtual partner open the door, representing the participant's level of avoidance of the virtual partner's active approach behaviors; PUA: the choice after virtual partner seek makeup, representing the participant's level of avoidance of the virtual partner's active approach behavior .SDIS: the psychological distance of the participant from the virtual partner in the VR game, with 1 representing high intimacy and 5 representing low intimacy, referenced from the Inclusion of Other in the Self (IOS) Scale (Arthur, et al. 1992). MDIS: the average distance between the participant and the virtual partner during the overall VR experience.

Table 2. Subgroups Study: The correlation results for the Fear of Intimacy and In-game Behavioral Data

		AA	**SDIS**	**VPDA**	**PAU**
Femal	FIS	p=0.4838	p=0.2242	p=0.1174	p=0.3676
	AAS-CD	p=0.5298	p=0.1456	p=0.6974	p=0.8894
	AAS-A	p=0.124	**p=0.00528****	p=0.0717	p=0.917
Male	FIS	p=0.7085	p=0.297	p=0.1424	**p=0.02807***
	AAS-CD	p=0.4892	p=0.1054	p=0.3718	p=0.9545
	AAS-A	p=0.9	p=0.896	p=0.764	p=0.379

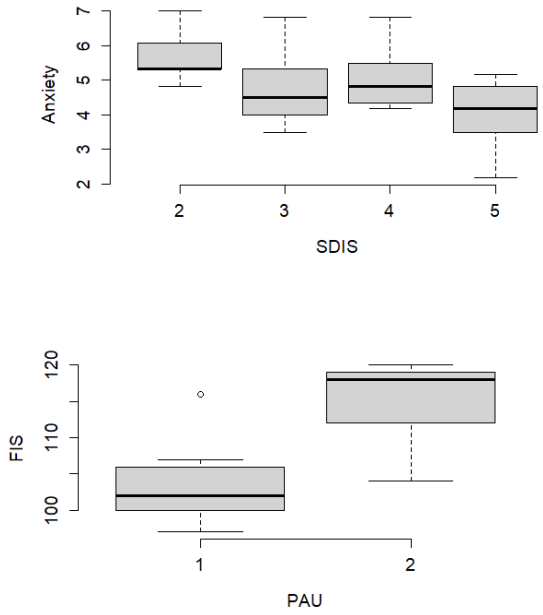


Figure 8. (Left) Female group's boxplot (Anxiety-SDIS). In multiple comparison, only the 2 vs 5 condition is significant (Tukey HSD p= 0.0178*). (Right) male groups' boxplot (FIS-PAU).

Table 2 shows two significant differences on our subgroups study. While in the scenario of female players sitting with virtual partners, there is a relationship between their feeling of psychological distance with their partner and their anxiety (F value=9.412, df=1, p=0.00528*). We found a significant difference in anxiety levels between females who feel "very close" and who feel "normal close" (diff-1.6561, lwr=0.2417, upr=3.0706, p=0.01781) by conducting a Tukey HSD test. Another finding is, male participants' choices in responding if they want to make up the relationship with their virtual partner (PAU) associate with their fear level (chi-sq=4.8235, df=1, p=0.02807). Out of 5 choices, 58.3% male choose "agree to make", and the rest of them chose "Hug and agree to make up." None of them do not agree to fix to relationship.

5.2 Differences in FIG groups

While we did not find differences in FIS score in the aggregate result, we reasoned that FIS scores are used to separate subjects into those at high-risk for fear of intimacy vs. those who are not [15].Thus we divided subjects based on FIS score range. Given the range of our FIS scores for a representative student population, we divided the scores into ranges based on standard deviations above and below the average FIS score [15], This produces three groups of 'Below Average'(N=10), Average'(N=17) and 'High Risk' (N=10), based on their reported fear level. We want to explore if people in those FIS groups performed differently toward the same game tasks, so we performed an ANOVA of the in-game behaviors (SDIS, AA, VPDA, and PAU) against the FIS groups.

Table 3: Descriptive statistics for FIS and AAS in groups

FIS Below Average	**FIS Average**	**FIS High Risk**
N=10	N=17	N=10

	M	SD	M	SD	M	SD
FIS	101.9	2.88	111.39	3.43	125.00	7.94
AAS-CD	3.75	0.35	4.22	0.43	4.34	0.57
AAS-A	3.47	1.13	4.61	1.30	4.90	0.92

Due to the non-normal distribution of the data, Kruskal-Wallis test was conducted on AA, VPDA, PAU and SDIS. The Kruskal-Wallis test showed that there was a significant difference between FIS groups (Below Average, Average, and High Risk) in PAU, M=6.588, df=2, p=0.037. Further multiple comparisons (Dunn test) revealed a significant difference in PAU between Average and High FIS groups, M=-2.555, df=1, p=0.032. In addition, due to the normal distribution of the data, one-way ANOVA was conducted on mean distance, length of speech and number of words, there were no significant differences between FIS groups.

For the biometric measurements, the count of Skin Conductance Response during and VR scene experience correlates with in-game audio recording time and words counts. A one-way ANOVA showed significant difference in the count of Skin Conductance Response under sexual orientation (the gender of the lovers or ideal lovers), $F(1,15)=5.659$, $p=0.032$, also was found. In addition, there were significant differences in Anxiety under SDIS only for females, $F(3,22)=3.685$, $p=0.027$.

5.3 Verbal Data in VR

We analyzed 31 out of 38 total participants' in-game audios responding to their virtual partner after they experienced the argument scenario. 7 participants' voice recordings were discarded due to the blurry sounds. 31 participant's voice recordings were translated into text-based documents and imported into Nvivo 12. Based on participants' positive or negative feedback, we categorize them into negative(N) and positive(P) groups. We also calculated the total count of words and length that each participant responded to, then compared that data with the participant's fear of Intimacy score, in-game avoidant behaviors, and biometrics. Nearly 61% of participants (19 out of 31) talked to their partners with positive tendencies, including seeking causes of the argument and offering solutions, initiating a conversation, asking partner's feelings and needs, talking about why they are emotional, sharing their own feelings and self-reflections. About 39% participants (12 out of 31) in the sample group responded to their virtual partner in a way that might potentially affect the relationship in a negative way, such as blaming virtual partners, avoiding communications, and neutral attitude towards the arguments and no actual actions. Some examples:

> *P1(N): "We can talk about, for example, what you are not satisfied with, and is there anything we didn't make clear in our past conversation, all the things we can talk about."*
> *P20(P): "Then tell me why you abandoned me there and left by yourself. You know what you did wrong?"*

We also calculated the total count of words and length that each participant responded to, then compared that data with the participant's fear of Intimacy score, in-game avoidant behaviors, and biometrics. Pearson correlation was measured on the physiological data, and we found high FIS group's the beat per minute during the resting state (BMP0) and audio recording time is significantly correlated ($r=0.823$, $p=0.023$,).

5.4 Design implications

Overall, the result of post-test interview show that VR scenes we built are realistic, appropriately scaled, immersive, essentially free of dizziness, and the options that participants make basically reflect their true

thoughts. We analyze some factors that enhance immersion and some that reduce it from a design and user experience perspective.

5.4.1 Factors that enhance the sense of immersion

(1) Appropriate scale of space and figures

Some participants mentioned that they considered that objects and characters we built in the VR environment are very close to the state we see in our lives because the scale between objects in the VR environment and participants themselves is very harmonious, just feel like we are really standing in a room about the same size as the reality.

(2) Physical interactions in VR

Participants in our VR environment can interact physically, trying to do anything they want to do instinctively. Many participants think that they feel good to opening the door by themselves. Because they can open the door by reaching the handle instead of through the mouse and keyboard, which enhances the sense of immersive in the test.

(3) Low Motion Sickness in VR

VR health-related issues are reported including, but not limited to nauseated feeling, vomiting, dizziness and cold sweats. These issues introduce a well-known side effect termed as motion sickness in VR users[41]. In our test, some participants think that they don't feel any uncomfortable, one participant had strong motion sickness when he experienced VR last year, but for this time, the motion sickness is quite mild and only a little when becoming the end of the test.

5.4.2 Factors that reduce the sense of immersion

(1) The character model is not realistic enough

When we did virtual partners' animation, we only built the animation of their body. Virtual partners can only express their emotions through their body language, without facial expressions. Some participants feel that virtual partners do not look like a real person very much. The virtual partner's voice is okay, but still feel a little difficult when detecting virtual partners' feeling expression. And some participants think that the movements of virtual partners are a little stiffness. Not realistic enough character models may reduce participants sense of immersive in VR.

(2) Personality difference between participant's and role's

We design a quarrel scene to motivate participants' fear of intimacy. However, some participants said they did not feel immersive in this part because they have not been in a fight with anyone.

6 Discussion

6.1 Major Findings

Some of the in-game behavioral data we collected did not directly assess the fear scores of participants, but we demonstrated that in-game behavioral design was reflective of a general fear group (Below Average, Average, and High Risk in FIS) that participants belonged to. We also found that our scenario-specific game designs (SDIS and PAU) captured anxiety differences for women and fear differences for men. This might related to the nature of female are more sensitive to interpersonal relationship in an initiate environment[27].

Our evaluation method involved the participants doing the FIS assessment before experiment then comparing participants' behavioral avoidance choices within the game to see if there was a correlation between the different avoidance choices and the FIS. We found significant differences in the responses of participants in specific fear groups, demonstrating the ability to predict levels of avoidance tendencies based on game behavior.

We found that the maximum and minimum distances to the virtual partner were unrelated to FIS and other anxiety measures, one of the reasons might be our virtual environment is in a small room where does not have much place for participants to move around. The gap between maximum and minimum is not that significant detectable. However, in the results of the data divided into subgroups according to gender (Female and Male), we found that there was a significant difference in the fear scores of males choosing different options when the virtual partner asked for making up. However, whether asking for a compatible interaction scenario can really assess men's intimacy fear level needs to be further studied. The second is that the results of our female participants' choice of psychological distance in intimate settings, sitting with virtual partner, could reflect their anxiety differences. In particular, the difference between female participants who felt they were generally intimate and very intimate was significant. We invited a female high fear participant (FIS=137), whose in-game behavioral avoidance is normal, for a post-experimental interview. The interview revealed that her fear was mainly about her partner's physical contact with herself. And measures of physical fear are included in self-reports such as the FIS. We can see one limitation of our game is that we were unable to assess participants' fear of physical contact intimacy, and this is largely limited by the current technology of VR experiments.

6.2 Innovation in Design

6.2.1 Innovations in game mechanics

As mentioned in 2.3, most previous work let participants to perform specific tasks in VR environment. Instead, we introduce storytelling into our game design. Participants' decisions will affect the development of storyline. We do not give specific tasks to our participants, just let them feel free to explore the environment, aiming to simulate the real-world situation in the VR environment.

One previous work let participants to speak to NPC and conversation agent[10] in therapy to release participants anxiety and enhance their sense of immersive. Inspired by this work, we introduce the section of free-form speaking. Different from the previous work, stimulating the sense of fear is not our goal. We record what participants talk in tests. We try to assess their level of fear by analyzing the verbal data.

6.2.2 Innovations in Assessment approach

As mentioned in 2.3, most previous works only evaluate the level from a single dimensional perspective. In our work, we try to assess the level in a comprehensive multi-dimensional way. The level of intimacy fear is assessed from a combination of biometric data, behavior data and verbal data. And in order to show the validity of our work, we compare the experimental data measured in the VR environment with the scores from classical scales.

VR has its advantages in shorten the assessment process in clinical settings, and it may release the pressure of patients who are shy or anxious to self-disclosure to clinicians for the first time. Rich data could be collected from the VR game, including both qualitative and quantitative, which are helpful for clinicians customize the intervention on individuals.

6.3 Limitation & Future Work

Due to local pandemic policy, we used a convenience sample approach to recruit participants, and this led to two limitations in our sample variety. Our male simple size (M=12) is relatively small compared to the female group(F=26,) and it might affect how our data is interpreted. Second, people with low and high levels of fear of intimacy are excluded in our study, further research on those two groups need to be completed in the future.

Our game only simulated environments that present a romantic relationship, and it may exclude the assessment of people who do not have such intimate experiences. Within the game, only emotional intimacy can be assessed, but in fact, fearing of physical intimate behavior, which are included in the FIS questionnaire. It is a challenge to stimulate a physically intimate environment in a pleasurable way that will not trigger people's trauma or ethical issues. The future work can explore the suggestibility of game elements to measure fear of intimate physical contact. A take away is that our in-game and behavior data shows our game has its potential to probe the fear intimacy without needing to establish rapport and this might let us bypass establishing rapport with some groups who are uncomfortable to communicate and self-disclose to stranger(clinicians). It is worth to mention that the individuals in our sample are in a high range of FIS and anxiety level, so the differences between individuals with low levels of intimacy levels and those with high FIS might not be recognized. This would imply that more of our in-game behaviors may be able to distinguish between high and low FIS values if these lower FIS scores for non-anxious individuals are better represented. We may have more findings when we conduct and compare in-game behavioral differences between two more distinguished groups in the level of fear of intimacy in the future.

7 Conclusion

We explored the potentials of VR as a tool to assess fear of intimacy and avoidant behaviors. We designed a role-play VR game and collected survey data (FIS, attachment style scales) regarding the participants, and attempted to use in-game behaviors to predict the participants intimacy fear levels. We took a research-centered approach to take what clinical psychologists do in the field into a game that assesses the criteria of clinical relevance. Some of these game measurements were able to predict FIS and other anxiety level differences. Moreover, post-interview with participants offers more insights into game designs that affect presence and sense of being in the role. Our mixed research studies have shown the ability to reflect the user's emotional feedback (anxiety and fear) in an intimate scenario without needing laborious and subjective in-person assessment.

This study takes VR application from the traditional realm of exposure therapy to the assessment of the disorder, taking its use case from the traditionally difficult to diagnose disorder of fear of intimacy. We also designed a role-play strategy and used specific behaviors and speaking-to-the-agent in the game to assess the severity and specificity of a subject engaged in play. Since the communicative and choice actions taken by the subject correlate to specific scales that measure different properties like anxiety, fear, and attachment, playing the game provides a more detailed profile of the participant in regards to fear of intimacy assessment. Thus VR works to help clinicians with assessment and detailed information difficult to obtain in person in short time frames, leading to insights ultimately about the treatment interventions themselves.

REFERENCES

[1] Martin M Antony. 1997. Assessment and Treatment of Social Phobia. *Can. J. Psychiatry* 42, 8 (October 1997), 826–834. DOI:https://doi.org/10.1177/070674379704200804

[2] Anu Asnaani, Mike Rinck, Eni Becker, and Stefan G. Hofmann. 2014. The Effects of Approach–Avoidance Modification on Social Anxiety Disorder: A Pilot Study. *Cogn. Ther. Res.* 38, 2 (April 2014), 226–238. DOI:https://doi.org/10.1007/s10608-013-9580-x

[3] Kim Bartholomew. 1990. Avoidance of Intimacy: An Attachment Perspective. *J. Soc. Pers. Relatsh.* 7, 2 (May 1990), 147–178. DOI:https://doi.org/10.1177/0265407590072001

[4] Daniel J. Canary, Harry Weger, and Laura Stafford. 1991. Couples' argument sequences and their associations with relational characteristics. *West. J. Speech Commun.* 55, 2 (August 1991), 159–179. DOI:https://doi.org/10.1080/10570319109374377

[5] K. Charmaz. 2014. *Constructing Grounded Theory*. SAGE Publications. Retrieved from https://books.google.com/books?id=v_GGAwAAQBAJ

[6] Nancy L. Collins and Stephen J. Read. 1990. Adult attachment, working models, and relationship quality in dating couples. *J. Pers. Soc. Psychol.* 58, 4 (1990), 644–663. DOI:https://doi.org/10.1037/0022-3514.58.4.644

[7] Martin Dechant, Sabine Trimpl, Christian Wolff, Andreas Mühlberger, and Youssef Shiban. 2017. Potential of virtual reality as a diagnostic tool for social anxiety: A pilot study. *Comput. Hum. Behav.* 76, (November 2017), 128–134. DOI:https://doi.org/10.1016/j.chb.2017.07.005

[8] Carol J. Descutner and Mark H. Thelen. 1991. Development and validation of a Fear-of-Intimacy Scale. *Psychol. Assess. J. Consult. Clin. Psychol.* 3, 2 (1991), 218–225. DOI:https://doi.org/10.1037/1040-3590.3.2.218

[9] Susan C. Doi and Mark H. Thelen. 1993. The Fear-of-Intimacy Scale: Replication and extension. *Psychol. Assess.* 5, 3 (1993), 377–383. DOI:https://doi.org/10.1037/1040-3590.5.3.377

[10] Kathleen Kara Fitzpatrick, Alison Darcy, and Molly Vierhile. 2017. Delivering Cognitive Behavior Therapy to Young Adults With Symptoms of Depression and Anxiety Using a Fully Automated Conversational Agent (Woebot): A Randomized Controlled Trial. *JMIR Ment. Health* 4, 2 (June 2017), e19. DOI:https://doi.org/10.2196/mental.7785

[11] G. Goldstein and M. Hersen. 2000. *Handbook of Psychological Assessment*. Elsevier Science. Retrieved from https://books.google.com/books?id=NO948o0F9XsC

[12] Shannon Greenfield and Mark Thelen. 1997. Validation of the Fear of Intimacy Scale with a Lesbian and Gay Male Population. *J. Soc. Pers. Relatsh.* 14, 5 (1997), 707–716. DOI:https://doi.org/10.1177/0265407597145007

[13] Karin Grossmann, Klaus E. Grossmann, Gottfried Spangler, Gerhard Suess, and Lothar Unzner. 1985. Maternal sensitivity and newborns' orientation responses as related to quality of attachment in northern Germany. *Monogr. Soc. Res. Child Dev.* 50, 1–2 (1985), 233–256. DOI:https://doi.org/10.2307/3333836

[14] Xiaoming He. 2021. Personal Communication.

[15] Travis S. Ingersoll, Jill M. Norvilitis, Jie Zhang, Shuhua Jia, and Sheldon Tetewsky. 2008. Reliability and Validity of the Fear of Intimacy Scale in China. *J. Pers. Assess.* 90, 3 (April 2008), 270–279. DOI:https://doi.org/10.1080/00223890701885019

[16] Nicholas C. Jacobson, Berta Summers, and Sabine Wilhelm. 2020. Digital Biomarkers of Social Anxiety Severity: Digital Phenotyping Using Passive Smartphone Sensors. *J. Med. Internet Res.* 22, 5 (May 2020), e16875. DOI:https://doi.org/10.2196/16875

[17] Maples-Keller Jl, Bunnell Be, Kim Sj, and Rothbaum Bo. 2017. The Use of Virtual Reality Technology in the Treatment of Anxiety and Other Psychiatric Disorders. *Harv. Rev. Psychiatry* 25, 3 (June 2017). DOI:https://doi.org/10.1097/HRP.0000000000000138

[18] Martin Johannes Dechant, Julian Frommel, and Regan Mandryk. 2021. Assessing Social Anxiety Through Digital Biomarkers Embedded in a Gaming Task. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, ACM, Yokohama Japan, 1–15. DOI:https://doi.org/10.1145/3411764.3445238

[19] Isabel L. Kampmann, Paul M.G. Emmelkamp, and Nexhmedin Morina. 2018. Self-report questionnaires, behavioral assessment tasks, and an implicit behavior measure: do they predict social anxiety in everyday life? *PeerJ* 6, (August 2018), e5441. DOI:https://doi.org/10.7717/peerj.5441

[20] Bastian Lange and Paul Pauli. 2019. Social anxiety changes the way we move—A social approach-avoidance task in a virtual reality CAVE system. *PLOS ONE* 14, 12 (December 2019), e0226805. DOI:https://doi.org/10.1371/journal.pone.0226805

[21] RAY LC and Yuka Fukuoka. 2019. Machine Learning and Therapeutic Strategies in VR. In *Proceedings of the 9th International Conference on Digital and Interactive Arts* (ARTECH 2019), Association for Computing Machinery, New York, NY, USA, 1–6. DOI:https://doi.org/10.1145/3359852.3359908

[22] Andrea M Letamendi, Denise A Chavira, and Murray B Stein. 2010. Issues in the Assessment of Social Phobia: A Review. (2010), 15.

[23] Cade McCall and Jim Blascovich. 2009. How, When, and Why to Use Digital Experimental Virtual Environments to Study Social Behavior: Social Behavior in Virtual Environments. *Soc. Personal. Psychol. Compass* 3, 5 (September 2009), 744–758. DOI:https://doi.org/10.1111/j.1751-9004.2009.00195.x

[24] Daniel W. McNeil, Barry J. Ries, and Cynthia L. Turk. 1995. Behavioral assessment: Self-report, physiology, and overt behavior. In *Social phobia: Diagnosis, assessment, and treatment*. The Guilford Press, New York, NY, US, 202–231.

[25] Stein Moutier. The History, Epidemiology, and Differential Diagnosis of Social Anxiety Disorder. *J Clin Psychiatry*, 5.

[26] Martin Prince, Vikram Patel, Shekhar Saxena, Mario Maj, Joanna Maselko, Michael R Phillips, and Atif Rahman. 2007. No health without mental health. *The Lancet* 370, 9590 (2007), 859–877. DOI:https://doi.org/10.1016/S0140-6736(07)61238-0

[27] S. Reis and B.F.S. Grenyer. 2004. Fear of Intimacy in Women: Relationship between Attachment Styles and Depressive Symptoms. *Psychopathology* 37, 6 (2004), 299–303. DOI:https://doi.org/10.1159/000082268

[28] Mike Rinck, Tobias Rörtgen, Wolf-Gero Lange, Ron Dotsch, Daniël H. J Wigboldus, and Eni S Becker. 2010. Social anxiety predicts avoidance behaviour in virtual encounters. *Cogn. Emot.* 24, 7 (2010), 1269–1276.

[29] Michael E Roloff and Danette E Ifert. 11 Conflict Management Through Avoidance: Withholding Complaints, Suppressing Arguments, and Declaring Topics Taboo. 60.

[30] Ranjan Roy. 2011. *Social Support, Health, and Illness: A Complicated Relationship*. University of Toronto Press, Toronto. DOI:https://doi.org/10.3138/9781442685314

[31] Aparna Shankar, Anne McMunn, James Banks, and Andrew Steptoe. 2011. Loneliness, social isolation, and behavioral and biological health indicators in older adults. *Health Psychol.* 30, 4 (2011), 377–385. DOI:https://doi.org/10.1037/a0022826

[32] Michelle D. Sherman and Mark H. Thelen. 1996. Fear of Intimacy Scale: Validation and Extension with Adolescents. *J. Soc. Pers. Relatsh.* 13, 4 (1996), 507–521. DOI:https://doi.org/10.1177/0265407596134002

[33] Jeffry A. Simpson. 1990. Influence of attachment styles on romantic relationships. *J. Pers. Soc. Psychol.* 59, 5 (1990), 971–980. DOI:https://doi.org/10.1037/0022-3514.59.5.971

[34] Roslyn M. Sparrevohn and Ronald M. Rapee. 2009. Self-disclosure, emotional expression and intimacy within romantic relationships of people with social phobia. *Behav. Res. Ther.* 47, 12 (December 2009), 1074–1078. DOI:https://doi.org/10.1016/j.brat.2009.07.016

[35] Cindy Turk. Issues For the Measurement of Social Phobia. 35.
[36] Matthias J Wieser, Paul Pauli, Miriam Grosseibl, Ina Molzow, and Andreas Mühlberger. 2010. Virtual Social Interactions in Social Anxiety—The Impact of Sex, Gaze, and Interpersonal Distance. *Cyberpsychology Behav. Soc. Netw.* 13, 5 (2010), 547–554.
[37] Bob G. Witmer and Michael J. Singer. 1998. Measuring Presence in Virtual Environments: A Presence Questionnaire. *Presence Teleoperators Virtual Environ.* 7, 3 (June 1998), 225–240. DOI:https://doi.org/10.1162/105474698565686
[38] 1985. *Social support and health.* Academic Press, San Diego, CA, US.
[39] Fear of Intimacy: Understanding Why People Fear Intimacy. *PsychAlive*. Retrieved from https://www.psychalive.org/fear-of-intimacy/
[40] Social Anxiety Can Be Triggered by 360-Degree Videos in Virtual Reality: A Pilot Study Exploring Fear of Shopping | Cyberpsychology, Behavior, and Social Networking. Retrieved September 9, 2021 from https://www.liebertpub.com/doi/suppl/10.1089/cyber.2019.0295
[41] Motion Sickness in Virtual Reality: An Empirical Evaluation. Retrieved September 9, 2021 from https://ieeexplore.ieee.org/abstract/document/9133071/