**3. THEORETICAL FRAMEWORK**

Psychologists have demonstrated the cognitive process of perspective taking through imagining oneself in the shoes of another to be very effective in stereotype reduction (Batson et al., 1997), learning (Siegler, 1995), and improved interpersonal communication (Fussell & Krauss, 1989). Batson et al. (1997) argue that empathy involves the cognitive ability and resources to engage in taking the perspective of another person. Thus, the high cognitive demand of mentally transposing oneself into another’s perspective is a severely limiting factor in the generalizability and applicability of these results. Moreover, Davis and Kraus (1997) have shown that individuals differ in their ability and motivation to engage in and hence benefit from this form of cognitive perspective taking.

The media affordances of virtual reality technology include multisensory inputs to layer perceptual information in a virtual environment in ways that can concretely allow one to see, hear, and feel as if they were having the sensations in the physical world, and thus users can literally be placed within the pointof-view of another. Ahn, Tran Le, and Bailenson (2015) used this technology to facilitate easy and effective perspective taking, and found that IVET were more effective than cognitive perspective taking and that IVET experiences led to greater self-other merging, attitude change, and helping behavior towards persons with disability. The Virtual Human Interaction Lab (VHL) at Stanford, led by Jeremy Bailenson, recently launched the “Empathy at Scale” project, aiming to create and develop applied research protocols for teaching empathy, specifically in anti-discrimination training.

Numerous studies have examined the impacts of Body Ownership Illusions (BOIs), originating with the rubber hand illusion (RHI; Botvinick & Cohen, 1998). The rubber hand illusion works by having a subject’s real hand hidden from view behind a panel while a rubber hand is placed on a table next to their real hand. By delivering synchronous tactile stimulation to a subject’s hand and the rubber hand, subjects experience the rubber hand as if it is their real hand, which is termed the body ownership illusion (BOI). Ehrsson et al. (2007) extended the RHI to full-body ownership illusions by filming from a mannequin body while subjects wore an IVET head-mounted display (HMD) and had their stomach stroked synchronously with the mannequin stomach. The effect occurs through what is termed “visuotactile triggers” for body ownership illusions. Kilteni, Maselli, Kording, and Slater (2015) describe how the RHI extends to BOI in avatar bodies in virtual reality by using vision and motor (visuomotor) synchronously to create a sense of ownership over avatar body.

This is accomplished with motion tracking that renders the user’s physical movements onto an avatar body in a virtual environment (see Figure 2). Instead of using an avatar body in a simulated environment to induce body ownership, the present study uses a stereoscopic video captured environment with binaural audio to explore empathy for another real person, as opposed to empathy through BOI with an avatar body. Thus, the present study explores the effects of synchronous visual and motor presentation while the subject moves together with the painter. The dependent measures for this study were adapted from Ahn and colleagues’s (2015) study on empathy towards persons with achromatopsia (color blindness), where a virtual simulation of a task space from the colorblind colleague’s point of view increased prosocial attitude and behaviour. Ahn et al. report an increase in self-other merging and feelings of oneness.

Virtual environments have been shown to significantly alter sense of self through transformed self-representations (Yee & Bailenson, 2007), disoriented spatial localization of one’s own the body (Leggenhager, Tadi, Metzinger, & Blanke, 2007), and modified form, shape, and morphology of the body, termed “homuncular flexibility” (Won, Bailenson, Lee, & Lanier, 2015). Further, virtual environments impact social interactions and social awareness, specifically implicit racial bias (Groom, Bailenson, & Clifford, 2009), social perspective taking (Gehlbach et al., 2015), and helping behavior towards persons with disabilities (Ahn, Le, & Bailenson, 2015). Despite that Bertrand et al. (2014) make the important distinction that embodied experiences under the BeAnother Lab paradigm involve real people instead of avatars, it is still useful to extend the findings of avatar studies to the plausible cognitive and behavioral effects when sharing experiences with real people. Yee and Bailenson (2007) coined the term “Proteus Effect” to describe the experience of transformed self-representation when users identify with the physical appearance of an avatar such that the avatar’s appearance affects the user’s behavior in the virtual world, or even in the real world. For example, embodying an attractive avatar increases intimacy with a confederate, as demonstrated by greater self-disclosure and proximity to confederate during a conversation.

It is interesting that this effect occurs even though the subject’s avatar was presented with a neutral or blank face to a confederate, meaning that the effect can be attributed to selfperception and not social feedback. Moreover, Yee, Bailenson, and Ducheneaut (2008) showed that this effect extended to subsequent face-to-face interactions. Freeman et al. (2013) conducted a study on decreased avatar height in a virtual simulation of riding on a subway train, and found that decreased height contributed to greater anxiety and paranoia. Rather than identifying with the physical appearance of the painter (which the subjects cannot see), the present study explores whether subjects identify with the painter’s thoughts and feelings while they paint along with her. Individuals often coordinate their movements either intentionally or unintentionally in rhythmic behavior with other individuals (Richardson, Marsh, Isenhower, Goodman, & Schmidt, 2007). This interpersonal coordination can occur overtly through physical contact or by detecting visual movement information, and coordination can occur even when the goal does not explicitly define the coordination itself (Richardson, Marsh, & Schmidt, 2005).Thus, visually mediated interpersonal communication can entrain movement coordination. This study uses visually perceived movements .

In everyday social interactions, people tend to mimic one another’s movements and gestures, termed the chameleon effect (Chartrand & Bargh, 1999), and this mimicking behavior has been linked to greater likeability and social influence, even by non-human digital avatars (Bailenson & Yee, 2005). This study explores whether this type of “mimicry” can enhance empathic understanding. Goodwin, McCloskey, and Matthews (1972) mechanically stimulated the muscle tendon of a physically constrained joint as a method to induce illusory body distortions, and blindfolded subjects experienced the illusion of movement. Thus, it seems plausible that based on the conclusions from these studies, subjects might experience a merging with someone else while moving together and seeing the other person’s body move from a first-person perspective. Further, Patel et al. (2006) conducted an experiment whereby they compared learning outcomes from traditional 2dimensional film media of a teacher instructing Tai Chi movements, with a significant effect of the 3-dimensional immersive virtual reality projection on learning. Thus, learning of movement patterns can be enhanced through training in virtual reality.

**Movement and interaction:**

Virtual reality tricks your brain into believing you are in a 3D world. The first way VR does this is with the stereoscopic display. This works by displaying two slightly different angles of the scene to each eye, simulating depth. This along with other ways to simulate depth like parallax (farther objects to you seem to move slower), shading and techniques create an almost life like experience.

This is arguably one of the most important parts of virtual reality. It is one thing to just look around a 3D space, but to be able to move around it and touch and interact with objects is a completely different ballgame. On Android, your phone’s accelerometer, gyroscope and magnetometer are used to achieve movement of the headset. The accelerometer is used to detect three dimensional movement with the gyroscope being used to detect angular movement followed by the magnetometer for position relative to the Earth.



**fig.3.1.**performers

## The power required for virtual reality:

Specifically on the desktop, VR requires a lot of horsepower for a smooth, consistent experience. In fact, the majority of people who own desktops are unable to use virtual reality, as their computers are not powerful enough. Steam recommends an Intel i5 Haswell or newer and either an Nvidia GTX 970 or AMD Radeon R9 290 for a smooth experience.

The main issue facing hardware is that for the Vive and Rift, your PC doesn’t just have to run a 1080p game at 60 FPS, it has to run at a higher resolution at 90 FPS. Most hardware can not do that.

It turns out that there is a very limited number of computers with these specs or better, so this will more than likely slow down the adoption of VR on the desktop. For mobile however, any Android phone with KitKat (4.4) or higher should not have any issues with basic VR functionality