Using Virtual Reality for Implicit Learning

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Abstract. Virtual Reality uniquely offers three illusions simultaneously: the illusion of being in the rendered place, the illusion that what is perceived to be happening there is really happing, and the illusion that the life-sized virtual body that apparently substitutes the body of the participant is their body. Needless to say, for any participant in a Virtual Reality experience these are not beliefs, but illusions, known to be false yet nevertheless profoundly influencing their physiology, attitudes, behaviour and even cognition both during the Virtual Reality exposure and also afterwards. We argue how these illusions are useful for implicit learning and unlearning, and give a number of examples.

Keywords: Implicit learning, unlearning, virtual reality, body ownership, presence, place illusion, plausibility, clinical psychology

1 Introduction

Virtual Reality can be used to give people the illusion of being in computer generated world, where the events that are occurring there are actually happening. This comprises two aspects – Place Illusion, the strong illusion of being in the virtual place, and the Plausibility Illusion , that the events that are happening there are really happening, both with the proviso that the participant knows for sure that this is not the case [1]. These two together are often called 'presence'. This can be utilized in many possible applications. For example, with students learning geography, virtual field trips are potential sources of learning, and sometimes may be logistically more feasible than actual field trips [2], though see also caveats discussed in [3]. For the learning of history, aspects of the ancient world have been constructed [4], and the World War 2 D-Day Normandy landings represented in a video game [5], and Allison [6] reviews such applications in the context of history education. A recent example reprising an event from the 1917 October Russian Revolution is described in [7]. Virtual reality in education goes back a very long way [8, 9]. For recent reviews see [10-14].

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As summarised in [15] there are several reasons why Virtual Reality (VR) is an excellent tool for education: (1) it can change the abstract into the tangible – e.g., mathematics can be represented in tangible form – e.g. [16]; (2) VR supports 'doing' rather than just observing (e.g., learning surgery doctors can safely manipulate objects rather than only watch others do it; (3) VR can utilise methods that are desirable but practically infeasible though possible in reality – for example, a field trip to Stonehenge one week and Niagara Falls the next (practically infeasible in reality but possible in VR). (4) VR can go beyond reality and yet may lead to better understanding of reality – e.g., for learning about aspects of physical people could experience how would it be to juggle in gravity different to how it is on Earth [9].

Here we concentrate on implicit [17] rather than explicit learning, and are more concerned with unlearning rather than learning. Implicit learning is acquiring knowledge and skills without conscious effort, and without explicitly having to learn specific information [18]. Unlearning is the process of unlearning a habitual way of thinking or accomplishing something, in order to be able to release new and perhaps better ways - for example, in engineering [19]. I discuss how some of our studies combine both implicit learning and unlearning, although they were not designed for this purpose. I first consider a fundamental example of unlearning – psychological therapy, which has mainly relied on the presence (Place Illusion and Plausibility) aspects of VR. I then consider implicit learning examples, through a transformation of body ownership. The implicit learning examples also involve unlearning.

2   Unlearning – VR in Psychological Therapy

Perhaps the most profound and well-researched example of virtual reality in unlearning is its application in clinical psychology. For recent reviews see [20, 21]. Typically cognitive behavioural therapy (CBT) is used. This requires that patients be exposed to situations where they feel anxiety in the case of anxiety disorders, or other types of negative feeling such as when people with paranoia encounter other people. CBT breaks down beliefs and attempts to diffuse and reframe negative thoughts, so that patients can at the very least learn to cope with their feelings and operate normally in the world (e.g. in the case of paranoia) or learn to completely dissipate their feelings of anxiety in situations that previously provoked this [22, 23]. This is genuine Unlearning, since such patients have somehow earlier learned to feel extreme discomfort in certain situations (e.g., public speaking or a facing precipice) and the CBT process shows them how to 'unlearn' these feelings while nevertheless in the provoking situation. In a recent randomised control trial a complex virtual environment was utilised for the problem of acrophobia (fear of heights). The CBT was delivered by a virtual therapist. The experimental group (n = 51) produced large clinical benefits compared to a control group (n = 49) [24].

Applications in clinical psychology go back to the early days of VR – for example

[25, 26] and there has been massive research in this area: fear of heights, various types of social phobia, agoraphobia, spider phobia and conditions such as post-traumatic stress disorder [27], paranoia and schizophrenia. Although there are very few RCT formal clinical studies, the overwhelming conclusion is that VR 'works', that the outcomes are at least as good as using traditional methods such as exposure through 'real' experiences (e.g., visits to high buildings, talks in front of real audiences), imaginal techniques, movies and photographs. It needs to be pointed out here that the success of these methods is not due to the VR in itself – VR is an adjunct, a tool employed in the context of CBT. The success is down to the methods of CBT, not specifically to the use of VR, which offers mainly economic and logistic advantages. However, the VR 'works' precisely because the clients have the strong illusion of being in the place (e.g., in front of an audience) and that the events that are happening are real. Even though the patients know for sure that nothing 'real' is happening, some aspect of brain processing does not distinguish between reality and virtual reality, so that people automatically respond realistically to virtual stimuli.

3   Body ownership and implicit learning

The third illusion, virtual body ownership, has been used as a method for bringing about implicit change. When a person is in a VR they will see a life-sized virtual body visually substituting their own from their first-person perspective (1PP), if this has been programmed. This 1PP view of their virtual body is typically supplemented with additional multisensory information that provides evidence that the body is their own. For example, when an object strikes the virtual body the participant should feel something synchronously in time and location on their own body (visuotactile integration) [28], or when they move their real body the virtual body should move congruently and synchronously (visuomotor integration) [29, 30] or both [31]. Under these conditions participants typically have the perceptual illusion that the virtual body is their body (even though of course they know that it is not). These ideas go back to the rubber hand illusion [32], which has also been replicated in VR [33].

Yee, Bailenson [34] observed that the form of the virtual body can have implications for the attitudes and later behaviours of participants. For example, at least four replications of studies where White people where embodied in a Black virtual body have shown that their implicit racial bias against Black people diminishes [35-38] (provided that the social context depicted is appropriate [39]). This is another type of 'unlearning' where associations between race and positive or negative attributes can (on the average) change simply as a result of an exposure to a virtual body of specific type, with some evidence that the effect endures. This has also been shown to map to behaviour, where White people will mimic the postures and gestures of a

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Black virtual character more when they are embodied as Black compared to White [38]. This is important since the Chameleon effect from social psychology suggests that such unconscious mimicry is a sign of greater social harmony.

In another example of how the virtual body can influence behaviour, participants, in a between-groups experiment, were embodied either in a dark-skinned casually dressed (Jimi Hendrix reminiscent body) or a light-skinned formally dressed body and were asked to play a hand drum. Tracking data clearly showed that those in the more casual looking body played the drums with far more body movement than those in the formally dressed looking body [40].

Changes due to embodiment in particular types of virtual body may also influence cognition. One set of studies has suggested that people embodied as Sigmund Freud, and with a strong illusion of body ownership in that body, give better counselling (to themselves) than when they do not experience body ownership, or when their counsellor is another copy of themselves [41]. Even more remarkably it seems that people with low self-esteem perform better on cognitive tasks when embodied as Albert Einstein than when embodied in a neutral virtual character [42].

There are also implications for motor learning. Embodiment in a virtual body that speaks in a higher pitched voice than the participant's own voice leads to participants not only having illusory agency over the speaking (even though they themselves did not speak) but later themselves actually speaking in a higher pitched voice [43]. However, for this to work it seems that the body ownership has to be the result of 1PP plus visuomotor rather than visuotactile stimulation [44]. We are currently exploring this finding in the context of motor learning.

4   Conclusions

Both the CBT type of approach that is explicitly aimed at transformation and the implicit methods based on body ownership have something in common: they are both ways of transforming attitudes about the self. The CBT method tackles this head-on in a deliberate way, and the clients know that this is the intention, whereas as the 'body ownership' method does not involve saying anything at all about what is expected from the client. In the body ownership – implicit learning – approach, change 'just happens'. A person can 'unlearn' how to have implicit racial bias (i.e., unlearn apparently deep-seated sets of associations), or 'unlearn' the effects of their low self-esteem without knowing that they are supposed to be unlearning these. This is a very interesting route for learning, and we are currently exploring this in a number of applications.

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