



Virtual reality replays of sports performance: Effects on memory, feeling of competence, and performance

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ABSTRACT

Memory can be altered after receipt of misleading information; the misinformation effect was first studied almost 40 years ago. Later studies showed that suggestive information could even lead to the creation of new false memories in people. Whereas previous research focused primarily on false information about passively observed events, we aimed to investigate whether memory for one's own physical performance can be altered by means of false, manipulated replays of these events in virtual reality, displayed from a first person viewpoint. We further explored the possibility of using the misinformation effect beneficially, by investigating whether it can affect feeling of competence, as well as subsequent sports performance. Participants ($N = 27$) took four series of shots at a goalpost on a soccer field. Between these series, they were shown three different types of virtual reality replays of their performance; one accurate representation of actual performance and two manipulated versions, one that made performance seem worse (negative manipulation) and one that made performance seem better (positive manipulation). Participants rated their feeling of competence before and after each replay and rated how accurately the replay displayed their real-life shots at the goal. The manipulated replays were considered equally accurate representations of actual performance as the non-manipulated ones. Also, the type of replay manipulation positively correlated with feeling of competence but did not influence sports performance. The present study showed that memory for one's own physical performance can be altered by means of manipulated virtual reality replays and that this can be used beneficially.

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1. Introduction

For quite some time now it has been known that retrieving memories is a reconstructive process (Bartlett, 1932). Unlike a video recording, which is the same when played repeatedly, information retrieval from human memory is susceptible to errors. Memory may be altered after receipt of misleading information; the first study on this 'misinformation effect' was conducted almost 40 years ago by Loftus, Miller, and Burns (1978). Studies showed that false details can be planted into memory for both simulated (e.g., a filmed car accident), as well as real-world events (Loftus, 2005). Moreover, the way questions about a past event are formulated can even alter memory for it. For instance, when asked how fast cars were going in films of automobile accidents, participants reported higher estimates of speed when the question contained the verb

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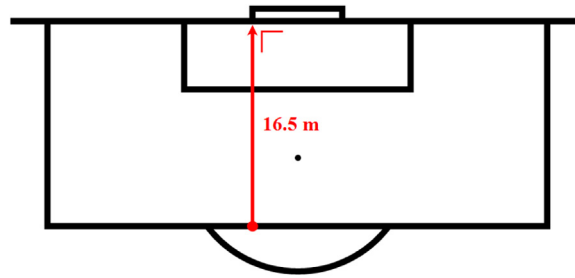


Fig. 1. The resting position of the ball during the sport task in the experiment (red dot). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

'smashed' than when the same question contained the verbs 'collided', 'bumped', 'contacted', or 'hit' in place of 'smashed' (Loftus & Palmer, 1974). Such findings stress the importance of using proper questioning techniques in court testimonies (Powell, 2005).

Later studies showed that suggestive information could even lead to the creation of new false memories in people. False memories were implanted by means of various forms of media, such as a written narrative about one's childhood (Loftus & Pickrell, 1995) or a doctored photograph (Wade, Garry, Read, & Lindsay, 2002). These studies can be framed in terms of varying levels of 'media richness' (Segovia & Bailenson, 2009), which can be described based on four criteria: capacity for immediate feedback; capacity to transmit multiple cues such as graphic symbols or human gestures; language variety, including numbers and natural language; capacity of the medium to have a personal focus (Daft, Lengel, & Trevino, 1987). According to Segovia and Bailenson (2009), the stronger the false, suggestive information is in terms of media richness, the more likely people are to adopt the information into memory. The personal focus criterion may be especially important in this respect, as self-referent encoding yields superior memory (Symons & Johnson, 1997).

Whereas previous research focused primarily on false information about passively observed events, in the present study we aimed to investigate whether memory for one's own physical performance can be altered by means of false, manipulated replays of these events in virtual reality (VR), displayed from a first-person viewpoint. The inherent characteristics of VR (e.g., user-specific viewpoints and a wide, three-dimensional field of view) provide a great sense of immersion, which makes it a very rich form of media (Segovia & Bailenson, 2009). We therefore expected that watching the manipulated replays would alter memory, so that the manipulated replays would be considered equally accurate representations of actual performance as the non-manipulated ones. In the present study we further explored the possibility of using the misinformation effect beneficially, by investigating whether the manipulated replays can affect feeling of competence, which refers to the concept of self-efficacy as introduced by Bandura (1977); the extent or strength of one's belief in one's own ability to complete tasks and reach goals. If so, such replays could potentially be used for therapeutic purposes, such as prevention or treatment of performance anxiety or trauma following bad performance in, for example, a soccer match. Furthermore, they may affect subsequent sports performance, as an increased feeling of competence should lead to an increase in intrinsic motivation, which in turn is positively correlated with quality of performance (Ryan & Deci, 2000).

2. Method

2.1. Participants

Participants were recruited via coaches of different soccer clubs and through a Facebook advertisement. To be eligible, participants had to be at least 18 years old and have played on a soccer team at a club for at least one year. Twenty-seven male amateur soccer players participated, and their mean age was 23.2 years (range 18–28; $SD = 3.00$).

2.2. Procedure

After reading the information sheet, participants signed the consent form. According to the information sheet, the goal of the experiment was to test the effects of watching VR replays of one's own sports performance on subsequent performance. Participants were first instructed to carry out a physical sport task, in which they had to take 10 shots across the ground at the left goalpost on a soccer field, from a 16.5 m distance (Fig. 1).

The experimenter recorded the distance missed with respect to the goalpost, as well as the side of the goalpost along which the ball passed. The distances were read from a tape measure (10 m long), which was rolled out on the goal line. After the sport task, participants were taken to the side of the field. Here, they rated their feeling of competence by indicating how difficult they considered the sport task, and how good they considered themselves in carrying out the task, on two 100 mm visual analogue scales (VAS) that ranged from 0 (very hard/very bad) to 100 (very easy/very good). Meanwhile, the experimenter entered the recorded miss distances and sides of the goalpost into the VR application (a modification of "Beyond Sports" v0.53; developed by Triple). When the competence test was finished, participants were instructed to put

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