Reconsideration of Ouija Board Motion in Terms of Haptic Illusions (IV): Effect of Haptic Cue and Another Player

Takahiro Shitara
shitara@kaji-lab.jp
The University of Electro-Communications
Chofu, Tokyo

Vibol Yem
yem@kaji-lab.jp
Tokyo Metropolitan University
Hachioji, Tokyo

Hiroyuki Kajimoto
kajimoto@kaji-lab.jp
The University of Electro-Communications
Chofu, Tokyo

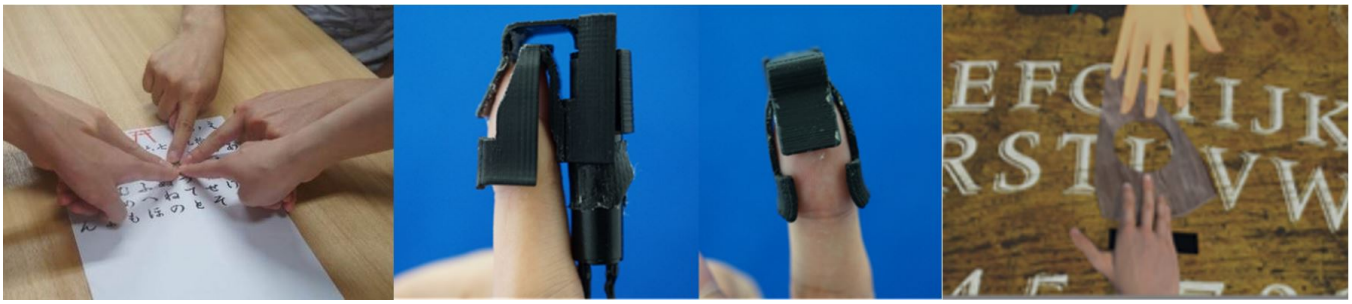

Figure 1: (Left) Ouija board. (Middle) Skin deformation device. (Right)Visual scene of the experiment.

ABSTRACT

The Ouija board game is associated with a type of involuntary motion known as an ideomotor action. We sought to clarify the conditions under which this motion occurs by evaluating the effect that visual and haptic movement cues have on its occurrence. Using our lateral skin deformation device, we found that the simultaneous presentation of visual and tactile illusory motion and force produced larger ideomotor actions than when either modality presented alone, an effect that was further potentiated by the presence of another player (an avatar).

CCS CONCEPTS

• **Human-centered computing** → *Virtual reality*; *Empirical studies in HCI*.

KEYWORDS

haptics, ideomotor action, ouija board, virtual reality

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1 INTRODUCTION

The Ouija board game can be played by multiple players, using a flat board marked with letters and numbers, and a planchette, which is a small piece that is placed on top of the board (Figure 1 Left). The players place their fingers on the planchette, ask questions of the board, and watch as the piece mysteriously moves across the board to point to various letters or numbers in response to the question. The movement of the game piece is considered a type of ideomotor action, i.e., a psychological phenomenon wherein a person produces an involuntary and unconscious movement [Stock and Stock 2004].

Our series of previous studies [Shitara et al. 2016a][Shitara et al. 2016b][Shitara et al. 2017] showed that the simultaneous presentation of visual and tactile stimuli was important to produce ideomotor actions. However, these haptic stimulations produced external force, which might have actually pulled the finger in a specific direction. Furthermore, these studies did not investigate the effect of other players. In this paper, we try to address these issues by using wearable haptic device, and presenting the other player (avatar) in virtual reality scene.

2 MATERIAL AND METHOD

2.1 Experimental System

We used a 1-DoF lateral skin deformation device that produces haptic movement cues [Yem et al. 2016] (Figure 1 Middle). An arm contacting the finger-pad is driven by a DC motor (Maxon 118396, Maxon holdings) with a 16:1 gear ratio to deform the skin. The motor can present both left and right skin traction stimuli. Note that the finger is not externally pulled by the device, yet the subjects typically perceive an illusory external force sensation.

Figure 1 right shows the experimental system. We used an Head-mounted display (Oculus Rift) to obstruct the subjects' view of their

own fingers. The visual virtual environment presented to the subjects was developed by Unity game engine, and the movement of the subject's hand was tracked with an optical motion sensor (OptitrackV120: DUO/TRIO). The resulting recording was synchronized with the movement of a virtual hand.

2.2 Conditions

We generated three different haptic cue conditions: 1. Skin deformation with a left shift, 2. Skin deformation with a right shift, 3. No stimulation. In the first two conditions, the stimuli were presented for 10 seconds. The skin deformation was applied to the fingertip to induce a pulling sensation. The maximum skin deformation produced was approximately 1 mm. For all conditions, the inter-stimulus interval was randomly varied between 0.5 and 1.5 s.

Visual stimuli consisted of an image of a virtual hand placed on a planchette, overlaid on a background image of the Ouija board game board. Two different visual conditions were used. In condition 1 (without visual motion), the image of the planchette did not move. In condition 2 (with visual motion), the image of the planchette was synchronized with the stimulus direction. Additionally, the planchette's movement in condition 2 also incorporated any movement that was produced by the participant's finger.

To evaluate how the presence of other players may affect ideomotor actions, two different conditions were used. A first condition where the only virtual hand was presented representing that of the subject, and a second condition where the hand of the other person was also touching the planchette.

Combinations of the three haptic conditions, the two visual conditions, and the two avatar conditions resulted in 12 conditions in total. Each specific combination was presented three times in a random order, for a total of 36 trials per participant. The experiment was divided into two parts. The first part was either composed of the 18 trials with the avatar of the other person, or of the 18 without. Following a 10-minute break, the remaining 18 trials were presented. The order of each 18-trial block was counterbalanced across participants.

Ten naïve participants who knows Ouija board, and have experienced HMD (eight males, 21-25 years of age, nine right-handed) participated in the study. During the experimental trials, participants were instructed to relax and hold their right arms slightly above the surface, to focus their attention on the virtual image of their hand, and to not forcefully resist the haptic cues. They were also asked to return their fingers to the center of the screen before the start of each trial.

3 RESULTS AND DISCUSSIONS

The results are shown in Figure 2. The different experimental conditions are depicted along the horizontal axis. The average displacement of the finger (mm) in the stimulus direction is illustrated in the vertical axis; the error bars correspond to the standard deviation. In the tactile cue conditions, hand movement that aligned with the deformation direction was scored as a positive movement. When no tactile stimulus was applied, hand movement that aligned with the visual movement was scored as positive. Finally, in the condition where no visual and no tactile stimulation was presented, we used the average absolute value of finger displacement.

We confirmed that participants made larger finger movements when exposed to a combination of visual and tactile motion cues compared with conditions where they only received visual or tactile cues alone. These data confirmed that visual and haptic movement cues would elicit actual finger motion with the Ouija board planchette. Furthermore, we confirmed that participants made larger finger movements when another player's avatar was present compared with the condition where no avatar was present. We speculated that the presence of others possibly obscures the assessment of the source of movement, which likely further contributes to the Ouija board phenomenon.

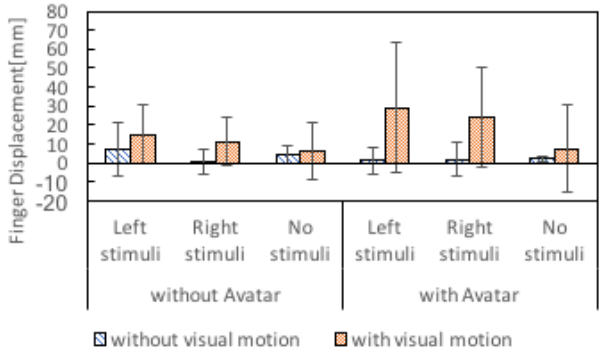

Figure 2: Mean finger displacement for each stimulus condition (positive stimulus direction)

4 CONCLUSION

The goal of the present study was to clarify the conditions under which Ouija board illusory motion occurs and to clarify the role played by visual and haptic cues. Our results showed that the simultaneous presentation of visual and tactile stimuli produced greater ideomotor action, which was further increased by the presence of an avatar.

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