# Disconnected Identity: An illusionary ownership over a 'dotified' body elicited by your movements.

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**ABSTRACT** In scrutinizing our sub theme 'gesture' within the context of the overall theme 'language', we eventually got drawn into the fundamental importance of our gestures in bringing about the sense of owning our bodies. Interestingly, our mind can get tricked into owning a different body by manipulating the sensory feedback it perceives. In our installation, you will experience the body ownership illusion over a virtual body consisting of dot patterns by mapping your own bodily actions onto it. The task to be performed is designed in such a way that you will feel the body ownership illusion over the dot patterns when you are forced to move your body and lose this illusion again when you are forced to hold your pose, thereby experiencing our statement '*I move, therefore I am*'.

## THEME EXPLORATION

We initiated our exploration by defining our sub theme 'gesture' and by exploring its scope within the overall theme of 'language'. We defined gesture as both the conscious and unconscious movements and positions of the body or body parts that are expressive of an idea, intention, emotion, opinion, or other form of information. Gesturing is an essential component of human communication. It is estimated that about 65-70 percent of all social communication is transmitted via gestures (Birdwhistell, 2010). Moreover, we are unconsciously mimicking each others posture and gesture in social interactions, thereby both creating and expression affiliation (Lakin et al., 2003). Furthermore, gesturing is a robust phenomenon in human communication. It occurs across all cultures and ages and across all kinds of tasks. Surprisingly, gesturing also occurs in people who have been blind from birth, even when they are knowingly speaking with another blind person (Iverson & Goldin-Meadow, 1998). This suggests that gesturing must be facilitating the speaker in some way. Indeed, co-speech gesturing has found to reduce the cognitive load for speakers (Goldin-Meadow et al., 2001). Moreover, our unconscious gesturing is even thought to bring new ideas to our mind that are not yet articulated in language (Crowder, 1996). Interestingly, we found that there is a whole body of research suggesting that human language has an embodied, metaphorical account of syntax, semantics, pragmatics and value (Johnson & Lakoff, 2002). As explained by Roth and Lawless (2002), the enactment of metaphorical gestures that forms a bridge between real world experiences and lingual concepts.

In the next phase of our exploration, we used the *Sticky Wisdom* ideation strategy (Allan & Murrin, 2007) that involves methods of *re-expression*, *random links* and *revolution* to facilitate fruitful brainstorming. For both the overall theme 'language' and our sub theme 'gesture' we wrote down ±20 related terms on sticky notes (*re-expression*) and added a third category consisting of ±30 random terms (*random links*). Then, we repeatedly drew one term from each of the stacks and individually tried to come up with as many interlinking ideas as possible within two minutes (*revolution*). In the end, this resulted in an extensive list of ideas, which we grouped into areas for further research. Subsequently, we met with our coach to get feedback on our list of research topics. Our coach noted that the ideation method we used got us stuck too much on practical application thinking and advised us to explore our sub theme more extensively by looking into scientific research on it. We then all individually immersed ourselves into scientific studies on gesture-related topics and summarized our most interesting findings for further discussion with each other. What stood out during these discussions was that we were all especially fascinated by the effect that gesturing has on ourselves rather than on the perceiving party. This led to a new research focus on embodied cognition: the theory that many features of cognition are shaped by aspects of the body. Within this paradigm, we found some interesting

researches on the effects that our gestures have on our emotional experience. For instance, Carney and colleagues (2010) found that one's posture can significantly influence one's neuroendocrine and behavioral state. In their research, they instructed participants to hold either an open and expansive (so-called 'high-power') pose or a closed and contractive (so-called 'low-power') pose for a brief period of one minute. Participants who had displayed the high-power pose showed elevated testosterone levels, decreased cortisol-levels and increased feelings of power, while an opposite pattern was measured for the low-power posers. Furthermore, we found some interesting results from studies on the facial feedback hypothesis. In those studies, people have to hold a pencil between their teeth in a configuration that either inhibits or facilitates smiling. Participants in the smile facilitating condition are found to experience more positive affect in response to positive stimuli (Strack et al., 1988) and faster recovery from negative stimuli (Kraft & Pressman, 2012). Even more strikingly, studies on the effect of facial BOTOX injections (which temporarily paralyze muscles) on emotional experience showed that inhibiting the capability of facial expression decreases the strength of self-reported emotional experience (Davis et al., 2010) and the ability to recognize others' emotions (Neal et al., 2011).

Absorbed by the above and many more interesting findings in the research paradigm of embodied cognition, we planned another meeting with our coach to ask for advice on how to find a focus for our research. Our coach advised us to seek for a mutual fascination and see if we could somehow connect that to our research on embodied cognition. We decided on 'illusion' as our mutual topic of fascination and, with that in mind, continued our research. Soon after, we all agreed on focussing ourselves on the body ownership illusion: The illusion of owning either a part of a body or an entire body that is not your own. As we will hereafter elaborate on, our gestures play an essential role in establishing the fundamental sense of owning our bodies and can therefore be employed to create the illusionary ownership over another body.

## BODY OWNERSHIP ILLUSION

We may take the feeling of ownership over our bodies for granted since we experience it continuously and effortlessly. However, our gestures - the positions and movements of our body and body parts - and the sensory registration of the effects of them are of crucial importance in eliciting the sense of body agency and body ownership (Synofzik et al., 2008). This led us to our statement '*I move, therefore I am'*.

Manipulating the sensory feedback of one's actions or sensations provides a powerful tool for eliciting an ownership illusion over another body or body part. There are several paradigms in the research on body ownership illusions. In the classical rubber hand paradigm, participants look at a rubber hand while the vision on their real hand is occluded. Both the rubber hand and the real hand then get stroked synchronously with a brush to establish embodiment of the rubber hand. Strikingly, the proprioceptive drift towards the rubber hand has direct effects on the homeostatic regulation of the real hand. Moseley and colleagues (2008) found that the temperature in participants' real hand decreases after proprioceptive drift towards the rubber hand occurs. Even more compelling, Barnsley and colleagues (2011) measured an increased histamine reactivity the participants' real hands after their proprioception drifted toward the rubber hand, implying that the interoceptive system starts to disown the real hand in favour of the rubber hand. Within the rubber hand paradigm participants are not allowed to move their real hand, since the rubber hand is inherently immobile and the resulting visuo-motor incongruency would rapidly destroy the illusion (Burin et al., 2015). The virtual hand paradigm and the virtual body paradigm therefore generally make use of visuo-motor synchronization, in which the actions of the participant's body are directly mapped onto the virtual body. Apart from providing a more natural experience, the allowance to move your body also greatly extends the kinds of tasks that can be performed.

We investigated what kind of body and what kind of task we would be interesting to use in creating a compelling body ownership illusion. Slater and colleagues (2009) demonstrated that visuo-motor congruence plays an important role in eliciting the body ownership illusion over a virtual body or body part, whereas human-likeness of body or body part is not. Therefore, we got curious if it would be possible to create the illusion of owning a body that is not clearly recognizable as such by merely synchronizing your body movements with those of the abstract representation. In investigating to what extent we could abstract the body representation, we found that researchers have successfully elicited ownership illusions over virtual objects ranging from a robot arm (Aymerich-Franch et al, 2017) to a wooden block representing a hand (Tieri et al., 2017). Furthermore, we ran into another study of Tieri and colleagues (2015) on the influence of visual body discontinuity in the virtual hand

illusion. They found that in disconnected hand conditions, participants did not report consciousness embodiment of the virtual hand. However, we were wondering whether this effect was due to the fact that they were using a human-like virtual hand under the non-natural condition of disconnectedness in their study, thereby evoking the idea of bodily impossibility. It could be argued that the non-natural condition of a disconnected limb would be able to still create the ownership illusion in case the hand part is non-natural looking as well. Taking all the above in account, we decided on trying to create a body ownership illusion over a collection of disconnected body parts that are non-human-like in appearance. In essence, you will be transformed into a collection of dots.

For the specific configuration of the dots, we looked into research on apparent biological motion. Johansson (1973) initiated a research program on visual perception of biological motion with a study that became known as *The Johansson Experiment*. He represented the motion of a human body by 10 to 12 animated bright dots at both the ankle, knee, wrist and elbow joints and either both shoulder and hip joints or just one dot at the center of the shoulders and hips. Johansson found that adequate motion combinations of these dots evoke a compelling impression of a human in motion. However, when the animation is paused, it can be hard to recognize a human body in the seemingly random collection of dots. Therefore, the illusion of recognizing a body in the animated dot configuration is dependent on movement. This further emphasizes our statement '*I move, therefore I am'*. Taking the knowledge into account that placing the dots at joint points has proven successful in creating the illusion of a body, we initially start out by placing the dots on joint points. Then, we will gradually change the position of the dots to non-joint body parts, remove dots, and add dots that are outside of your body to explore the limits of the illusion.

## THE INSTALLATION

The installation is designed to let you experience that your movement is essential for recognizing yourself in an abstracted representation of your body. Since we chose to represent the whole body and since we wanted to make the body ownership illusion as strong as possible, we designed our installation in virtual reality from the first person perspective and placed a mirror in the virtual environment so that the user can observe his virtual body as a whole. To maximize the illusion, the user's movement is mapped onto the dotified body synchronously. Since the experience is happening in virtual reality, it is important to include a display in the real world in order to create visitors engagement. The display will be showing the virtual experience from the user's (first person) perspective. In the last feedback session it was noted that an extra factor for engaging visitors with our work would be to implement a scoring. We considered this advice, but in the end decided not to implement scoring into our experience, since it would lead to a tendency to perform the tasks as fast as possible instead of taking the time to observe your moving body, which is key to eliciting the body ownership illusion.

The virtual environment is built in the Unity3D development platform and the dotified bodies were created in Blender. We created the dotified bodies on an existing body armour, which ensures that the dots move along with the avatar. To map the user's movements onto the dotified body designs, we make use of the Kinect 2 and a purchased Unity asset (*Instant VR Advanced*). At the onset of the experience you will be verbally instructed to mimic the dot patterns that are displayed within the virtual room. This task forces you to move your body, which is key to establish the body ownership illusion over the 'dotified' body. After successfully imitating the displayed dot pattern, you are instructed to hold your pose, while the dots that make up your body are gradually rearranged. This causes the body ownership illusion to collapse. After your body rearrangement is complete, a new dot pattern to be mimicked will appear. The sequence of the dotified body patterns and the sequence of the dot patterns to be imitated are designed in such a way that it hard to recognize yourself after each body metamorphosis.

## THE EXPERIENCE

Our task design alternately calls upon different Gestalt principles for the perceptual grouping of elements. Firstly, when you are forced to move your dotified body in order to mimic the displayed dot configuration, the dots will be perceived as a body according to the the Gestalt Laws of Similarity (visual elements that physically resemble each other are likely to be perceived as part of the same object) and Common Fate (visual elements are likely to be perceived as a unit if they move together). Because your movement is directly mapped onto the dotified body, you will experience agency over it. Since you are able to perceive visual feedback of your dotified body in action in the virtual mirror, the body ownership illusion will be established. Hence, our statement 'I move, therefore I am' will be experienced. Subsequently,

when the user is forced to hold his/her pose after successfully mimicking the dot configuration, the Gestalt Law of Prägnanz will already distort the body ownership illusion to some extent. Then, while the user is still forced to hold his/her pose, the dots that make up his/her body will be reconfigured to disintegrate the Gestalt Law of Past Experience and cause the body ownership illusion to fade away further. In order to maximize the disintegration of the body ownership illusion, the transformations are chosen in such a way that the successive dotified body configurations will appear as disjointed collections of dots in the pose that the user is in. Then, the cycle starts over by presenting the user with another displayed dot configuration to mimic. In this manner, the user will be experiencing '*I move, therefore I am*' again and again by consecutively creating the body ownership illusion when they are moving and destroying it when they are holding their pose. This procedure cycles until the game time is finished. When time is up, a powerful thrill is created by suddenly pulling the dotified body down through the floor, which straightforwardly ends the experience.

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