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The contribution of the body and motion to whole person recognition

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ABSTRACT

While the importance of faces in person recognition has been the subject of many studies, there are relatively few studies examining recognition of the whole person in motion even though this most closely resembles daily experience. Most studies examining the whole body in motion use point light displays, which have many advantages but are impoverished and unnatural compared to real life. To determine which factors are used when recognizing the whole person in motion we conducted two experiments using naturalistic videos. In Experiment 1 we used a matching task in which the first stimulus in each pair could either be a video or multiple still images from a video of the full body. The second stimulus, on which person recognition was performed, could be an image of either the full body or face alone. We found that the body contributed to person recognition beyond the face, but only after exposure to motion. Since person recognition was performed on still images, the contribution of motion to person recognition was mediated by form-from-motion processes. To assess whether dynamic identity signatures may also contribute to person recognition, in Experiment 2 we presented people in motion and examined person recognition from videos compared to still images. Results show that dynamic identity signatures did not contribute to person recognition beyond form-from-motion processes. We conclude that the face, body and form-from-motion processes all appear to play a role in unfamiliar person recognition, suggesting the importance of considering the whole body and motion when examining person perception.

1. Introduction

When recognizing people in daily life we have a vast array of information at our disposal as we typically see the whole person and often in motion. However, research on the subject usually focuses on the role of faces in the process of person recognition. In the current study we focus on person recognition beyond the face and assess the roles of the body and motion in recognition of the whole person as well as the specific mechanisms involved in this process.

The processing of the whole body in motion has been primarily studied with point light displays (first described in Johansson, 1973). These displays are created by attaching reflective tape or LED lights to joints of the body and then filming a person while performing different types of actions. The resulting videos are then edited to create displays in which only the lights on the joints are visible and no other visual information. This enables the study of motion with minimal contribution from other sources of information and such displays have been used to show that from point light motion it is possible to perceive the gender of a walker (Kozlowski & Cutting, 1977), their emotions (Atkinson, Dittrich, Gemmell, & Young, 2004), the weight of objects they are carrying (Runeson & Frykholm, 1983) and much more (for reviews see Blake & Shiffrar, 2007 and Thornton, 2006). Most relevant to the current study are studies showing person recognition based on point light displays of familiar or familiarized people (e.g. Cutting & Kozlowski, 1977; Hill & Pollick, 2000; Jacobs, Pinto, & Shiffrar, 2004; Loula, Prasad, Harber, & Shiffrar, 2005; Troje, Westhoff, & Lavrov, 2005), as well as matching of unfamiliar people (e.g. Richardson & Johnston, 2005; Stevenage, Nixon, & Vince, 1999). These studies varied greatly in the type of design and stimuli they employed as well as in the recognition rates they obtained, which varied from poor but above chance person recognition to sometimes near perfect recognition rates. Overall these findings suggest that motion can play a role in person recognition.

In naturalistic person recognition, isolating the role of motion is more complex, because while point light displays allow for the examination of motion independent of form information (if the

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distance between the points of light is controlled for), in naturalistic situations we are also exposed to rich information from the face and body. Thus, studies using full light videos of people in motion are needed to isolate the roles of the face, body and motion and assess their relative contribution to person recognition. Several studies have used full light videos displaying people in motion for examining person recognition (e.g. Bruce, Henderson, Newman, & Burton, 2001; Burton, Wilson, Cowan, & Bruce, 1999; Liu, Seetzen, Burton, & Chaudhuri, 2003; Pilz, Vuong, Bülthoff, & Thornton, 2011; Roark, O'Toole, & Abdi, 2003; Roark, O'Toole, Abdi, & Barrett, 2006; Schiff, Banka, & de Bordes Galdi, 1986). In most of these studies, after seeing the full body in motion person recognition was examined from the face alone (Bruce et al., 2001; Burton et al., 1999; Liu et al., 2003; Pilz et al., 2011; Roark et al., 2006; Schiff et al., 1986) or, when person recognition was performed on the full body, only the face was presented at study (Roark, O'Toole, & Abdi, 2003). While many insights into face based person recognition have been gained using such paradigms, the contribution of the body to person recognition, beyond the face, cannot be assessed in these cases.

Recently several studies examined person recognition of the whole person in motion and highlighted very interesting interactions between the body and motion: The most comprehensive study on the subject was conducted by O'Toole et al. (2011). In their study, full body, face and body only stimuli where presented in pairs and participants had to determine if the same identity was presented in both stimuli. Each pair included the same type of images: either pairs of faces, pairs of full bodies or pairs of bodies alone. In order to examine the contribution of motion to person recognition, the two stimuli in each pair were presented in videos, multiple still images from the videos or a single static image from the video. Using this method O'Toole et al., 2011 showed that exposure to dynamic information improved person recognition in cases where the body was present, while motion did not contribute to person recognition based on the face alone. The same group recently examined the time course of person recognition in videos of familiarized people and highlighted the significance of the face and body to person recognition as it unfolds over time and viewing distance (Hahn, O'Toole, & Phillips, 2015). This study shows that the body contributes to person recognition at larger viewing distances from the observer, whereas at shorter distances the face dominates. Another recent study examined person recognition by presenting videos of the whole person and examining person recognition from either videos or static images of the full body, face or body alone (Robbins & Coltheart, 2015). This study found some advantages to full body compared to face recognition but no advantage to recognizing people from videos compared to still images. Overall, these studies show that the body and motion do contribute to person recognition beyond the face. Nevertheless, it cannot be determined what type of motion information plays a role in whole person recognition.

When examining the contribution of motion to whole person recognition, two processes should be taken into account: form-from-motion (or structure-from-motion) processes and dynamic identity signatures (described in O'Toole, Roark, & Abdi, 2002 in the context of faces). Form-from-motion processes refer to the creation of a better representation of the shape of a moving object relative to the representation of the same object's shape if viewed in static displays alone (e.g. see Koenderink, 1986 and Ullman, 1979 on the computational aspects that may be invovled in these processes and how they might take place in human perception). Form-from-motion processes may play a role in person recognition for example if seeing a person in motion allows us to form a better representation of what that person's general body shape looks like when they stand still. Dynamic identity signatures on the other hand refer to unique motion patterns that can be used for person recognition, or 'identity-specific' movements (O'Toole et al., 2002): a particular way of swinging one's hand or a slight limp for example can act as dynamic identity signatures and may be used as cues to recognize a person in motion (see Larsen, Simonsen, & Lynnerup, 2008 on the possible use of gait analysis in court).

After seeing a person in motion both form-from-motion processes and dynamic identity signatures may play a role in person recognition. These processes can be dissociated by examining recognition from videos and still images separately. When recognizing a person from a still image for example, we rely mainly on form information since dynamic identity signatures are not available. When recognizing a person in video, dynamic identity signatures can contribute to person recognition beyond form-from-motion processes. Comparing person recognition between video and still images can therefore reveal the independent contribution of these two motion processes. It should be noted that motion may contribute to person recognition in additional ways (see for example theories on dynamic mental representations, Freyd, 1987), and the dissociation between these two processes may not be complete (as implied motion cues may be available in still images and dynamic information may better highlight form). However, the comparison between video and still images can provide some initial understanding of the relative roles of form and idiosyncratic motion related information in recognition of the whole dynamic person.

In the current study we thus outline whether the body and motion contribute to person recognition beyond the face, and examine the different types of motion processes that may mediate this contribution. In Experiment 1 we assessed the contribution of the body to person recognition and the role of form-from-motion processes. In Experiment 2 we examined whether dynamic identity signatures can contribute to whole person recognition beyond form-from-motion processes.

2. Experiment 1 – Do the face, body and form-from-motion processes contribute to person recognition?

To examine the relative contribution of the face, body and form-from-motion processes to person recognition we created a matching task in which the stimuli were presented sequentially, in pairs. The first stimulus is each pair always depicted the whole person and could either be a video clip of a person walking adapted from the Video Database of Moving Faces and People (O'Toole et al., 2005) or multiple still images from the video which contained similar visual information to that in the video but without motion. The second stimulus in the pair was a still image of a person depicting either the full body or face alone and participants were asked to determine if both of the stimuli in each pair depicted the same identity. Fig. 1 shows a schematic presentation of the experimental design.

Using this method the contribution of the body to person recognition could be assessed by examining the difference between full body and face based recognition. In particular, if person recognition from the full body proves better than person recognition from images of the face alone then the body contributes to person recognition beyond the face. The contribution of from-from-motion processes to person recognition could be assessed by examining the differences between recognition following exposure to videos vs. multiple still images. If person recognition from still images after exposure to videos proves better than person recognition after exposure to still images alone then from-from-motion processes contribute to person recognition.