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Running head: Memory of biological motion

Memory of gender and gait-direction from biological motion:

Gender fade away but directions stay

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Abstract

The delayed-discrimination method has been used to demonstrate a high-fidelity non-decaying visual short-term memory (VSTM) for so-called pre-attentive basic features. In the current study I show that the non-decaying high VSTM precision is not restricted to basic features by using the same method to measure memory precision for gait-direction and gender-stereotypical gait patterns from high-level point-light walkers. Non-decaying VSTM of direction was found for delays up to nine seconds whereas memory for gender decayed. For both tasks response times (RT) increased with the delay, but only gender RT took longer when the two walkers faced different directions to the line of sight compared to the same direction. The results may reflect differences between local and global processes, or an ecologically valid strategy where VSTM resources are focused on changing variables, such as keeping track of people's movements rather than variables that are constant during short timescales, such as their gender.

Key words: Visual short term memory, biological motion, delayed discrimination, gender, direction.

Delayed discrimination studies measuring the precision of visual short term memory (VSTM) have almost exclusively used simple meaningless features traditionally used to investigate low-level visual mechanisms, such as spatial-frequency (Magnussen et al., 1990), speed (Magnussen & Greenlee, 1992), direction of motion (Blake, Cepeda & Hiris, 1997), orientation (Raney & Harvey, 1994), and color (Nilsson & Nelson, 1981) and consequently attributed such memory tasks to low-level memory processes (e.g. Magnussen & Greenlee, 1999). An exception to this trend is a study of VSTM precision of facial emotional expressions and identity (Bankó, Gál & Vidnyánszky, 2009). In the delayed discrimination method two stimuli are presented one after another with a delay and participants are required to discriminate the two stimuli. One common theme of all these precision measurements using delayed discrimination tasks is that they demonstrate a remarkable precision that does not seem to decay as the retention interval is increased up to 10-30 seconds. The task is believed to involve implicit memory systems that store shapes without any meaning at a stage in the visual processing hierarchy before object perception and identification processes are activated (for a review see Magnussen & Greenlee, 1999). The overall high non-decaying precision of feature memory stand in sharp contrast to the low VSTM capacity estimations ranging from 1 to about 3 objects (Alvarez & Cavanagh, 2004; Luck & Vogel, 1997; Olsson & Poom, 2005) and about 3 human actions (Wood, 2007). However, studies investigating the precision of such higher-level stimuli are sparse.

Since Gunnar Johansson's (1973) classical demonstrations of the perception of biological motion from point-light displays, people have been fascinated by the visual systems ability to extract high-level information from motion patterns alone. Such point-light walkers provide an opportunity to use the delayed discrimination method with the same biological-motion stimuli in two different tasks, discrimination of walking direction and discrimination

of gender-stereotypical gait patterns. Even though the motions of human actors are revealed only by light spots attached to the 12 major joints, one can immediately perceive the human figure and the actions performed. Such point-light displays are ideal to test influences from high-level meaningful stimuli on perception and VSTM. Body movements exposed by such point-light displays immediately reveal walking direction (Johansson, 1973), how much weight is carried (Runeson & Frykholm, 1981), identity, emotional state, personality (Blake & Shiffrar, 2007), age (Montepare & Zebrowitz-McArthur, 1988), and gender (Kozlowski & Cutting, 1977; Mather & Murdoch, 1994). Gait direction and gender judgments have frequently been used as dependent variables when studying biological motion (Neri, Morrone, & Burr, 1998; Poom & Olsson, 2002). Perception of direction and gender from point-light walkers may rely on different mechanisms.

Perception of biological motion relies on both global (Bertenthal & Pinto, 1994) and local processes (Troje & Westhoff, 2006; Hirai, Saunders, & Troje, 2011). Although global translational movement is absent when a point light walker is displayed as walking on a treadmill, direction can still be obtained by the recovery of motion defined shape of the walker, or by the local varying motions of individual dots (Hirai, Saunders, & Troje, 2011). Judgments about the gait direction of point-light walkers depend particularly on the motion patterns of the wrists and ankles (Mather, Radford, & West, 1992) and can be obtained from local information about the motion of the feet (Troje & Westhoff, 2006). Gender judgments from biological motion patterns require other cues. Recordings of eye-movements show that attention is directed to different regions of interest in gender and direction judgments. In both tasks participants frequently fixated the pelvis region but in the gender task there were relatively more fixations at the shoulders and in the direction task there were more fixations at the feet, although an individual's performance could not be predicted from the distributions of

fixations (Saunders, Williamson, & Troje, 2010). Torso shape displayed by dots on shoulders and hips is a potential cue to gender with men generally having wider shoulder width relative to their hips than women (Cutting, Proffitt, & Kozlowski, 1978). Another gender cue is provided by lateral body sway during gait where the stereotypical masculine attitude is to show greater lateral sway of upper body, the head and thorax, than the pelvis, whereas stereotypical feminine attitude is characterized by the opposite sway pattern (Murray, Drought, & Kory, 1964; Murray, Kory, & Sepic, 1970). When these two cues are pitted against each other it's evident that gender discrimination is based primarily on lateral body sway in shoulders and hips, and not on torso shape (Mather, & Murdoch, 1994).

In the study reported here I examine for the first time VSTM precision for meaningful point-light walkers using two tasks, discrimination of gender-stereotypical gait pattern and direction discrimination. I hypothesize that meaningful complex motion stimuli may obey different rules than shown for basic features in previous studies using the delayed discrimination task. For example, since perception of direction can be obtained from local cues whereas gender from point-light walkers relies on global information, task instructions may activate qualitatively different mechanisms involved in these tasks. In addition, memory resources may be directed to important changing variables in the environment rather than variables that stay invariant (Bankó, Gál, & Vidnyánszky, 2009). Increasing the delay should reduce memory precision if information is lost during maintenance, the memory representation gets progressively noisier (Lee & Harris, 1996), or if recall gets harder with the passage of time. Further, response times (RTs) in a delayed spatial frequency discrimination task increases when gratings have different orientations compared to the same orientations, while the precision is left unaffected. This has been interpreted as a time consuming comparison process between separate orientation specific representations (Magnusson &

Greenlee, 1999). In this study, to investigate orientation specificity, the synthetic walker faced either the same or opposite directions to the line of sight.

Method

Participants

Twelve healthy adults, seven females, participated in both tasks. Their ages ranged from 22 to 36, average age was 28. All had normal or corrected to normal visual acuity. All participants gave informed consent to participate and were compensated with a cinema ticket (worth 90 Swedish Kronor, or about 9 Euro). The procedures were approved by the Uppsala university ethical review board.

Stimuli

A computer algorithm was developed to display artificial walkers with 13 points at the main joints: ankles, knees, hips, shoulders, elbows, hands, and head (Fig 1A). The coordinates of each point was specified in a three-dimensional space. A complete gait cycle of 1.2 sec was composed of 60 static frames and for each frame the coordinates of the main joints were updated. Harmonic pendulum motions specified the motions of the limbs where the joint angle (A) varied over time (t) as $A(t) = A_0 \times \cos(\omega(t) + phase) + A_1$. Angle A_0 is the maximum pendulum amplitude, Angle A_1 specifies the constraint that for example the elbow can't bend backwards beyond a straight arm position, in that case $A_1=A_0$. Arm swing was 40 deg about the shoulder and 40 deg about the elbow as displayed by α and β in Figure 1A. Corresponding leg swing was 40 deg about the hip and 50 deg about the knee.

In addition to sideway sway, hips and shoulders performed pendulum motions in horizontal directions around the vertical and up-down motions due to pendulum motions

around the facing direction along the x-axis. Due to gravity, the ground level enforces vertical 'bounce' motions of the whole body during the gait cycle since the lowest foot position always has ground contact which in turn constrains the position of the rest of the body resulting in natural soft bouncing vertical motion pattern typical for human gait. Foot pendulum motions around the ankle further increased the naturalness of the gait pattern, but only the ankle positions were shown by dots. After the coordinates were updated for each frame the synthetic walker could be rotated about the vertical to face different directions. The location of each point was then polar-projected to be displayed on the screen y (height) and z (width) coordinates. The distance to the nodal point was three length units where one length unit was the height of the artificial walker. None of the points were occluded by other body parts during the gait cycle. The 3D structure of such parallel projected point-light motion displays is ambiguous with respect to depth-order so that approaching and receding walking patterns are indistinguishable. Although there is a strong bias to perceive such walkers as facing the observer (Vanrie, Dekeyser, & Verfaillie, 2004), the polar projections further unambiguously specified the walkers facing direction toward the observer.

The walker's length was 8.5 deg of visual angle on the screen and appeared on the same location as walking on a tread mill. Body measures on one typical average weighted male and one typical average weighted female were used for specifying the average measures of limbs and torso of the artificial walker. The torso measures were randomly varied within a rectangular distribution with a width of 30 % around the average measures. This random variation of shoulder-width and hip-width prevented the use of torso measurements, such as the perspective view of shoulder or hip-width when judging direction. A neutral walker was specified with same hip and shoulder sway with $\varnothing_{\max} = 5$ deg around the x-axis and with $\theta_{\max} = 2$ deg amplitude around the y-axis (\varnothing and θ as in Figure 1A). The relation between \varnothing_{\max} and

θ_{\max} was held constant but the relative magnitude of hip to shoulder sway was independently varied by a “gender” factor, the sway ratio, specifying the amount of gender-stereotypical female gait. The resulting pattern of moving dots on the screen caused a vivid impression of a walking person facing about 30 degree to the left or to the right.

FIGURE 1 ABOUT HERE

Procedure and data analyses

An adaptive threshold estimating algorithm called ZEST, zippy estimation by sequential testing (King-Smith et al., 1994), with a two-interval forced choice procedure, was used to obtain the required difference between pairs of stimuli to obtain the threshold for making 80 % correct discriminations in the long run. Weber fractions, $\Delta S/S$, where S is a stimulus parameter (sway ratio or walking direction) and ΔS is the inter-stimulus difference, were used to quantify the difference between stimulus pairs at each trial. The ZEST algorithm rapidly converges toward the threshold estimate and the Weber fraction obtained after 30 trials was used as the threshold estimate. At each trial the first walker was presented at the left side of the screen, facing either to the left or right with an angle of about 30 deg from the observer’s line of sight. After a variable delay the second walker appeared at the right side of the screen also facing either left or right. Both walkers completed one gait cycle. On half of the trials both the walkers faced the same direction, on the other half of the trials one faced left and the other faced right to measure influences of orientation difference. These conditions were interleaved in the experimental runs but separately treated by the adaptive testing algorithm. Response times were measured and fading of perceptual memory was tracked by comparing performance at 0, 1, 3 and 9 seconds delay run in separate randomly ordered blocks.

The 30 trials x 4 delays x 2 facing directions resulted in 240 trials / task. The two tasks were run on separate days. Before the tasks each participant were shown examples of point-light walkers so they would be familiar with the stimuli and the task. Two walkers were successively displayed. *Task 1* was to determine which walker had the most feminine gender-stereotypical walking pattern. *Task 2* was to judge which walker had a gait direction appearing closest toward the observer. Participants were instructed to respond as fast and accurate as possible. Half of the participants started with task 1 and the other half began with task 2.

In task 1 gender-stereotypical gait was completely specified by the ratio between hip and shoulder sway. Greater ratios between hips and shoulder sway characterized a more female gait pattern. Figure 1B and C shows the dot trajectories during one gait cycle, where the gait pattern in Figure 1C has a larger sway ratio which is perceived as more stereotypically feminine compared to the gait pattern in Figure 1B. This can be seen most clearly by identifying the trajectories of the shoulder and hip dots, where the motion amplitudes of the shoulder dots in Figure 1B is somewhat larger than in Figure 1C and the reverse is true for the hip amplitude. The Weber fraction specifying the gender difference of Figs 1B and C is .3. This sway ratio also influenced the motions of the limbs and head, only ankle positions were not influenced. At each trial the sway ratio of the first walker was randomized using a rectangular distribution +/- 30 % from the neutral gait to prevent criterion setting strategies (Lage & Treisman, 1998), still the sway ratio was within natural gait pattern limits, preventing the appearance of a caricatured walking style. In task 2 at each trial the first of the two presented walkers facing direction was randomly scattered using a rectangular distribution +/- 30 % around an average facing of either 30 deg left or 30 deg right, so at each new trial a new pair of stimuli is presented to minimize strategies based on criterion setting

(Lages & Treisman, 1998). The sway ratio in task 1 and the walking direction in task 2 between the two walkers differed at each trial by an amount that was progressively tuned in asymptotically by the adaptive procedure to yield 80 % correct discriminations.

Weber fractions from tasks 1 and 2 were analyzed together by a $2 \times 2 \times 4$ (task \times orientation difference \times time delay) within subject analysis of variance (at the conventional ad hoc level of $p < .05$) and partial eta-squared effect sizes were calculated. The same analysis was separately performed on the RTs. Analyses of interaction effects and post-hoc comparisons were performed to further evaluate the results.

Results

Thresholds

The Weber thresholds for obtaining 80 % correct discriminations of gender-stereotypical gait patterns and direction judgments are shown in Figure 2. For discriminations of gender with delays up to 1 sec a threshold of .25 was required. Additional increase of the delay up to 9 sec raised threshold to about .35 which is a 40 % increase. Compare the dot trajectories between Figure 1B and C displaying a Weber fraction of .3, demonstrating that the difference between the motion trajectories is quite small, still people reliably detected this difference from the motion patterns and correctly used it for gender discrimination. In the direction discrimination task, on the other hand, precision did not decay and the threshold for direction discrimination was .2 across all delays, implying a difference in gait direction of 6 deg for obtaining 80 % correct direction discriminations when discriminating other peoples gait directions about 30 deg off from collision course.

Main effect of delay was significant [$F(3,33) = 7.0$, $p < .001$, $\eta^2 = .39$], and task [$F(1,11) = 21$, $p < .001$, $\eta^2 = .66$], and so was the interaction delay \times task [$F(3,33) = 7.09$, $p < .001$, $\eta^2 = .39$] since only the threshold in the gender task increased with the delay.

No main effects of orientation was found [$F(1,11) = .81$, $p = .39$, $\eta^2 = .068$], and neither was any interactions found between orientation and delay [$F(3,33) = .38$, $p = .77$, $\eta^2 = .034$], or orientation \times task [$F(1,11) = .032$, $p = .86$, $\eta^2 = .0029$], or task \times orientation \times delay [$F(3,33) = .38$, $p = .77$, $\eta^2 = .033$].

Separate analysis of the two tasks showed that only for the gender task was there a significant effect of delay [$F(3,33) = 9.2$, $p < .001$, $\eta^2 = .45$]. This effect of delay was found for both orientation conditions when these were separately analyzed [same orientation: $F(3,33) = 2.88$, $p = .05$, $\eta^2 = .21$; different orientation: $F(3,33) = 5.12$, $p = .0052$, $\eta^2 = .32$]. The Tukey post hoc test showed that the Weber thresholds were significantly larger for the 9 sec delay in the different orientation condition than the 0 and 1 sec delays [$p < .05$]. No other post hoc comparisons were significant.

FIGURE 2 ABOUT HERE

Response times

Response times are shown in Figure 3. Responses took longer when delay increased [$F(3,33) = 23$, $p < .001$, $\eta^2 = .68$]. From zero delay up to 9 sec delay RTs increased from about 300-350 msec to about 500-550 msec. Also a main effect of orientation was found [$F(1,11) = 5.3$, $p = .042$, $\eta^2 = .33$], but no main effect of task [$F(1,11) = 1.8$, $p = .20$, $\eta^2 = .14$]. As seen in Figure 3 the RTs for discrimination of gender-stereotypical gait patterns, as opposed to direction discriminations, took little longer when the two walkers faced different

directions from the observers than if they faced the same direction, the interaction task \times orientation was close to significance [$F(1,11) = 4.2$, $p = .066$, $\eta^2 = .27$]. No interactions between orientation and delay were found [$F(3,33) = .48$, $p = .70$, $\eta^2 = .042$], or between task and delay [$F(3,33) = 2.24$, $p = .10$, $\eta^2 = .17$], or task \times delay \times orientation [$F(3,33) = .63$, $p = .60$, $\eta^2 = .054$].

The two tasks were separately analyzed and only for the gender task was there significantly longer RTs in the different orientation condition than in the same orientation condition [$F(1,11) = 7.1$, $p = .022$, $\eta^2 = .39$].

Tukey post hoc comparisons showed that the effect of delay, in the gender task with different orientation, resulted in significantly longer RTs with 9 sec delay than for 0 and 1 sec delays [$ps < .007$]. Also, in the same orientation condition significantly longer RT was obtained for the 9 sec delay than for 0 sec delay [$p = .035$]. The effect of delay in the direction task was due to the significantly longer RTs in the 9 sec delay than in the 0, 1 and 3 seconds delay conditions [$ps < .001$]. No other post hoc comparisons were significant.

FIGURE 3 ABOUT HERE

Discussion

Memory performances for perceptually high-level meaningful point-light walkers in some respects obey the same rules as the low-level features investigated in previous studies using the delayed discrimination task. Discriminations of direction from biological point light walkers were done with the same precision when pairs of stimuli were presented successively with no delay as when presented with 9 seconds delay. Beyond one sec delay memory precision for gender-stereotypical gait patterns did decay substantially, providing evidence for

different processes or different strategies involved in these two tasks. As previous studies have found for spatial frequency (Magnussen & Greenlee, 1999), an orientation difference between stimuli did not influence discrimination thresholds for either gender or direction. It has been known that basic features such as spatial frequency, orientation, speed and color are retained with a very high fidelity over up to 10-30 sec delays (Magnussen et al., 1990; Magnussen & Greenlee, 1992 ; Blake, Cepeda & Hiris, 1997; Raney & Harvey, 1994; Nilson & Nelson, 1981) whereas contrast of simple gratings decay in memory (Lee & Harris, 1996; Greenlee, Magnussen, & Thomas, 1991). About nine sec delay is commonly used in discrimination tasks (Bankó, Gál & Vidnyánszky, 2009; Magnussen & Greenlee, 1999), although some researchers report using up to 30 sec delays (reviewed by Magnussen & Greenlee, 1999). Probably at some point over 9 sec delay thresholds for direction discrimination would rise, but importantly the 9 sec delay was enough to reveal the memory decay in the gender task, and this delay quite long compared to the supposed duration whereby information can be retained in VSTM. Phillips (1974) for example concludes that VSTM deteriorates greatly within 10-20 sec. It has been suggested that decaying vs. non-decaying features may be reflected by the distinction between extensive and intensive dimensions, where stimuli are represented by either distributed activity or the magnitude of neural activity respectively (Magnussen & Greenlee, 1999). The neural mechanisms involved in the tasks presented here remain unclear, especially whether gender is represented as an intensive dimension that according to the hypothesis account for decay in memory, and gait direction as an extensive dimension that therefore resist decay.

A possible hypothesis accounting for the different influences of delay in the direction and gender tasks may rely on the distinction between local and global processes activated by separate task instructions. There is evidence for automatic processing of local biological

motion signals that is independent of the global configuration processing (Wang, Zhang, He, & Jiang, 2010). It was recently found that local direction signals conveyed by feet-motion act as a pre-attentive feature in visual search tasks (Wang et al., 2010). Whereas walking direction may be judged from a basic pre-attentive local cue (Hirai, Saunders, & Troje, 2011; Wang, et al., 2010) information about gender-stereotypical gait patterns are found in the relation between hip and shoulder sway inherent in the global configuration of motion. In this view the non-decaying high precision VSTM of gait-direction, and features such as orientation and spatial frequency are all associated with pre-attentive local features. The gender task on the other hand involve global processing of the motion pattern which may activate higher level mechanisms in the visual hierarchical processing system than mechanisms involved in the pick-up of local features.

An alternative hypothesis, based upon VSTM processes, rests on the assumption that higher level meaningful stimuli such as biological motion patterns as opposed to low level features may obey different storage strategies. For example, the organization of the face perception system may emphasize a distinction between the representation of invariant aspects of faces that underlies the recognition of individuals, and the representation of changeable aspects of faces, such as another individual's direction of attention (Haxby, Elizabeth, Hoffman, & Gobbini, 2000). Bankó, Gál and Vidnyánszky (2009) in their Experiment 1, found a marginally significant ($p=.07$) memory decay for facial identity over a 6 sec delay, whereas discrimination of facial emotions was not affected by the delay ($p=1.0$), although in their second experiment they failed to find any difference. Gender is information about identity that, like facial identity, is an invariant attribute over short time scales (Calder & Young, 2005; Haxby et al., 2000) and requires no further monitoring after an initial identification is accomplished. Consequently, as suggested by Bankó, Gál and Vidnyánszky

(2009), storage of fine grained identity information in VSTM may not be needed since such non-varying distal stimuli constitute an external memory which can be checked anytime when needed by looking (O'Regan, 1992). A demonstration of our inability to store visual information is change blindness with the remarkable example that during a social encounter with a stranger, participants often fail to detect identity changes after a brief staged separation (Simons & Levin, 1998) further supporting that other person's identities are not prioritized by the human VSTM. On the other hand, other persons gait direction may continuously change and is especially important to monitor since it may suddenly signal an approaching individual which may require preparation of some action. It may also be valuable to monitor where other people are facing and where they direct their attention. Consequently, the direction of a point-light walker induces a reflexive shift of observers' spatial attention in the same direction (Shi, Weng, He, & Jiang, 2010). This process requires frequent updating to check for changes which in-turn requires internal memory.

The RT measurements revealed an additional difference between direction and gender tasks in that the relative orientation of the two walkers influenced RTs only for gender discriminations, responses took about 50 ms longer when the walkers faced different directions than if they faced the same direction. The direction discrimination task was to decide which walker appeared with the closest walking path in relation to the observer, and may be represented in memory as an angular deviation from the line of sight, while ignoring information whether gait direction is to the right or left relative the observer. For gender judgments, however, it seems that some additional time consuming process operates when walkers face different directions, maybe because the comparison involves comparing activities across different neural populations as suggested for the additional time required for discriminating spatial frequency between differently oriented gratings (Magnussen &

Greenlee, 1999). Response times increased progressively as delay got longer. Reasons for this may be that information successively consolidates to long term memory as previously suggested for basic features (Magnussen & Greenlee, 1999) which results in longer retrieval time. Results from feature discrimination studies, presenting individual results from few participants, suggests a two-stage process where RTs are constant for delays up to about three seconds and thereafter increases. No indications for such two-stage process were found here. The aggregated data across many participants presented here, however, may conceal evidence for discontinuities. An alternative explanation to the increased RTs following increased delay may simply be that longer delays generate an overall slower tempo followed by the participants.

The high precision of feature and eccentricity discriminations stands in sharp contrast to the very low VSTM capacity, traditionally measured with the change detection method where several objects are presented twice with a delay and the task is to report if any object was switched between presentations. Although capacity estimates for inter-categorical objects are around 3-4 objects (Luck & Vogel, 1997) and the capacity for observed human actions is 2-3 actions at once (Wood, 2007), the capacity estimate for intra-categorical objects is only about one object (Alvarez & Cavanagh, 2004; Diamantopoulou, Poom, Klaver, & Talsma, 2011; Olsson & Poom, 2005). The low capacity and at the same time high precision of VSTM can be reconciled by assuming a high fidelity all-or-none storage limit of one item, or that precision degrades severely when an individual attempt to store more items that compete for the resources.

Both local and global components contribute to biological motion perception and the division of contributions is probably task dependent. It is known that direction can be detected from the local motion of the feet alone, maybe pre-attentively (Wang et al., 2010), whereas

discrimination between gender-stereotypical gait patterns as specified in this study requires processing of the global motion configuration. Different tasks typically involve different brain regions involving multiple special purpose brain areas in on-line visual processes which are also activated during maintenance in short term memory (Pasternak & Greenlee, 2005; Bankó, et al., 2009). The findings presented in this study provide psychophysical evidence for different task specific mechanisms involved in delayed discrimination tasks for biological motion stimuli that in some aspects obey the same rules as previously found for basic features. The results add evidence for different processes involved for discriminating different attributes from point-light walkers by using the delayed discrimination paradigm.

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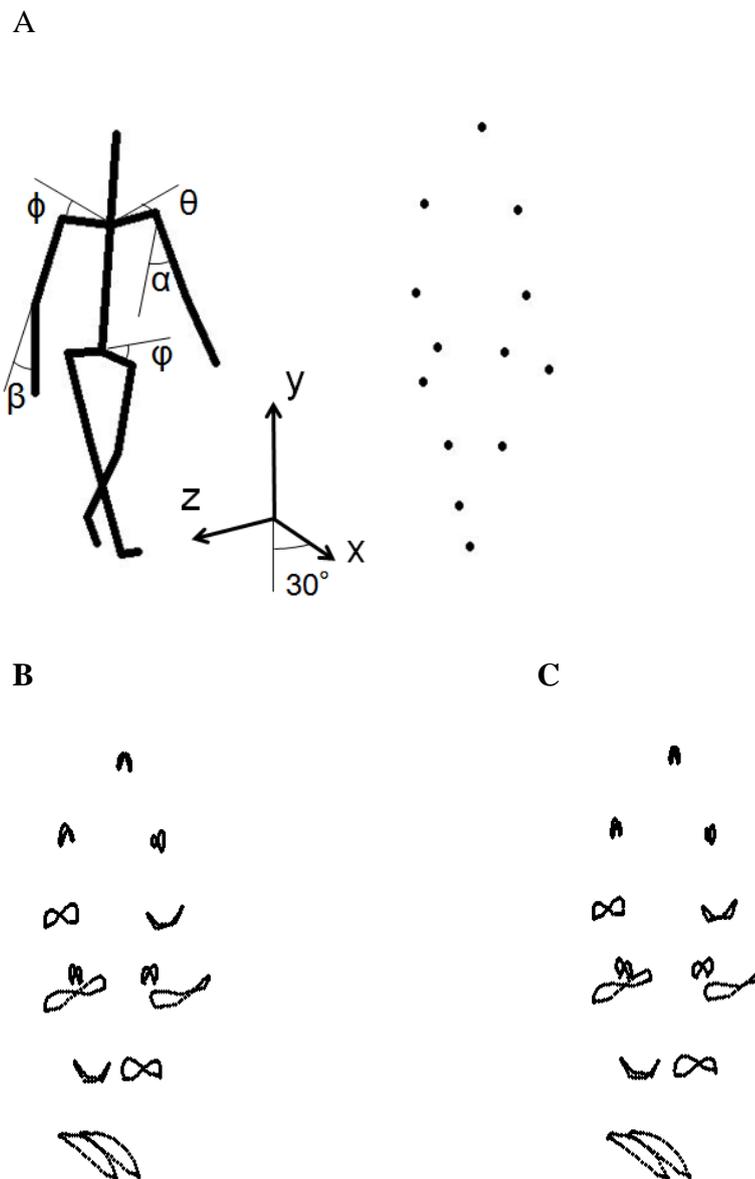


Figure 1 A. Left: The walker, facing 30° to the right, displayed as a stick figure to demonstrate the composition of limbs and torso. Displayed are the pendulum motions of over-arm around the shoulder, and under-arm around the elbow. Leg and feet were also involved in pendulum motions. Shoulder sway around the x and y-axis are also shown, the hips performed similar motions in anti-phase but only sway around the x-axis is shown here. The lateral motions of hips and shoulders along the z-axis are not shown. In the actual displays only dots at the larger joints and the head were visible as shown to the right. B and C shows complete

gait cycle trajectories of the 13 points on synthetic point light walkers, facing 30 deg to the right. The gait pattern of B is characterized as more masculine than C due to less hip to shoulder sway (Weber fraction is .3).

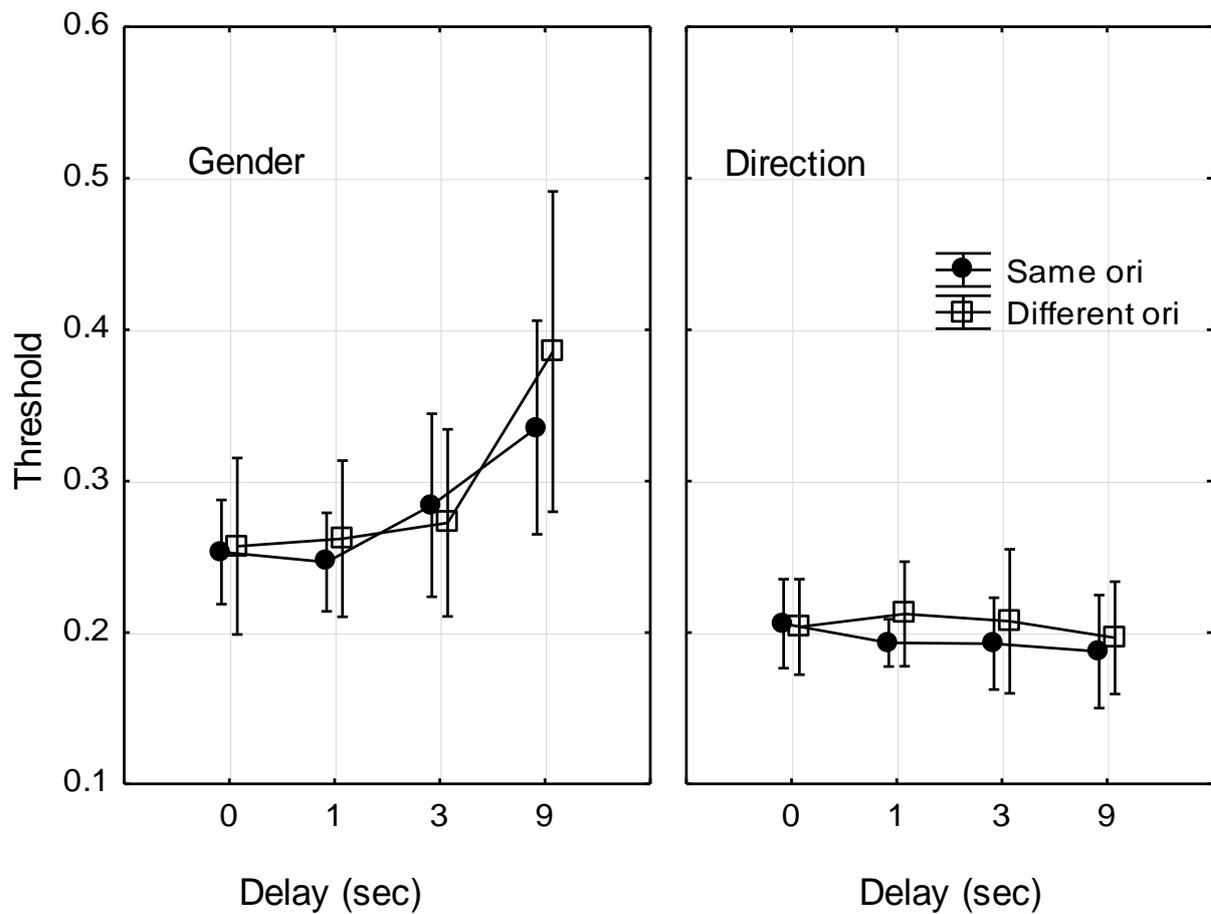


Figure 2. The thresholds for obtaining 80 % correct discriminations of gender-stereotypical gait patterns (task 1) and gait direction (task 2) expressed as Weber fractions are displayed separately for walkers having the same orientation (both left or both right), and different orientations from the observers line of sight (one left and the other right). The 95 % confidence intervals are shown.

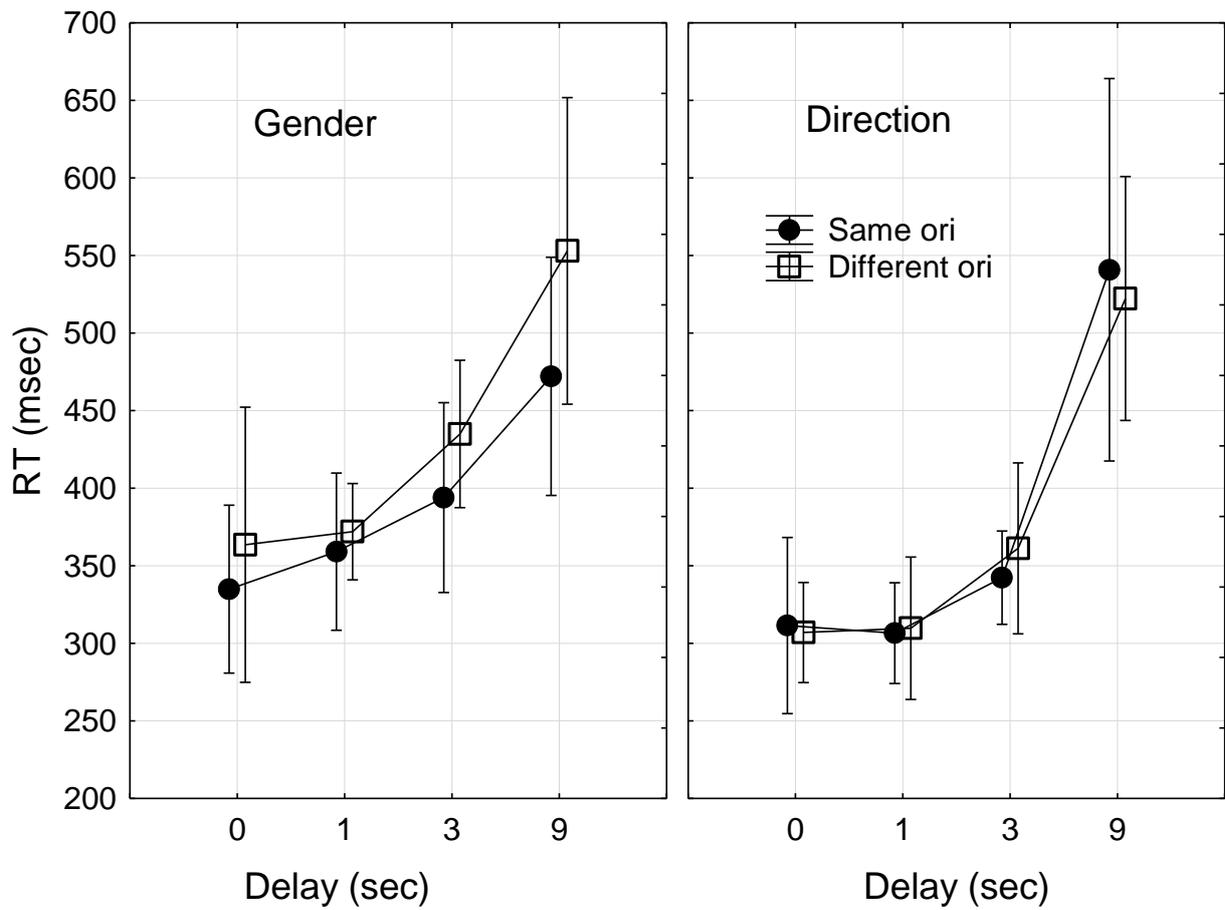


Figure 3 Response times as a function of delay in gender task (task 1) and gait direction task (task 2), displayed separately for walkers having the same orientation (both left, or both right) and different orientations from the observers line of sight (one left and the other right). The 95 % confidence intervals are shown.