



Research paper

Reaction time in gait initiation depends on the time available for affective processing



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HIGHLIGHTS

- Reaction time depends on the delay between emotional image onset and start signal.
- When this delay was 0.5 s a congruency effect for reaction time appeared.
- When this delay was 3 s the congruency effect disappeared.
- An emotion regulation strategy is thought to be implemented for unpleasant pictures.
- This strategy revealed a change of image valence appraisal and initial posture.

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ABSTRACT

Previous studies have reported that reaction time in gait initiation was affected by emotion eliciting pictures. This study examined the effect of a change in the delay between image onset and the imperative “go” on reaction time. From a standing posture, 19 young adults had to walk (several steps) toward pleasant or unpleasant images in two conditions. In the short condition, the word “go” appeared 500 ms after image onset and participants were instructed to initiate gait as soon as possible after the word go appeared. In the long condition, the same procedure was used but the word “go” appeared 3000 ms after image onset. Results demonstrated that motor responses were faster for pleasant pictures than unpleasant ones in the short condition. In contrast, no significant difference was found between both categories of pictures in the long condition. Moreover, we found that self ratings of valence of unpleasant pictures were less unpleasant in the long condition than in the short one whereas there was no difference for pleasant pictures between both conditions. This result reflected a change in the affective significance of unpleasant pictures in the long condition. We also found in the long condition, that the body was inclined forward and to the stance limb during the standing posture and importantly with a similar extent for pleasant and unpleasant pictures. This change clearly reflected a facilitation of the gait initiation process. Overall, results suggested that this gait facilitation when confronted to unpleasant pictures resulted from emotional regulation processes enabling to reappraise these pictures and to override the initial avoidance tendency that they caused.

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1. Introduction

The impact of emotional states on the control of behaviour has been largely investigated using typical button press tasks. In contrast, a few studies focussed on the effect of emotion eliciting pictures on the production of a whole body movement i.e.

gait initiation. These studies provided original data related to approach/avoidance behaviour. In this study, we focussed on a discrepancy between some of these studies [1–4] regarding the time for gait initiation planning (i.e. reaction time). Indeed, the major finding presented by Naugle et al. [1] was at odds with the other studies [2–4]. The main purpose of this study was to examine this discrepancy.

The gait initiation process consists of two phases. A postural phase precedes the execution phase. In the former, the role of anticipatory postural adjustments (APA) is to destabilize the erect posture prior to the stepping limb movement by displacing the cen-

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tre of foot pressure (CP) backward and to the stepping foot, enabling thus the centre of body mass (CM) to be propelled forwards and to the stance foot [5]. APAs are centrally driven [6] and reflect the means (muscular pattern) to be implemented for reaching the goal related to movement planning.

Emotion is considered to prime the body for action [7]. According to the biphasic theory of emotion [7,8], emotion is fundamentally organized around two basic motivational systems: appetitive and defensive, priming approach and avoidance behaviours respectively. Considering the self as located in the body, evidence for this motivational direction hypothesis was found using upper limb flexion (approach)/extension (avoidance) movements in response to emotional words [9]. Nevertheless, approach/avoidance behaviours can be conceptualized in a different way by considering a decrease (approach) or increase (avoidance) in the distance between the self and the affective stimulus location [10,11]. Thus, the results demonstrating that participants were faster to initiate gait toward pleasant pictures than unpleasant ones [2,3] were consistent with the motivational direction hypothesis. For unpleasant stimuli, it was suggested that more time was required for motor planning because a conflict (between the direction of movement and the valence of stimulus) had to be overridden [3].

In the present study we sought to examine the discrepancy between the findings of four studies [1–4] concerning the time to initiate gait that is reaction time (RT). In three of these studies [2–4] participants were found to be faster to initiate gait toward pleasant pictures than unpleasant ones, whereas in the other one [1] high arousing unpleasant pictures provided the shortest reaction times. Very recently, a reason for this discrepancy has been proposed from a critical difference between the paradigms used [12]. Indeed, in three studies [2–4], participants were instructed to perform gait initiation as soon as possible after image onset, whereas in the other study the emotional image was initially viewed for 2–4 s and the movement was initiated after image offset [1]. Thus, the time for which participants viewed emotion eliciting pictures would influence the time necessary to plan gait (i.e. RT) depending on valence of emotional pictures. The study of Stins et al. [12] using both paradigms demonstrated that gait was initiated faster with pleasant pictures at onset and fastest responses were found with high arousal unpleasant pictures at offset, in line with the study of Naugle et al. [1]. The authors [12] argued that upon picture offset participants were in a state of heightened arousal. Especially high arousal unpleasant pictures likely triggered powerful action tendencies so that participants were faster to initiate gait in the offset condition. However, it was difficult to understand how a state of heightened arousal was able to override the initial avoidance response tendency elicited by these pictures. Furthermore, it was noteworthy in the study of Stins et al. [12] that when valence of pictures was solely considered, no difference between pleasant and unpleasant pictures was found at offset. One possibility to explain this finding was that an emotion regulation process [13] might be involved over prolonged viewing of unpleasant pictures. Indeed, the process model of emotion regulation proposed by Gross [13] distinguishes two forms of cognitive emotion regulation: suppression (defined as the inhibition of an ongoing emotion-expressive behaviour) and reappraisal. The latter operates primarily through meaning-evaluation mechanisms enabling to change the affective significance of an emotional stimulus. So, a reappraisal strategy would be able to change the affective significance of unpleasant pictures and a mechanism of suppression would be able to override the initial avoidance response tendency elicited by these pictures. Both mechanisms might thus account for the finding of Stins et al. [12].

In the current study, pleasant and unpleasant pictures were presented for either a short (0.5 s) or long (3 s) duration and then the

word “go” appeared on the picture indicating that gait had to be initiated. We expected that gait was initiated faster for pleasant than unpleasant pictures for a short presentation of pictures. In contrast, no difference between pleasant and unpleasant pictures was expected during prolonged viewing of pictures. Indeed, this additional time would allow both forms of emotion regulation [13] to operate in order to neutralize the conflict (stress) inherent to plan a forward movement toward unpleasant pictures and thus fulfilled what participants were instructed to do. We reasoned that increasing the time available for affective processing allowed a reappraisal strategy to operate, leading to change the affective significance of unpleasant pictures. As a result, we expected that the self reported valence and/or arousal of unpleasant pictures was rated as less unpleasant and/or arousing during the long than the short presentation of pictures. Moreover, we expected a change during the standing posture after image onset only for a long presentation of pictures. This change would be characterized by a forward body tilt reflecting a facilitation to initiate gait. We expected that this change was present for pleasant pictures but also for unpleasant ones, indicating that participants were able to override the avoidance response tendency elicited by the latter. This would reflect that a mechanism of suppression operated. The possibility that postural changes occurred on the medio-lateral direction, as previously reported [14,15], was also examined.

2. Methods

2.1. Participants

Nineteen young healthy adults (age 18–26 years, 11 women recruited from the University of Paris Ouest Nanterre participated in this study with their informed consent. All were right handed, had normal or corrected-to-normal vision and did not report any psychiatric disorders.

2.2. Materials and methods

We used a force platform (AMTI, 120 × 60 cm) that measured the three components of ground reaction forces (F_x , F_y and F_z) and moments (M_x , M_y and M_z).

In each condition, twenty images (10 pleasant and 10 unpleasant) selected from the international affective picture system (IAPS) [16] were used. As in the study of Naugle et al., 2011, one half of pleasant and unpleasant images were low arousing (LA) and the other half were high arousing (HA), representing four affective categories: happy people for low arousing pleasant images, erotic for high arousing pleasant images, sad people for low arousing unpleasant images and attack for high arousing unpleasant images.¹ The normative valence of pleasant and unpleasant images differed significantly ($M=7.23$, $SD=0.49$ for pleasant images; $M=2.38$, $SD=0.40$ for unpleasant images). The normative arousal of both image categories was similar, depending only on its level (low/high) ($M=4.98$, $SD=0.53$ for LA pleasant images; $M=6.35$, $SD=0.26$ for HA pleasant images; $M=5.09$, $SD=0.41$ for LA unpleasant images; $M=6.83$, $SD=0.34$ for HA unpleasant images). To ensure that valence and arousal of the pictures were equivalent between both conditions, a statistical analysis was performed indicating no effect of condition and no interaction between the image

¹ IAPS images : LA pleasant : 2030, 2070, 2071, 2091, 2216, 2224, 2311, 2340, 2345, 8496 ; HA pleasant : 4607, 4608, 4611, 4643, 4660, 4670, 4676, 4677, 4694, 4695 ; LA unpleasant : 2095, 2141, 2455, 2703, 2799, 2800, 2900, 3230, 9041, 9421 ; HA unpleasant : 2811, 6210, 6230, 6250, 6260, 6300, 6313, 6350, 6370, 6510 ; neutral (nogo) : 7000, 7010, 7020, 7043, 7053, 7055, 7056, 7080, 7090, 7150, 7175, 7190, 7233, 7235.

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