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AGE-RELATED DIFFERENCES IN PROCESSES ORGANIZING GOAL-DIRECTED LOCOMOTION TOWARD EMOTIONAL PICTURES

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Abstract—Previous studies yielded evidence for an interaction between age and valence in numerous cognitive processes. But, to date, no research has been conducted in the field of motor skills. In this study, we examined the age-related differences in the organization of an emotionally goal-directed locomotion task. Faced with a pleasant, unpleasant, or neutral picture displayed to the side of a stop button, younger and older adults were instructed to walk toward the button (intermediate goal) and push it to turn-off the picture (final goal). Kinematic and ground reaction forces were recorded. The main findings indicated that older adults' response times (RTs) did not differ across the valence picture. The fastest RTs were found in younger adults when faced with pleasant pictures, suggesting that older people may focus either on intermediate or final goals, depending on their value of pleasantness, and prioritize positive goals. We also found that the spatial coding of locomotion (trajectory and final body position) was affected in the same way by the valence of the intermediate goal in both age groups. Taken together, these findings provide new perspectives regarding the potential role of the emotional valence of the intermediate and final goals on the cognitive processes involved in action coding, such as in mental representations of action in older adults. © 2016 IBRO. Published by Elsevier Ltd. All rights reserved.

Key words: emotions, cognitive processes, positivity effect, goal-directed locomotion, older adults.

INTRODUCTION

Many studies addressing the role of emotions in the organization of motor behavior have been based on the motivational direction theory (Cacioppo and Gardner, 1993; Lang, 1995; Duckworth et al., 2002) associating emotions with primitive behavioral tendencies of approach and avoidance. According to this model, pervasive and automatic tendency to unconsciously evaluate the environmental stimuli result in behavioral predispositions toward the stimulus. A positive evaluation based on positive or appetitive emotions produce immediate approach tendencies while negative evaluations based on negative or aversive ones produce immediate avoidance tendencies (Lane et al., 1997, Lang et al., 1997, Chen and Bargh, 1999, Elliot and Thrash, 2002, Elliot, 2006).

However, in daily life, our motor behaviors are not uniquely performed depending on the event's appetitive or aversive value per se; they are also made in light of their outcomes (Haggard, 2005; Shadmehr, 2010; Haith et al., 2012). In line with this, recent studies have challenged the classical model of approach-avoidance (for a review, see Kozlik et al., 2015) positing that the anticipations of positive and negative action outcomes may influence the action control differently. According to this view, a voluntary action is associated with the affective meaning of intended response effects, allowing for a motivational control of behavior. Such motivational influence would be determined by needs and desires as well as the agent's current intentions (Bamford and Ward, 2008; Eder and Rothermund, 2008; van Dantzig et al., 2008; Eder et al., 2015). Thus positive and negative action outcomes have directive and incentive functions for actions: they help to selectively enhance behaviors that generate pleasant and desired effects, and they facilitate the selection of the compatible associated response over other responses (Eder and Rothermund, 2008; Eder and Klauer, 2009; Eder et al., 2013; Eder et al., 2014, 2015).

In this way, motor behavior used to interact with the environment may be influenced both by the anticipation of the affective consequences of action as well as by automatic processes activating defensive and appetitive motivational responses. In a previous study (Vernazza-Martin et al., 2015), we analyzed these two potential influences on goal-directed locomotion in young adults. Subjects were instructed to turn off pleasant, unpleasant, or neutral emotional pictures that appeared on a wall as soon as they saw the image. They had to press a stop

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button located five meters in front of them next to the picture with their right hand.

We hypothesized that the processes organizing goal-directed locomotion would take two goals into account, with each goal being preferentially associated with one explanatory model related to the approach avoidance-responses: a *final goal* that allows for the future action on the environment (*i.e.* turning off an emotional picture by pressing a button), associated with the affective meaning of the intended response goal, and an *intermediate goal* corresponding to the body displacement itself to achieve the final goal, and associated with the motivational direction. We then examined to what extent the emotional valence of the future action (final goal) *versus* the emotional valence of the intermediate goal (*i.e.* body displacement toward emotional picture) can influence these processes in young adults.

The interest of our experimental design was that approaching a valenced picture to turn it off should create an emotional conflict due to a contradiction between the motivational circuits automatically activated by its perception and the anticipation of the affective consequences of the final action (*i.e.*, removing the stimulus). In this way, walking toward pleasant pictures would activate the appetitive circuit and facilitate approach behavior (motivational direction model) but turning it off would produce unpleasant affective consequences (Eder et al., 2013). Conversely, walking toward unpleasant pictures would activate the defensive circuit and facilitate withdrawal behavior while turning it off would produce pleasant affective consequences.

We found that the emotional valence of the intermediate goal produced the greatest impact on the processes organizing goal-directed locomotion. As a result, walking toward a pleasant picture was facilitated even when the result of the final goal was negative (*i.e.* turning off the pleasant picture), whereas walking toward an unpleasant picture was hindered, even when the result of the final goal was positive (*i.e.* turning off the unpleasant picture). These findings suggested that the motivational direction model better accounts for the emotional processes organizing the goal-directed locomotion in young adults.

To our knowledge, no systematic research has yet been conducted to specifically understand how advancing age may affect behavioral tendencies of approach and avoidance. This is surprising because in the literature on normal aging, it has long been established that emotion is processed differently with age. For instance, when compared with younger adults in perceptual (Vieillard and Bigand, 2014), attention (Mather and Carstensen, 2003) and memory tasks (Charles et al., 2003), older adults show a preference for positive information over negative information (*e.g.*, for a review, see Reed and Carstensen, 2012). This robust empirical phenomenon, called positivity effect, has been explained into the framework of the socioemotional selectivity theory (Carstensen et al., 1999). According to this motivational model, perceiving their future time as constrained leads older people to prioritize present-oriented

and pleasure-related goals. As a result, older adults would be more motivated than younger adults to maximize positive experiences and to minimize negative ones and less likely to focus on gaining knowledge and information for a hypothetical future.

Based on these considerations, our aim was to investigate the age-related differences on the subjective assessment of pictures and to examine the effect of age on locomotion to attend intermediate (*i.e.*, walking toward the picture) and final (*i.e.*, turning off the picture) goals. We were interested to test whether a positivity effect is observed at the level of the locomotion organization. This study should also give more understanding on the processes involved in approach-avoidance responses in older people.

To this end, we tested a new sample of older adults with the experimental approach previously developed by Vernazza-Martin et al. (2015) in young adults. Since previous works have convincingly demonstrated that older people prioritize positive information over negative information, one might expect that the findings of Vernazza-Martin et al. (2015) – indicating that younger adults' locomotion organization was facilitated when walking toward pleasant pictures relative to unpleasant ones (as intermediate goal) – would be strengthened in older people, thus supporting the motivational direction model. At the same time if, as indicated by the socioemotional selectivity theory (SST), the motivational changes in older people lead them to be more sensitive to the positive emotional consequences of their actions, locomotion organization would be facilitated when turning off unpleasant pictures relative to pleasant ones (as a final goal), thus supporting the affective meaning of the intended response goal model.

EXPERIMENTAL PROCEDURES

It should be noted that all materials and procedures employed here were tried and tested in a previous study (Vernazza-Martin et al., 2015).

Participants

Eighteen right-handed older adults (8 males, 10 females, 77 ± 5 years old on average [70–80]) and twenty young right-handed participants (10 males, 10 females, 22.5 ± 2.1 years of age on average [18–35]) volunteered for the experiment. None of the participants reported any motor, neurological, emotional, or balance deficits, and they all exhibited normal visual acuity. The entire experimental protocol conformed to the Declaration of Helsinki, and informed consent was obtained from all of the participants according to the guidelines of the Paris VI ethics committee.

Emotional pictures

The emotional stimuli used to induce emotional states during the experiment were comprised of 45 digital photographs selected from the International Affective Picture System (IAPS):

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