

Do Eye Movements Predict Beliefs? A Bio-behavioural Investigation on Implicit Attitudes

Mele M.L.^{1,2}, Federici S.^{1,2}

¹ Department of Human Science and Education, University of Perugia; Perugia, Italy

² ECONA, Interuniversity Centre for Research on Cognitive Processing in Natural and Artificial Systems, Sapienza University of Rome; Rome, Italy

Summary

Implicit social cognition is an empirical phenomenon encompassing the effects of experience on judgements and decisions. We evaluate whether eye movements relate to implicit associations according to embodied cognition theories, claiming that cognition directly affects the content of sensory-motor systems. We propose that a psychological attribute, such as an implicit attitude towards an ethnic category, influences individuals' eye movements during the visual exploration of related relevant stimuli. By using eye-tracking methodology in a bio-behavioural study, we found that participants with high implicit attitudes towards an ethnic category performed high fixation duration towards the stimuli that disconfirmed their implicit attitude. The results provide evidence for an association between social beliefs and eye movements, thus highlighting the oculo-sensory-motor embodiment of social cognition.

Introduction

Social cognition theories traditionally investigate attitudes by focusing on both verbal and non-verbal human expressions representing beliefs, feelings, and attitudes. Many studies confirmed that attitudes are the outcome of implicit and unaware psychological processes related to social stimuli (BARGH *et al.*, 1992; FAZIO *et al.*, 1986). Attitude is a relatively latent or context-sensitive organisation of favourable or unfavourable beliefs, feelings, and behavioural dispositions towards objects, groups, events, or symbols that guide or influence behaviour (ANDERSON, 1974; GREENWALD and BANAJI, 1995; HOGG and VAUGHAN, 2008; TESSER, 1978). Nosek and Banaji define attitude in more operational terms as “an association between a concept and an evaluation – an assessment of whether something is good or bad, positive or negative, pleasant or unpleasant” (2009, p. 84). Attitudes can be directly inferred from behaviour, regardless of whether the subject is aware or not of the related underlying evaluation purposes (AJZEN and FISHBEIN, 1980; FAZIO and ZANNA, 1981). Therefore, since attitudes are not a directly observable construct, they can be investigated only by measuring behavioural responses to social stimuli reflecting the underlying positive or negative feedback (DE HOUWER, 2003; GREENWALD, MCGHEE, and SCHWARTZ, 1998; MURRAY, 1943; NOSEK and BANAJI, 2001; PAYNE *et al.*, 2005; WITTENBRINK, JUDD, and PARK, 1997).

Although the state of the art agrees in considering the behavioural response of implicit processes as an index of mental attributes, it is still unclear how eye movements can provide a predictive model of implicit processes. Top-down theories of embodied cognition show that modality-specific cognitive systems—i.e., the systems that underlie the sensory perception of a given context, the effector systems that underlie action, and the introspective systems that underlie the aware experience of emotion, motivation, and cognitive operations—would simultaneously activate bodily experiences (BARSALOU, 1999; DAMASIO, 1994; GALLESE, 2003; GLENBERG, 1997). This work comes from the following questions: Does eye behaviour predict information on implicit social processes? Which eye dynamics are involved in this process? Can we benefit from an eye-tracking methodology to enhance the existing implicit process assessment techniques? The following cognitive and behavioural study aims to answer these questions, concluding that eye movements are more related to implicit attitudes than previously thought.

Materials and Methods

This study aims at investigating whether ethnic category/attribute pairs influence eye movements during an Implicit Association Test (IAT). We found a positive relationship between fixation duration and implicit attitudes.

Participants. 30 Caucasian (15 female; age $M = 34$; $SD = 4.31$, 80% right-handed; 33% with contact lenses) took part in the experiment. Subjects were selected in accordance with a previous assessment of both visual acuity and dominant eye.

Materials. Eye movements were measured by means of the ITU Gaze Tracker software (www.gazegroup.org) which tracks eye movements with a mean error in visual angle degrees of 1.48 ($SD = 0.58$) (JOHANSEN *et al.*, 2011). An IAT measuring ethnic bias was administered twice, in a random order. The test combines two ethnic categories, Caucasian and African, with two qualitative attributes, good or bad. The IAT was administered both online (<http://www.millisecond.com/download/library/IAT>) to measure the IAT scores, and by means of the OGAMA software (<http://www.ogama.net/>) to measure and analyse the eye movements performed during the visual interaction with the IAT stimuli.

Design and procedure. The testing sessions were conducted in a silent and sufficiently lit room. Participants were asked to complete either the online IAT or the OGAMA IAT first, by associating a pictorial or textual stimulus presented in the centre of the screen to one of two ethnic categories (Caucasian vs. African) or a bipolar attribute (good vs. bad) (Table 1). The OGAMA slideshow consisted of three different kinds of blocks: one control block and two experimental blocks, called initial and reversed. Nineteen trials compose each block, in which the position (left or right) of the attributes bad and good is fixed for all trials, whereas the position (left or right) of the African or Caucasian categories varies between blocks. Therefore, for the initial blocks, the category/attribute pair Caucasian/good was presented on the left and African/bad was presented on the right while for the reversed blocks, African/good was presented on the left and Caucasian/bad was presented on the right (see Table 1).

Control Block	Control Block	Initial blocks	Reversed blocks
•White Black•	•Good Bad•	•White/Good Black/Bad•	•Black/Good White/Bad•

Table 1 Categories and attributes positions for the “Black”-“White” Implicit Association Test (IAT). The black dots on the table indicate the left or right position of the target on the screen.

Results

86% of subjects showed an automatic preference for Caucasian people compared to African people (33% strong preference, 33% moderate, and 20% slight preference), 7% showed no automatic preference and 7% showed a slight automatic preference for African people compared to Caucasian people.

A multiple linear regression analysis showed a trend effect of fixation number and duration (Intercept = .85; $t(27) = 8.09$; $p < .01$) in predicting automatic preferences, although they are not sufficiently strong to singularly explain the effect when taken apart ($R^2 = .029$, $F(2, 27) = .415$, $p > .05$, fixation number $\beta = .118$, $p > .05$; fixation duration $\beta = .064$, $p > .05$).

A repeated-measures ANOVA on fixation number showed a main effect of condition ($F(2, 28) = 4.198$, $p = .025$) and position (left, right) ($F(1, 29) = 4.677$, $p = .039$). No significant interaction was found between condition and position ($F(2, 28) = 1.033$, $p > .05$). The rANOVA on fixation duration showed no effect of both condition and position and no significant interaction between condition and position.

The ANOVA on fixations towards the category/attribute pair combinations revealed that, for the participants with an automatic preference for Caucasian people, fixation number for the pair African/bad ($M = 2.93$; $SD = 5.38$) was significantly lower than Caucasian/good in the initial blocks ($M = 7.8$; $SD = 14.8$) $F(1, 29) = 14.34$, $p < .05$, whereas no difference between the African/good ($M = 4.5$; $SD = 6.4$) and Caucasian/bad pairs was found in the reversed blocks ($M = 3.73$; $SD = 7.4$) $F(1, 29) = .237$, $p > .05$. Moreover, in the initial blocks, fixation duration was higher for African/bad ($M = 1374.3$; $SD = 2586.5$ ms) than Caucasian/good ($M = 810.7$; $SD = 2556.3$ ms) $F(1, 29) = 7.85$, $p < .05$ and, in the reversed blocks, fixation duration was higher for African/good ($M = 1442.5$; $SD = 2649.1$ ms) than Caucasian/bad ($M = 1212.5$; $SD = 2791.2$ ms) $F(1, 29) = 3.38$, $p < .05$.

Conclusions

The aim of this study was to understand whether eye movements could be considered as a predictive variable of implicit measures, according with embodied cognition theories claiming the interdependency between cognition and sensory-motor mechanisms. Data showed a trend effect for the predictive relationship among implicit attitudes, fixation number, and fixation duration.

The results on the differences between the eye fixations and the category/attribute pair combination suggest that people tend to gaze for more times towards the Caucasian/good combination but for longer times towards the ethnic category corresponding to the object of their implicit negative attitudes, i.e., African people, independently from its combination with the qualitative attribute (good or bad). These results show that the visual attention focus is guided by the location of the object of the implicit negative attitude, in this case the out-group ethnic category “black”. We believe that people fixate for more time on the “black” target to confirm their implicit negative attitude towards African descendants since the African category appears to be more salient than the Caucasian one for Caucasian participants. However, it is important to underline that, in the experiment shown here, the Caucasian/good and African/good pair combinations occur only on the left side of the screen. Therefore, we cannot say if participants gaze more towards the African/good combination because of the actual saliency of the target stimulus or because of a side effect. All participants, in fact, use Latin alphabets and, therefore, begin the reading process generally starting from the upper left side of a visual textual space (DE KERCKHOVE and LUMSDEN, 1988). Therefore, although the result of the IAT is not influenced by the left or right position of the positive attribute good (GREENWALD *et al.*, 1998), the methodological design behind the IAT did not systematically exclude or explain any influence of the lateralisation on the visual strategies used by the participants to explore the Areas of Interest (AOIs) in the experimental condition. A research following this study systematically analysed and controlled the lateralization effect on eye movements on the IAT (MELE, FEDERICI, and DENNIS, 2014).

This research provides a first step in understanding how implicit attitudes are associated with oculo-sensory-motor mechanisms, which guide human perception and behaviour. As the embodiment theories propose, social perceptual stimuli elicit cognitive responses (FAZIO, 2007; STRACK and DEUTSCH, 2004), which in turn produce bodily responses that are coherent to the belief system underlying psychological attributes (BARSALOU, 1999). The results guided us to study in more depth the involvement of oculo-sensory-motor mechanisms into social information processing mechanisms (MELE *et al.*, 2014), since the measure of these mechanisms seems to be a predictive measure of psychological constructs like attitudes and prejudices (DE HOUWER and MOORS, 2010).

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