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The Effects of Overt Head Movements on Valenced Image Recognition and Recall in Bulgarians*

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Abstract

Vertical and horizontal head movements (universally associated with nodding and shaking, respectively) have frequently been demonstrated to affect cognitive processes. Two experiments were conducted to test the hypothesis that overt head movements can influence memory for valenced images. In the first experiment, participants were instructed to perform either vertical or horizontal head movements while viewing a slideshow of 76 randomized positive and negative images, which they later had to recognize from a set containing 50% of the same target images and 50% distractor images. No interaction between head movement type and image valence was obtained. In the second experiment, participants were told to remember as many images as possible from a slideshow of 60 randomized valenced images, which they were later asked to freely recall. A significant interaction was obtained, with a higher rate of recall for positive images when vertical head movements (VHM) were performed and a higher rate of recall for negative images when horizontal head movements (HHM) were performed.

Keywords: overt head movements; image recall and recognition; embodiment.

Introduction

Previous work has demonstrated that inducing overt head movements can influence certain cognitive processes due to their positive or negative association with a given cognitive activity. For example, Wells & Petty (1980) showed that the manipulation can have an effect on persuasion. Participants in their study performed either vertical or horizontal head movements while listening to a simulated radio broadcast, containing either a message in agreement or disagreement with participants' attitudes (proattitudinal or counterattitudinal messages). Those participants who performed VHM agreed with the content of the broadcast more than those who performed HHM, regardless of the content of the message. Participants also found it more difficult to perform head movements that were incompatible with the message (VHH during a counterattitudinal broadcast vs. HHM during a proattitudinal broadcast). Consistent results were obtained by Briñol & Petty (2003).

This manipulation has produced similar effects in various other domains. Tom et. al. (1991) showed that VHM led to an increased preference for neutral objects, while HHM led to a decline in preference for the same. In another study, it was demonstrated that overt head movements can affect product choice and price perception (Tom et. al., 2006). Eppley & Gilovich (2002) examined the effects of the same manipulation on the anchoring and adjustment heuristic, demonstrating that participants induced to accept values by nodding adjusted to self-generated anchors less than those induced to deny values by shaking their heads.

Apart from attitudinal effects, overt head movements have also been demonstrated to influence memory. Förster & Strack (1996) induced overt head movements in participants while they listened to valenced adjectives and found that VHM led to better recognition for positive adjective and HHM led to better recognition for negative adjectives in a surprise recognition task. They refer to this as a *motor-compatibility* effect, suggesting that the process of learning valenced words was more effective when accompanied by compatible head movements during the encoding phase, which led to better recognition during the test phase. They point to natural and socially-learned co-occurrences of overt and covert responses as a possible explanation of this effect. An example of the former is the co-occurrence of basic emotions with specific facial expressions, while learned nonverbal responses like nodding and shaking our heads to indicate agreement and disagreement, respectively, are an example of a socially-learned co-occurrence of overt and covert responses.

Following Förster & Strack's methodology, in this study we explore the influence of overt head movements on the recognition and free recall of valenced images. We performed two experiments in order to investigate whether a similar motor-compatibility effect would be obtained, by inducing either HHM or VHM while participants viewed positive and negative images, which they later had to recognize among distractor images (Experiment 1) or freely recall (Experiment 2).

There were two main motivations behind this study. First and foremost, we wanted to see if the manipulation extends to memory for images. It is well known that people's memory capacity for images is far superior to that for words (Shepard, 1967; for an old but good review of the literature, see Landauer, 1986). Hence, observing the same effect

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would be a non-trivial finding, further confirming the validity of the effect. Second, Bulgaria is a unique place to test this manipulation, given that nodding and shaking mean the exact opposite to what they mean in the rest of the world – shaking denotes agreement, whereas nodding indicates disagreement. If the mechanism of this effect is social in nature, as Förster & Strack suggest, we should expect the exact opposite results: facilitation for encoding negative images while performing VHM and facilitation for encoding positive images while performing HHM. Thus, the results would give insight into the extent to which culture mediates this effect.

Experiment 1

Method

Participants

Nineteen New Bulgarian University students (11 men and 8 women) were given course credit for participation in what they were told was a marketing study to test the comfort and quality of a headphone set.

Stimulus Material and Apparatus

Seventy six target images (38 positive and 38 negative) were selected from The International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) for the encoding part of the procedure, along with half as many positive and negative distractor images (closely resembling half of the target images thematically) for the recognition part of the procedure. The reason why such distractor images were used for the retrieval procedure is that people have a naturally high memory capacity for images (Brady, 2008; Schacter, Israel, & Racine, 1999; Shepard, 1967), which can lead to ceiling effects. One of the most impressive demonstrations of this is a study by Standing (1973), who, using a single-trial learning task with a delayed recognition test, tested subjects' memory capacity for groups of pictures ranging from 20 to 10,000 and found that, even though percentage of retention gradually declined, the absolute number of stimuli retained increased as the set of learning material increased. In an attempt to avoid losing the effect of the head movement manipulation because of such a ceiling effect, we increased the difficulty of the recognition task by introducing interference with distractor images thematically related to half of the target images (the presentation of similar distractor images has been shown to reduce accuracy in image recognition; Goldstein & Chance, 1970). These distractor images were presented in the recognition task instead of the target images that they resembled in order to confused participants and prevent them from getting perfect accuracy scores. For samples of positive and negative target-distractor pairs, see Figure 2.

Images were selected for similar levels of arousal (approx. 5 on a 1-9 scale). The average valences of the negative and positive stimuli were approximately 3 and 7, respectively, also on a 1-9 scale. For the first part of the procedure, images were presented on a 17" monitor (1024×760) in Microsoft PowerPoint© and then in E-Prime® 2.0 during the recognition task.

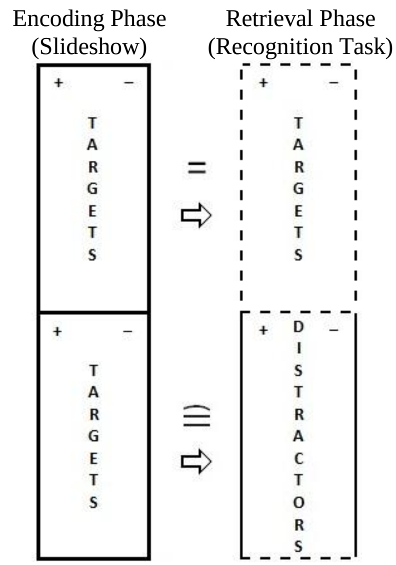

Figure 1. A visualization of the procedure in Experiment 1. On the left: Encoding phase, consisting of 76 positive (+) and negative (–) target images (top left and bottom left blocks). On the right: Recognition task, in which half (38) of the original (=) targets (top right block) are presented with 38 distractor images (bottom right block), corresponding (≡) to 38 of the original targets excluded from the retrieval phase.

Design and Procedure

The experimental design was a 2×2 mixed-model factorial comparing head movement type (horizontal vs. vertical) between subjects and image valence (positive vs. negative) within subjects. The dependent measure was the accuracy of recognition during the test phase.

Participants were introduced to the experiment by signing a consent form and being told that they were participating in a marketing study to test the comfort and quality of a headphone set (this is the same cover story as the one used by Wells & Petty, 1980). The entire session consisted of an encoding phase, a distractor task, and a recognition task (see Fig. 1 for a visualization of the procedure). Each of the 76 positive and negative images appeared on screen for 3 seconds as Astor Piazolla's tango "Adios Nonino" played in the background (the same type of music used by Förster & Strack, 1996). Stimulus order was pseudo-randomized (same order for each participant). The set of images was preceded and followed by a 6 second long blank slide and the entire slideshow lasted for 4 minutes. Ten of the participants were instructed to perform HHM while listening to the music and viewing the images (presumably to test the sound quality of the headphones under more realistic conditions, namely, during movement), while the remaining nine performed VHM. The experimenters would demonstrate the movement and instruct participants to maintain one head movement per second for the entire duration of the slideshow.

After the encoding procedure was over, participants were asked to fill out a feedback form regarding comfort of the headphones, sound quality, difficulty of the head movements, and likability of the music as part of the cover story. They were then given a distractor task for 15 minutes, during which they had to assemble two different wooden puzzle cubes (similar to the classic Soma puzzle cube).

Once those 15 minutes were up, the experiment proceeded to a surprise recognition task. Participants were presented with only half (38) of the target images from the original slideshow mixed with 38 distractor images. For each image that appeared on the screen, participants had to press an "old" button to indicate that they had seen the image before or a "new" button if they hadn't seen it. The images remained on the screen until both responses were given. Once done, participants were thanked for their participation and dismissed. All were debriefed via e-mail once the study was over.

(a) Positive target image

(b) Positive distractor image

(c) Negative target image

(d) Negative distractor image

Figure 2. Sample target and distractor images. Target images (top and bottom left) were presented during the encoding procedure and replaced by their matching distractors (top and bottom right) in the recognition procedure.

Results and Discussion

We performed a repeated measures ANOVA with valence as a within-subject and head movement as a between-subject factor. There was a main effect of valence, $F(1, 17) = 8.253$, $p < 0.05$, with better discrimination for negative images, $Pr = 0.53$, as opposed to positive images, $Pr = 0.43$.[1] There was no main effect of head movement type, $F(1,18) = 0.59$, $p = 0.812$. Contrary to what was hypothesized, there was no significant interaction between head movement type and image valence: $F(1, 17) = 0.001$, $p = 0.975$. Average accuracy for participants performing HHM was $Pr = 0.4$ for positive images and $Pr = 0.5$ for negative ones, while participants performing VHM had an average accuracy score of $Pr = 0.46$ and $Pr = 0.56$ for positive and negative images, respectively (see Fig. 3).

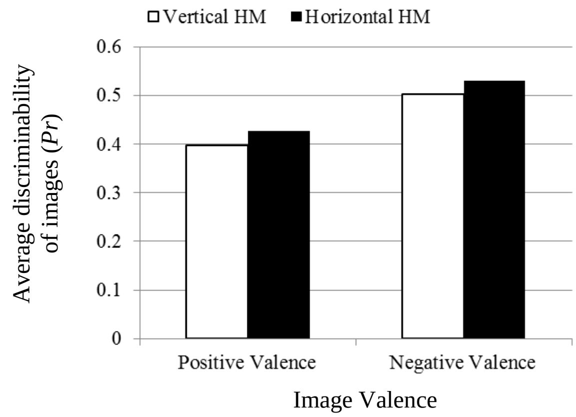

Figure 3. The average discriminability of images as a function of head movement type and image valence.

Due to the fact that accuracy scores are generally high on image recognition tasks because participants rely on their implicit memory, we tried to deliberately deteriorate their performance by presenting them with distractor images closely resembling half of target images from the encoding procedure, which explains why they made errors in the first place. However, even though it prevented a ceiling effect, this manipulation could have caused other problems. By increasing the difficulty of the task with thematically similar distractor images, we may have suppressed an existing HM-image valence interaction due to the strong interference *between* the similar target-distractor pairs. A reason for this suspicion is that some studies have demonstrated constructive memory effects in image recognition (e.g., Foley & Foy, 2008 and Miller & Gazzaniga, 1998 demonstrated this using the DRM paradigm).[2]

We decided to conduct a second experiment, but instead of increasing the memory task's difficulty by introducing interference, we replaced the recognition task with a free recall task, which requires participants to rely on their explicit memory. We expected this manipulation to prevent a ceiling effect without introducing additional strong memory effects, as in Experiment 1.

[1] Due to the fact that several participants made no false alarms during the recognition task, our first preference, *d'*, could not be calculated and *Pr* was used instead. *Pr* is a coefficient that describes participants' discrimination performance; the higher its value, the better participants' discrimination between targets and distractors, and vice versa. It is calculated using the following formula: $Pr = H - FA$, where H (hits) is the proportion of correct identifications of targets, and FA (false alarms) is the proportion of incorrect identifications of distractors (Snodgrass & Corwin, 1988).

[2] For more on the DRM paradigm, see Roediger & McDermott (1995).

Experiment 2

Method

Participants

Twenty-six volunteers and New Bulgarian University students (6 men and 20 women), took part in Experiment 2, the latter of whom were given course credit for participation. The cover story from Experiment 1 was maintained.

Stimulus Material and Apparatus

Thirty positive and 30 negative images were selected from IAPS (Lang et. al., 2008). They were selected according to the same criteria used in Experiment 1.

Design and Procedure

The experimental design and stimulus presentation were the same as in Experiment 1. The changes made in this experiment's procedure were as follows: Participants were explicitly told to try to remember as many of the images from the slideshow as possible, as they would be asked to recall them later, after filling out the feedback form. Following the learning phase, participants were asked to write down all the images they could remember, listing each one on paper (free recall test phase) and using the minimum number of words to accurately describe them. They were given 20 minutes to describe as many images as they could remember. Upon completion of this task, they were thanked for participating and dismissed.

Results and Discussion

Two independent experts were used to evaluate the correspondence between the descriptions of recalled images given by participants and the images used in the slideshow. Only answers which gained unanimous consent by the experts were counted as correctly recalled images. Overall agreement between them was 98%.

The average number of correctly recalled images was 20.04. Similar to Experiment 1, on average, more negative (10.73) than positive (9.31) images were recalled for a main effect of valence, $F(1, 24) = 5.03$, $p < 0.05$. There was no significant main effect of head movement type, $F(1, 24) = 0.207$, $p = 0.653$. Contrary to Experiment 1, the crucial interaction between head movement type and valence was significant, $F(1, 24) = 4.5$, $p < 0.05$. That is, more positive images were recalled by participants who performed VHM (9.69), compared to participants who performed HHM (8.92). In contrast, more negative images were recalled by participants who performed HHM (11.7), compared to those performing vertical ones (9.77; see Fig. 4). It is evident that the difference between vertical and horizontal head movements is greater for negative ($d = 1.14$) than for positive ($d = 0.4$) images. It is curious to note that this is the opposite of what Förster & Strack (1996) observed for valenced adjectives and may be due to some type of negativity bias. Many previous studies have failed to demonstrate memory effects for images as a function of valence, but according to Ochsner (2000), this may have been a result of using memory measures that lack sensitivity to differences in the experience of past events. Using the remember/know paradigm, the author obtained more remember responses for negative images compared to positive ones, whereas positive images evoked more know responses (i.e. they were just familiar, rather than remembered). Kensinger et. al. (2007) have similarly shown a general recognition advantage for negative stimuli.

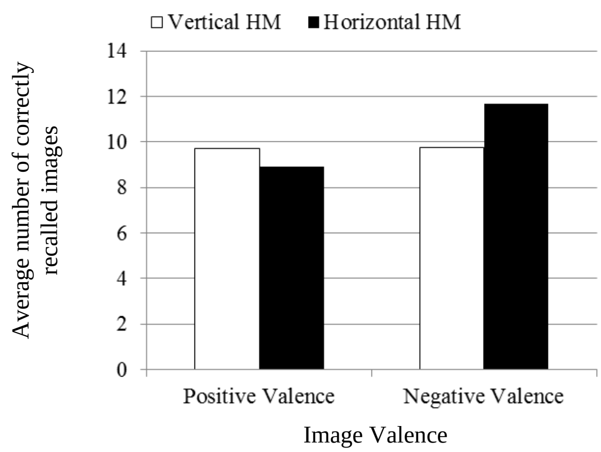

Figure 4. The average number of recalled images as a function of head movement type and image valence.

General Discussion

Despite the positive results obtained in Experiment 2, the findings of Experiment 1 did not show a significant interaction between head movement type and image valence. We hypothesized that our attempt to prevent a ceiling effect during the recognition task by introducing strong interference between target and distractor images may have concealed an otherwise existing effect of the head movement manipulation. In Experiment 2, we employed a different method for eliminating the possible ceiling effect by changing the recognition task to a free recall task, which proved successful in finding the significant interaction.

A finding consistent across both experiments was that more negative images were remembered than positive images, even though they were specifically selected for equal arousal ratings. One possible explanation for this is that negative events leave stronger memory traces compared to positive events. Studies on memory have tended to focus more on arousal levels of stimuli than on valence, but recent research has shown it to be an important factor in encoding and retrieval processes. Multiple studies show that negative information is remembered more vividly than positive information, that it is remembered in more detail, and that people are better at remembering whether they saw or only imagined negative stimuli, whereas with positive stimuli, they are more likely to be confused (for a review, see Kensinger, 2009). This body of research and the results of our experiments are in line with the general trend observed in various domains in psychology (e.g. impression formation, learning, judgments, information processing, memory, etc.) that bad is stronger than good (for an extensive review of the converging evidence across research domains, see Baumeister, 2001).

Our study extends the overt head movement paradigm to the domain of memory for images. The significant interaction found between head movement type and image valence in Experiment 2 is consistent with the results of Förster & Strack (1996), who found the same interaction between head movement type and adjective valence. Obtaining a significant interaction between head movement type and image valence despite people's exceptional memory capacity for images offers further support for the motor-compatibility effect. The main idea that information is better encoded while compatible head movements are performed, as opposed to when incompatible head movements are performed, is in line with the findings of other researchers in many other domains (see the Introduction of this paper for a brief review) and is also consistent with findings of other research on stimulus-response compatibility (Romaiguere et. al., 1993; Solarz, 1960).

Interestingly, the reversed meaning of head movements in Bulgarian culture seems to have no influence on the effect observed in previous studies. We found that upon asking how they gave nonverbal responses for "yes" and "no", oftentimes participants demonstrated nodding and shaking, respectively, whereas when implicitly tested about this right after the explicit test (the experimenter would informally ask the participant a yes/no question, the answer to which was known in advance), they would often respond in the traditional Bulgarian way (shaking for "yes" and nodding for "no"). Our findings may suggest that the motor-compatibility effect is independent of culture, but it may also be due to the strong influence of Western culture (e.g., through media, mass communication, globalization, etc.). The discrepancy suggests that the issue of which nonverbal head gestures Bulgarians perform to denote agreement/disagreement is not clear cut and is an interesting empirical question on its own.

Summary

We conducted two experiments to test the effect of overt head movements on the encoding of positive and negative images. The main findings of our study are the following:

1) Negative images were remembered more than positive images, despite equal levels of arousal;
2) Head movement type interacted significantly with image valence during the free recall task, but not during the recognition task;
3) Contrary to what was expected, the direction of the interaction was the same with Bulgarian participants as has been reported in previous studies with non-Bulgarians, despite the cultural difference in meaning of vertical and horizontal head movements.

Although interesting, these results require further investigation in future studies.

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