Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale

Carefully Encoding Approach/Avoidance Body Locomotion With Interpersonal Conduct in Narrated Interactions

Hipólito Marrero, Elena Gámez, José M. Díaz, Mabel Urrutia, and Manuel de Vega

Online First Publication, February 2, 2015. http://dx.doi.org/10.1037/cep0000046

Canadian Journal of Experimental Psychology / Revue canadienne de psychologie expérimentale

1196-1961/15/$12.00 http://dx.doi.org/10.1037/cep0000046

Carefully Encoding Approach/Avoidance Body Locomotion With Interpersonal Conduct in Narrated Interactions

Hipólito Marrero, Elena Gámez, José M. Díaz, Mabel Urrutia, and Manuel de Vega
University of La Laguna

Approach and avoidance tendencies towards valenced others could be associated with our interpersonal conduct towards them: helping would be associated with approach tendency, and harming (or denying help) would be associated with avoidance. We propose that the encoding of this association enjoys attentional priority, as approach/avoidance representations of past interactions would regulate one's predisposition to either help or harm in subsequent interactions. Participants listened to interactions conveying positive/negative conduct between 2 characters. The conduct verb was then presented visually with a cue prompting participants to quickly step forward or backward. Subsequently, they performed a recognition task of noncentral story details. In matching conditions (positive conduct-step forward, negative conduct-step backward) the concurrent step should interfere with the encoding of motor representation of the conduct verb, and the verb encoding should divert attentional resources from the consolidation of memory traces of less relevant information. Results showed the predicted impairment in the recognition task in matching conditions, which supports an attentional bias towards encoding motor approach/avoidance representation of interpersonal conduct in the process of comprehending narrated interactions.

Keywords: attention, approach/avoidance, narratives, motivated interpersonal conduct, embodied cognition

A key function of the affect system is to elicit approach/avoidance responses (Lang, Bradley, & Cuthbert, 1990). Affective responses organise experience by directing our limited attention and processing capacities toward aspects of the environment with adaptive implications for behavioural regulation (Crawford & Cacioppo, 2002; Zajonc, 1998). For this reason, the relation between valenced stimuli and approach/avoidance motivational motor tendencies constitutes a relevant aspect of the environment to be represented, and would automatically capture the attentional resources necessary for its processing.

Previous research has found that evaluative processing is coupled with action dispositions in both directions. Approach motions are compatible with evaluating positive objects, whereas avoidance motions are compatible with negative object evaluation. Typically, it has been reported that encoding positive/negative information and concurrent approach/avoidance arm actions elicit faster responses when both activities are compatible ("positive-approach," and "negative-avoidance" conditions) than otherwise (Chen & Bargh, 1999; Duckworth, Bargh, García, & Chaiken, 2002; Rinck & Becker, 2007). Chen and Bargh concluded that valenced words are evaluated automatically, and this automatic evaluation involves the activation of approach or avoidance arm movements. Likewise, keeping a bodily state of approach (i.e., arm flexion) induces better recognition for concurrent positive information, whereas a bodily state of avoidance (i.e., arm extension) induces better recognition for negative information (Cacioppo, Priester, & Berntson, 1993; Förster & Strack, 1996; Förster & Stepper, 2000). This supports the claim that bodily states facilitate the encoding of compatible affective information improving its subsequent recognition.

Facilitation in compatible stimuli-motion conditions has been explained as a result of stimuli and motion being "things that go together" in everyday experience (Alluisi & Warm, 1990). Its relationship would correspond to overlearned stimulus-response (s-r) sequences we naturally experience between valenced environmental information (e.g., positive/negative words) and approach/avoidance reactions (Gawronski, Deutsch, & Strack, 2005). As a result, overt motor actions of approach/avoidance would induce preparedness for encoding consistent valenced information; and vice versa, valenced information would initiate directive forces on motoric behaviour (approach/avoidance). This constitutes a motivational account for affective-motor compatibility effects (Eder & Klauer, 2009).

From a different perspective, Eder and Rothermund (2008; see also Eder & Klauer, 2009) have proposed an alternative explanation to compatibility effects, the common coding account, based on the theory of event coding (TEC; Hommel, Müsseler, Aschersleben, & Prinz, 2001). Event coding theory assumes a common coding of

Hipólito Marrero, Elena Gámez, José M. Díaz, Mabel Urrutia, and Manuel de Vega, Department of Cognitive Psychology, University of La Laguna.

This study was supported by the Spanish Ministry of Economy and Competitiveness (Grant SEJ2011-28679), the Canarian Agency of Research, Innovation and Knowledge Society (NEUROCOG project), the Education Department of Cabildo Insular de Tenerife, and the European Regional Development Funds.

Correspondence concerning this article should be addressed to Hipólito Marrero, Departamento de Psicología Cognitiva, Social y Organizacional, Facultad de Psicología, Universidad de La Laguna, Campus de Guajara s/n, 38071, LA Laguna, S/C de Tenerife, Spain. E-mail: hmarrero@ull.es

stimulus and response features. Motor responses become activated through the anticipation of the responses' sensory consequences in action planning. These coded features shared by actions with perceptual stimuli, modulate the interaction between processing stimuli and concurrent actions. In contrast to the motivational account, common coding predicts either facilitation or interference of approach/avoidance with compatible concurrent stimuli encoding. Interference would be because of feature binding conflicts: stimuli encoding cannot access valenced code (either positive or negative) during concurrent performance because it is occupied by the integration phase of the approach/avoidance event. By contrast, facilitation occurs if stimuli shortly precede motion execution, as this activates common valence code, making it more accessible for action event encoding. Of interest to the authors, common coding and motivational accounts could be complementary instead of alternative explanations of compatibility effects. They may correspond to different cognitive mechanisms: a more general perceptual-action cognitive mechanism and a more specific s-r motivational mechanism for approach and avoidance associations (see Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010).

We consider that previous studies convincingly support that valenced stimuli are associated in our brain with approach/avoidance behaviours; however, these studies also have some limitations. First, most studies use as linguistic stimuli lists of valenced adjectives or nouns. However, more complex linguistic materials, like stories referring to valenced interpersonal events, have yet to be tested for approach/avoidance effects. This study attempts to fill this gap, using stories that describe interpersonal behaviours with strong affective valence. Second, arm motions cannot be unambiguously attributed to approach or avoidance. Approach and avoidance reactions do not seem rigidly associated with particular muscular patterns. They should be defined in terms of their perceivable effects, approach reactions reduce the distance between a stimulus and oneself, whereas avoidance increases it (van Dantzig, Pecher, & Zwaan, 2008), and depends on people's representation of themselves in space rather than on their physical location (Markman & Brendl, 2005), or on the evaluative interpretation (positive or negative) of the overt action (Eder & Rothermund, 2008; Eder & Klauer, 2009). For instance, in Chen and Bargh's (1999) study, arm flexion was defined as an approach reaction (pulling a pleasant stimulus toward oneself) and arm extension as an avoidance reaction (pushing an aversive stimulus away). By contrast, other researchers have shown that arm flexion could also be interpreted as avoiding an aversive stimulus, and arm extension can be interpreted as reaching for a positive stimulus (e.g., Seibt, Neumann, Nussinson, & Strack, 2008; van Dantzig et al., 2008). Likewise, Ether and Rothermund demonstrated that congruency effects between valenced stimuli and motor actions were reversed when the same lever movements "toward" and "away" from the body were labelled as "downward" pull and "upward" push that involve an opposite meaning. Therefore, it seems preferable to choose motor responses unambiguously interpretable as approach/avoidance. One interesting possibility is body locomotion, which constitutes a genuine form of approach/avoidance behaviour (Koch, Holland, Hengstler, & van Knippenberg, 2009; Stins, Roelofs, Villan, Kooijman, Hagenaars, & Beek, 2011). Thus, stepping forward normally reduces the distance to a stimulus, whereas stepping backward increases distance. For this reason, we will use bodily locomotion rather than arm motion as the approach/avoidance motor system.

On theoretical grounds, our study focuses on the role of approach/avoidance motor representations in interpersonal conduct encoding in the context of narrated interactions. We will integrate ideas from embodied cognition, emotion processing, attention, and language. This integrative approach to research on embodied human cognition has been used in previous research (Havas, Glenberg, & Rinck, 2007; Havas, Glenberg, Gutowski, Lucarelli, & Davidson, 2010).

What is the role of approach/avoidance in understanding interpersonal actions? In this article, we propose that understanding interpersonal actions in the context of social interactions involves carefully encoding and storing approach/avoidance motor representations, as we explain below.

Approach/avoidance affective responses have a relevant role in adaptive behavioural regulation. To attain efficient behavioural regulation, associations between affective stimuli and motor tendencies should be encoded together with relevant contextual information. In this regard, Crawford and Cacioppo (2002) have demonstrated that stimuli (whether rewarding or threatening) are attended and encoded in association with the place where they usually appear. This association is clearly relevant to approach/avoidance behavioural regulation in accordance with the positive (rewarding) or negative (threatening) valence of the stimulus associated with particular places.

Much like conduct in spatial settings, interpersonal interactions also require adaptive regulation, as positive conduct (helping) must be oriented toward reliable/rewarding individuals, while negative conduct (harming, denying help) must be oriented toward unreliable/threatening others. In this regard, the contextual association of approach/avoidance motor tendencies toward valenced others with our interpersonal conduct toward them would be relevant for individual survival, and so enjoys attentional precedence.

How might approach/avoidance motor tendencies toward valenced others be associated with our interpersonal conduct toward them? First, we have to consider that interpersonal conduct would have an affective motivational valence, that is, it would be valenced as either intentionally positive or negative toward the other. This valence would be encoded with approach/avoidance motor representations as follows. We exchange positive conducts with individuals we find to be reliable/rewarding. As rewarding individuals, they constitute stimuli that automatically elicit the approach tendency. Conversely, we exchange negative conduct with others we find unreliable or threatening. As such individuals, they constitute aversive stimuli eliciting avoidance (Chen & Bargh, 1999; Duckworth et al., 2002; Gawronski et al., 2005; Seidel, Habel, Kirschner, Gur, & Derntl, 2010; Stins et al., 2011; Wentura, Rothermund, & Bak, 2000). This association between individuals as valenced stimuli with approach/avoidance tendencies has been supported by several studies. For instance, Wentura et al., demonstrated that in response to target words representing the traits of others, either approach or avoidance were facilitated, depending on whether the trait referring to the other was confident (i.e., honest) or threatening (i.e., brutal), respectively. Likewise, it has been shown that either approach or avoidance is facilitated in response to others' faces depending on the face being happy or angry, respectively (Seidel et al., 2010; Stins et al., 2011).

Human action, either social or physical, is contextually encoded, which involves motor activations and emotional reactions we experience during its realisation (Barsalou, 2008; Gallese, 2006). As a result, and because of either overlearned or even wired-in associations, forward (approaching) body locomotion motor representation would form part of the process of encoding and storing positive (helping) conduct. Likewise, backward (avoidance) body locomotion representation would form part of the process of encoding and storing intentionally negative interpersonal conduct.

The encoding of motor approach/avoidance representations in understanding interpersonal conduct would take attentional precedence, as we assume that approach representation of stored past interactions regulates predisposition to help, whereas avoidance representation regulates predisposition to harm or denying help in future interactions. Thus, motor representations of past interactions need to be carefully encoded: encoding positive (approach) conduct with rewarding individuals and negative (avoidance) conduct with unreliable/threatening ones will have consequences for survival.

When might attentional precedence in interpersonal conduct encoding be necessary? As approach and avoidance are basic human action tendencies (Gray, 1991; Miller, 1944), they could be elicited by a great variety of concurrent stimuli. Therefore, there may be competition (and interference) for approach/avoidance motor representations at the moment of encoding interpersonal conduct, and even when approach/avoidance motor representations are involved in the execution of usual locomotion (stepping forward/backward). Encoding of and attention to stimuli are closely related (Logan, 2002). Attentional disengagement may be more difficult when a certain stimulus is difficult to encode, at least until it has been categorised. Therefore, difficulty in encoding and attention allocation would be positively related (see Gawronski et al., 2005). Likewise, precedence in attention allocation toward adaptive relevant information would be automatic (Chen & Bargh, 1999; Lang et al., 1990).

In the case of interference for approach/avoidance motor representations at the moment of conduct encoding, attention would be automatically diverted toward saving encoding of approach/avoidance in the conduct. Therefore, we hypothesise an affective attentional bias (Todd, Cunningham, Anderson, & Thompson, 2012) toward encoding interpersonal valenced conduct, which could be shown through motor interference at the moment of encoding approach/avoidance components of interpersonal conduct. The hypothesised attentional bias would be shown in encoding others' conducts either observed or verbally described, inasmuch as human action understanding would be based on embodied simulation (Gallese, 2003, 2006).

Attentional processes in encoding approach/avoidance stimulus associations have been examined by previous research (Chen & Bargh, 1999; Förster & Stepper, 2000; Förster & Strack, 1996; Gawronski et al., 2005). It has been demonstrated that valenced stimulus-motor response compatibility (i.e., positive stimulus-approach motion and negative stimulus-avoidance motion) frees attentional resources from stimuli encoding. In contrast, stimuli that are incompatible with either an approach or avoidance action orientation attracted attention for their encoding. For instance, Gawronski et al. observed detrimental effects of response-incompatible in contrast to response-compatible affective distracter stimuli on the memorization of meaningless stimuli, or on a secondary task performance. Attentional cost of stimuli encoding in incompatible conditions has been explained as a result of enhancing attention to orientation—incongruent stimuli. This incongruence may functionally regulate approach/avoidance motivation, as selective attention to stimuli that are incongruent with a given behavioural orientation may inhibit the current action. Inhibiting a dominant motivational orientation in the light of environmental information of an opposed valence (i.e., a threat while being engaged in approach motivation) is adaptively relevant (Gawronski et al., 2005: see also Rothermund, Voss, & Wentura, 2008).

In our study, participants received episodes like the one shown in Table 1. After listening to a description of a friendly or unfriendly relationship and an initial interaction, they were visually presented with a verb describing a consistent interpersonal conduct (either positive or negative) between the characters on a computer screen in front of them. At the same time, participants were prompted by an arrow cue below the verb to immediately and quickly perform an incidental motor task (stepping either forward or backward), to listen to a final sentence. Subsequently, they listened to the sentence and then performed a recognition test on some of the story's noncentral details. We collected the stepping latency and the recognition test latency and accuracy.

Interference or facilitation can be predicted either from encoding the valenced conduct toward the approach/avoidance stepping, or from approach/avoidance stepping toward conduct encoding, or bidirectionally. However, we were interested in observing the attentional consequences of motor interference from approach/avoidance motions toward conduct encoding. To do this, stepping and text processing were presented to participants as independent tasks, in a dual task paradigm, and participants were told that the stepping task had priority over text processing. Therefore, we predicted that forward and backward stepping latencies would be similar in positive and negative stories.

Table 1
An Example of an Experimental Story in the Two Versions (Spanish/English Translation)

Setting	Las calles están llenas de gentey los coches transitan con dificultad./The streets are jam-packed with people and the cars pass with difficulty.
Close relationship	Sara y Sonia se adoran./Sara and Sonia adore each other.
Distant relationship	Sara y Sonia se repelen./Sara and Sonia repel each other.
Interaction	Sonia está charlando muy animadamente con una conocida,cuando aparece Sara con un serio problema personal que le quiere contar de manera inmediata.Sonia/Sonia is animatedly chatting with an acquaintance when Sara appears with a serious personal problem that she wants to tell her.Sonia
Positive conduct VERB	ESCUCHA/LISTENS
Negative conduct VERB	*IGNORA/IGNORES*
Final sentence	a Sara toda la tarde/(to) Sara the rest of the afternoon.
Recognition test	CALLES/STREETS

Predictions for the recognition task (latency and errors) would be different according to the theoretical approach adopted. According to the motivational account, the target-conduct could act as an isolated stimulus, and therefore, mutual facilitation is predicted, which is the consensus in previous research in the case of compatible (positive–negative) conduct with approach/avoidance motions. If we take into account that concurrent motion has priority (instructions were to "take the step with priority immediately and quickly"), facilitation would only influence the target conduct processing. This would free attentional resources from conduct encoding toward text processing, which would make the consolidation of memory traces of text details stronger. Therefore, better recognition of text details (shorter latencies and fewer mistakes) is predicted in compatible conditions. Conversely, in the case of incompatibility of stepping motion with valence of the target conduct (stepping forward-negative conduct and stepping backward-positive conduct) encoding mismatching valenced conducts would demand attentional resources, as being incongruent with the body motion orientation. These resources would be withdrawn from consolidation of text memory traces. As a result, impairment of recognition of text details would occur.

From the common coding perspective, the valence common code (either positive or negative) would be occupied by approach/avoidance motion event integration in compatible conditions, as stepping has been prioritized. This occupation would impair the conduct verb encoding. What could be the attentional consequences of this impairment of conduct verb encoding? Eder and Klauer (2009) have responded to this question when they discussed an alternative interpretation to the Gawronski et al.'s (2005) results of attentional cost for encoding incompatible valenced distracter stimuli. According to them, these results can be explained as a consequence of impairment of encoding compatible stimuli, instead of incompatible distracter stimuli draining attention from the memorization or the secondary tasks. Because of common coding binding conflicts with the concurrent approach/avoidance action, attention could have been freed from processing compatible stimuli and supplied to these tasks, which caused a performance improvement in the compatibility condition. Thus, common coding would predict that attention could be diverted from the impaired target-conduct encoding toward text processing in matching conditions, and as in the motivational account, a better recognition of text details would be predicted in these conditions.

By contrast, we predicted motor interference in text processing in matching conditions, because encoding of the motor component of the conduct verb and overt motion performance compete for the same motor representation at this early stage of verb processing. Motor interference has been demonstrated in the process of understanding verbal descriptions of physical human actions (Boulenger, Roy, Paulignan, Deprez, Jeannerod, & Nazir, 2006; Buccino, Riggio, Melli, Binkofski, Gallese, & Rizzolati, 2005; Chersi, Thill, Ziemke, & Borghi, 2010; de Vega, Moreno, & Castillo, 2013). For instance, in the Buccino et al. study participants had to respond if action-related sentences are concrete or abstract in a go-no go task when a "go" signal appeared at the second syllable of a verb preceding a noun. Results showed that participants responding with their hand were slower if the sentence referred to a hand action in contrast to a foot action, whereas participants responding with the foot showed the opposite pattern. Likewise, de Vega et al. (2013) used an action-sentence compatibility paradigm (ACE; Glenberg & Kaschak, 2002) to demonstrate a mutual influence between processing sentences describing a toward/away transfer action ("you gave me the book" vs. "I gave you the book") and toward/away hand movements prompted by a visual cue. They found interference for matching conditions when the cue was presented 200 ms after the verb onset, whereas facilitation emerged with a larger 350 ms verb-cue interval. These results support the possibility that action execution and action language understanding might share motor processes (see Chersi et al., 2010).

In accordance with our attentional bias toward interpersonal conduct hypothesis, motor interference in matching conditions would involve attention having to be diverted to the encoding of the conduct verb. As mentioned before, participants were told to do two tasks concurrently: stepping and text comprehension and that stepping had priority. At the moment of stepping, participants will start to encode the conduct verb, whereas the conduct verb is displayed on the screen until step execution (see Figure 1). Approach/avoidance motor representations would have been activated at this early stage of conduct verb encoding, and interfered with by the stepping execution in matching conditions. Consequently, automatic allocation of additional attentional resources toward the encoding of interpersonal conduct would take place. These resources are drained from the ongoing process of comprehending the text. In this regard, we have to take into account that the text is understood by finding a causal path linking its opening to its final outcome (see Fletcher, Hummel, & Marsolek, 1990), as it is necessary to build up a coherent mental model of the narrated situation (Graesser, Singer, & Trabasso, 1994; Long & Lea, 2005; Rapp & van den Broek, 2005). The causal path to comprehending our narrated interactions would be on connecting the target conduct with previous interpersonal information necessary to understand why the conduct happened (see Gámez & Marrero, 2001). Attention would then be focused on establishing such causal connections (Fletcher & Bloom, 1988; Fletcher et al., 1990).

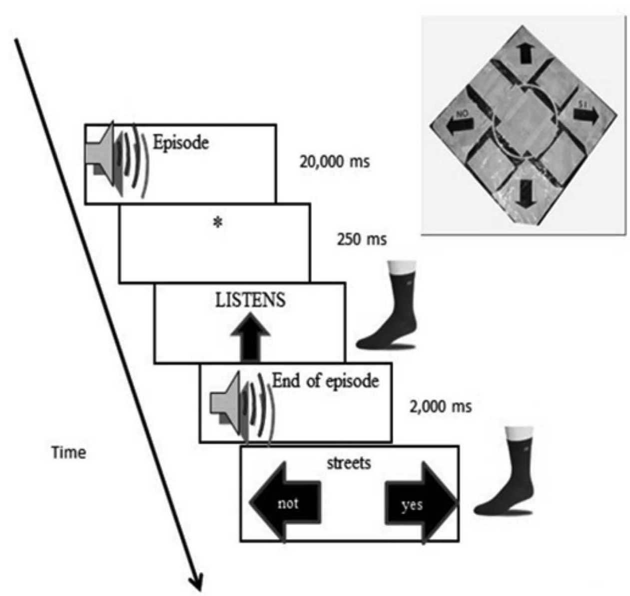

Figure 1. Schema of experimental trial.

Therefore, attention toward encoding interfered conduct verbs would not be drained from the process of establishing this causal path between the pieces of interpersonal information. Consequently, we hypothesise that the attentional resources supplied to encoding of interfered conduct verbs would be withdrawn from consolidation of memory traces of noninterpersonal contextual details of the mental model of the narrated situation.

Previous research has tested attentional effects of approach and avoidance on the difficulty in encoding valenced stimuli in a subsequent recognition task (Förster & Strack, 1996; Förster & Stepper, 2000; Gawronski et al., 2005). Similarly, we tested our hypothesised attentional effects of approach and avoidance motion on difficulty in encoding valenced conduct verbs in a subsequent recognition task. More specifically, we hypothesise that conduct verbs are more difficult to encode in matching conditions, and given their privileged status as adaptive information, would lead to attention to being drained from consolidation of memory traces of less relevant story details. Thus, memory traces of noncentral details would be weaker in these conditions, as less attention would have been supplied to them, which would impair subsequent recognition. Therefore, we predict longer latencies and more errors in matching conditions in the recognition task.

Method

Participants

Fifty-two right-footed students at the University of La Laguna (43 females, mean age: 18.7) participated in exchange for course credits.

Materials

The study used 36 experimental stories adapted from Gámez and Marrero (2001). Each story described either a friendly or unfriendly relationship between two characters and then gives a consistent (positive or negative) episodic interaction, conveyed by a conduct verb that was presented visually (see Table 1). Positive interactions consisted of supporting/accepting the other, and negative interactions consisted of rejecting, ignoring or attacking the other. In addition, 18 filler stories were created with similar topics, but not conveying positive/negative conduct. Two additional stories were written for training purposes.

Fifty university psychology students, none of whom were involved in the main experiment, evaluated conduct verb predictability on a 1 to 7 Likert scale in the context of each story. Twenty-five participants evaluated 45 positive stories, and 25 evaluated 45 negative stories, mixed with filler stories. We selected 36 positive and 36 negative stories. All the narratives: close-positive, distant-negative were in the range of medium to high predictability (from 3.50 to 6.56 in the close-positive, and from 3.50 to 5.42 in the distant-negative). The mean difference between predictability of positive and negative conduct verbs was significant ($M = 4.8$, $SD = 0.49$; $M = 4.0$, $SD = 0.88$), $t(48) = 4.58$, $p = .000$. Positive conduct verbs were more predictable. However, we think that such differences in conduct verb predictability are relatively unimportant in this research, given the fact that we are interested in the interaction between story valence and stepping, rather than the main effect of story valence. Likewise, we consider that medium predictability is enough for encoding of evaluative meaning of conduct verbs. Therefore, this difference in predictability should not influence our results. Length and lexical frequency of targets corresponded to the central intervals of their respective distributions: length: 5–11 characters; frequency: 30–100 per million (Alameda & Cuetos, 1995).

Design and Procedure

A within-subject factorial design was used, with 2 Story valence (positive: close relationship/positive conduct vs. negative: distant relationship/negative conduct) × 2 Stepping (forward vs. backward) conditions. Thirteen participants were randomly assigned to one of four sets of stories resulting from the counterbalance of experimental conditions. This ensured that every participant received an equal number of stories for each of the four conditions (positive story-forward stepping, positive story-backward stepping, negative story-forward stepping, and negative story-backward stepping), and no participant received the same story twice. Stories were randomly presented to the participants in each of the four counterbalancing sets.

Participants were told to carefully listen to daily life short stories while having to stay in the circle of a rug (80 cm^2) in front of a computer screen (100 cm in front of them) to perform a stepping task. There were four arrows on the rug pointing, respectively, to the front, back, right, and left of the participant (see Figure 1). Under each arrow, there was a contact sensor connected to the computer. Participants were informed that the arrow cue would appear on the computer screen below a written word that continued the narrative being listened to.

A stepping training phase followed: while standing in the circle in the middle of the rug, participants were prompted to step in the different directions. Then, participants received two training texts to practice the dual task (text processing and stepping); finally, they were given the 36 experimental stories (nine for each combination of story valence and stepping condition) mixed with the 18 filler stories.

As is shown in Figure 1, for each story, participants first listened to the episode describing the initial situation and the characters' relationship through two loudspeakers placed on either side of the computer screen, while standing in the circle on the rug. After they had heard the initial episode, the critical conduct verb was visually presented in the middle of the screen, replacing a fixation point, and participants were prompted by the arrow cue appearing below the conduct to step either forward or backward. Participants were told that they had to take the step with priority immediately and quickly with his or her dominant leg to listen to the final sentence. After stepping motion, they had to return to the circle and listen to the final sentence. Subsequently, a recognition probe appeared on the screen, and participants were told to step as quickly as possible to the right if the word had been mentioned and to the left if it had not. Target words referred to contextual noninterpersonal details either in the introductory setting at the beginning of narratives, or in the phrases describing the previous interaction. The experimental stories were followed by a recognition probe that was in the story, whereas the filler stories included a probe that had not been mentioned. Therefore, one-third of correct responses were negative.

Results

We carried out one analysis of variance (ANOVA) with Story valence and Stepping as within-participant factors on stepping latencies. Latencies over 1,700 ms and under 600 ms (4%) were substituted by the subject-mean ±2 *SD* (Table 2).

Only the main effect of stepping was significant, $F(1, 51) = 24.52$, MSe = 23465, $p = .000$, $\eta_p^2 = 0.32$. Stepping took more time in the backward ($M = 1157$, $SD = 199$) than in the forward condition ($M = 1051$, $SD = 197$). As we predicted, conduct verb valence did not significantly modulate forward-backward stepping latencies inasmuch as stepping execution was being prioritized.

We carried out one ANOVA with Story valence and Stepping as within-participant factors on recognition task latencies for correct responses. Recognition latencies over 2,500 ms or under 800 ms (6%) were substituted by the subject-mean ±2 *SD*. The means and *SD*s of experimental conditions are shown in Table 3.

Only the story valence * stepping interaction was significant, $F(1, 51) = 7.88$, MSe = 27758, $p = .007$, $\eta_p^2 = 0.134$. Planned comparisons revealed that recognition latencies in positive stories showed a nonsignificant tendency to be longer with forward stepping ($M = 1{,}696$) than with backward stepping ($M = 1{,}630$), $t(51) = 1.57$, $p = .12$, $d = 0.218$. Likewise, recognition latencies in negative stories were longer with backward stepping ($M = 1{,}698$) than with forward stepping ($M = 1{,}633$), $t(51) = 1.92$, $p = .06$, $d = 0.267$, marginally significant. Moreover, recognition latencies in the backward stepping condition were significantly longer with negative stories ($M = 1{,}698$) than with positive stories ($M = 1{,}630$), $t(51) = 2.03$, $p = .047$, $d = 0.281$. In addition, recognition latencies in the forward stepping condition were longer with positive stories ($M = 1{,}696$) than with negative stories ($M = 1{,}633$), $t(51) = 1.70$, $p = .094$, $d = 0.236$, marginally significant.

To gather more statistical evidence on the meaning of the story valence * stepping interaction, we collapsed the matching conditions (positive story-step forward and negative story-step backward), and the mismatching conditions (positive story-step backward and negative story-step forward) and submitted the new data to an analysis, in which the matching condition produced longer recognition latencies ($M = 1{,}697$, $SD = 364$) than the mismatching condition ($M = 1{,}632$, $SD = 361$), $t(51) = 2.81$, $p = .007$, $d = 0.39$.

Although specific contrasts only reach significance in the contrast between negative and positive stories in the backward stepping condition, the contrast between collapsed matching and mismatching conditions showed a robust matching effect. Therefore, latencies of the recognition task support the predicted impairment in the matching conditions: positive story-stepping forward and negative story-stepping backward.

Table 2
Means and SDs (in Parenthesis) of Stepping Latencies as a Function of Story Valence and Stepping

	Story valence		
Stepping	Positive (P)	Negative (N)	P-N
Forward (F)	1053 (196)	1049 (217)	04
Backward (B)	1143 (212)	1170 (221)	−27
F-B	−110	−121	

Table 3
Means and SDs (in Parenthesis) of Recognition Task Latencies for Correct Responses as a Function of Story Valence and Stepping

	Story valence		
Stepping	Positive (P)	Negative (N)	P-N
Forward (F)	1696 (383)	1633 (371)	63
Backward (B)	1630 (407)	1698 (395)	−68
F-B	66	−65	

We carried out one ANOVA with Story valence and Stepping as within-participant factors on errors in the recognition task. Only the story valence * stepping interaction was significant, $F(1, 51) = 4.58$, MSe = 0.945, $p = .037$, $\eta_p^2 = 0.082$. Planned comparisons revealed that errors in positive stories showed a nonsignificant tendency to be greater with forward stepping ($M = 1.75$) than with backward stepping ($M = 1.46$), $t(51) = 1.30$, $p = .20$, $d = 0.177$. Likewise, errors in negative stories showed a nonsignificant tendency to be greater with backward stepping ($M = 1.73$) than with forward stepping ($M = 1.44$), $t(51) = 1.31$, $p = .196$, $d = 0.196$. Moreover, errors in the backward stepping condition showed a nonsignificant tendency to be greater with negative stories ($M = 1.73$) than with positive stories ($M = 1.46$), $t(51) = 1.333$, $p = .189$, $d = 0.184$. In addition, errors in the forward stepping condition showed a nonsignificant tendency to be greater with positive stories ($M = 1.75$) than with negative stories ($M = 1.44$), $t(51) = 1.417$, $p = .163$, $d = 0.196$ (Table 4).

To gather more statistical evidence on the meaning of the story valence * stepping interaction, we collapsed the matching conditions (positive story-step forward and negative story-step backward), and the mismatching conditions (positive story-step backward and negative story-step forward) and submitted the new data to an analysis, in which the matching condition produced more errors ($M = 1.74$, $SD = 0.860$) than mismatching condition ($M = 1.45$, $SD = 0.829$), $t(51) = 2.14$, $p = 0{,}037$, $d = 0.296$.

As in the case of recognition latencies, the contrast between collapsed matching and mismatching conditions showed a matching effect. Therefore, errors in the recognition task support the predicted impairment in the matching conditions: positive story-stepping forward and negative story-stepping backward.

On the whole, recognition impairment supports that approach/avoidance stepping interfered with the conduct verb encoding in matching conditions. This would have caused attention to be diverted to conduct verb encoding from text memorization, making the consolidation of noncentral text details weaker.

Table 4
Means and SDs (in Parenthesis) of Recognition Task Errors as a Function of Story Valence and Stepping

	Story valence		
Stepping	Positive (P)	Negative (N)	P-N
Forward (F)	1.75 (1.21)	1.44 (1.14)	.31
Backward (B)	1.46 (1.09)	1.73 (1.34)	−.27
F-B	.29	−.29	

Discussion

Todd et al. (2012) defined attentional bias as "the tendency to have one's attention initially drawn and sustained by one category of salient stimulus over another" (p. 365). According to this, our results support an attentional bias toward interpersonal conduct encoding. When conduct verb encoding was concurrent with stepping motion that matched the approach/avoidance motor representation assumed to be associated with the conduct valence (positive story/step forward and negative story/step backward), performance in a subsequent recognition task was impaired (longer latencies and more errors). The recognition task impairment supports the idea that encoding approach/avoidance motor representation of conduct verbs was interfered with by the matching concurrent stepping execution. As a result, interpersonal conduct encoding was made more difficult, and so would attract attention toward its encoding (Logan, 2002). As the encoding of interpersonal conduct has to be preserved as relevant adaptive information, attentional resources would have been diverted to this encoding, that are drained from the ongoing process of comprehending the text. Attentional resources would be withdrawn from consolidation of memory traces of noninterpersonal contextual details, as less relevant in the mental model built up for comprehending the narrated situation.

These results are at odds with the motivational account. From this account, the target-conduct verb would be encoded as an isolated stimulus that is eased by compatible concurrent motion responses of approach/avoidance, as stepping would induce preparedness of stimuli evaluative encoding. This facilitation frees attentional resources from target-conduct encoding to be diverted to consolidation of text details memory traces. Therefore, a better performance in the recognition task in matching conditions is expected, which did not occur.

These results are also in contrast to the common coding perspective. From the common coding approach, the valence common code (either positive or negative) shared between valenced conduct verb and stepping is occupied by event motion integration in matching conditions, as stepping has been prioritized. According to Eder and Klauer (2009), this impairs target-conduct encoding because of feature binding conflicts. As attention could not be diverted to encode the target-conduct when the common code is occupied, it would be freed from that, and supplied to text processing. Therefore, consolidation of memory traces of text details is benefited, and a better performance in the recognition task is also expected in matching conditions.

Common coding and motivational accounts constitute alternative interpretations of approach/avoidance compatibility effects. Common coding interprets these effects in the framework of a general theory of perception and action compatibility, the theory of event coding (TEC; Hommel et al., 2001). By contrast, motivational account interprets them as a demonstration of the specificity of stimulus and approach/avoidance associations grounded in our brain. Our study would be appropriately framed in the motivational proposal, as we put forward that the specific approach/avoidance reactions we experience in interactions form part of interpersonal conduct encoding. However, common coding and motivational accounts could be complementary instead of alternative explanations of compatibility effects, as they could refer to differentiated cognitive mechanisms (Krieglmeyer et al., 2010).

Previous research has found that valenced stimuli interact with compatible approach and avoidance responses; usually facilitation is shown by shorter approach/avoidance congruent responses (Chen & Bargh, 1999; Duckworth et al., 2002; Rinck & Becker, 2007; Seidel et al., 2010; Solarz, 1960; Stins et al., 2011; Wentura et al., 2000). By contrast, in our study, stepping did not show such interaction, as the valence of the conduct verb did not significantly interfere with forward and backward stepping. We consider that such a discrepancy is related to methodological differences in the way the motor task is presented. Effects of valence stimuli on approach/avoidance movements usually appear when approach/avoidance act as the way of responding once stimulus has been encoded, or an evaluative judgment is made. This task presentation follows an s-r sequence that could cause facilitation (initiation of motor reactions) as "they are things that go together" (Alluisi & Warm, 1990). For instance, and especially relevant to our study, Stins et al. (2011) examined approach/avoidance tendencies to valenced faces adopting stepping as the motor response. Participants had to step forward or backward once they had categorised the valenced face (as either happy or angry). They found the typical congruency effect with approach (stepping forward toward positive faster than stepping forward toward negative); results were more ambiguous with avoidance. By contrast, stepping and text processing were presented in our study as independent tasks, in a dual task paradigm, and participants were told that the stepping task had priority over text processing. With this presentation, stepping is not a response to conduct verb encoding, and thus no effect of congruency is expected in approach/avoidance stepping latencies.

It could be argued that impairment in a recognition task does not directly demonstrate that attention has been diverted to encoding motor representations of conduct verbs. We agree with this argument, as this impairment only shows that less cognitive capacity was used toward consolidating memory traces of narrative details in matching conditions. Further research is necessary to support this attentional hypothesis, using event-related potential attentional measures at encoding valenced interpersonal conduct, like P300, exploring approach/avoidance hemispheric asymmetries (see Berkman & Lieberman, 2010), and observing electroencephalogram activity in the μ/α frequency range to show the involvement of motor representations in this process.

This study broadens the scope of previous attentional research on approach and avoidance in several relevant aspects. First, it examines approach/avoidance associations with interpersonal conduct (either helping or harming/denying help), instead of approach/avoidance associations with environmental stimuli. Second, it proposes a novel approach for approach/avoidance association. Instead of focusing on encoding the s-r association of valenced stimuli-approach motor reactions (either congruent or incongruent), we focused on encoding the response–response association between conduct and motor approach/avoidance reactions, as concurrent contingent responses toward valenced others. Previous research has shown mutual facilitation when action orientation and stimuli valence are congruent. This facilitation effect has been explained as a result of bidirectional conceptual-motor compatible coactivation. While previous research usually used lists of valenced individual words as stimuli and arm flexion/extension as motion, in this study we used more complex linguistic materials as stimuli: narrated interactions that conveyed target interpersonal conduct verbs. From a different perspective, we have proposed that motor representations of approach and avoidance form part of the process of encoding (and storing) motivationally valenced interpersonal conduct. Within this framework, concurrent execution of overt stepping competes for approach and avoidance motor representations involved in interpersonal conduct encoding. As a consequence, we predicted that step motion congruent with the conduct valence interferes with (instead of facilitating) interpersonal conduct encoding.

Our results contribute to embodied and social cognition research in two relevant matters. First, a contribution to the field of understanding verbal descriptions of human action is made. Previous research has shown that motor processes are involved in understanding verbal description of physical human actions (Boulenger et al., 2006; Buccino et al., 2005; Chersi et al., 2010; de Vega et al., 2013; Glenberg & Kaschak, 2002; Glenberg, Sato, Cattaneo, Riggio, Palumbo, & Buccino, 2008). According to Gallese (2003, 2006), motor representations we experience as systematically associated with action execution form part of action understanding either performed by ourselves, or by others, either observed or verbally described, inasmuch as action understanding can be based on embodied simulation. Our results support the notion that interpersonal actions could be understood in a similar way. Obviously, interpersonal actions are quite abstract (i.e., to help or to harm), and usually do not have systematic associations with specific effectors as required for their execution. However, as our results suggest, interpersonal actions are systematically associated with motor reactions of approach and avoidance that we experience in interactions and form part of the process of interaction encoding.

Second, a contribution to attentional processes related to approach/avoidance behavioural regulation in social realms has also been made. Crawford and Cacioppo (2002) have demonstrated an attentional bias toward encoding concurrent contextual spatial information linked to approach/avoidance reactions to stimuli. Beyond behavioural regulation in natural settings, our results support that such types of adaptively relevant contextual associations with approach and avoidance reactions are also carefully encoded in interpersonal conduct. In the case of approaching others for interactions, concurrent information is not a stimulus (e.g., a place), but an operant conduct. As in the case of approach/avoidance regulation to spatial places, an attentional bias toward encoding approach/avoidance motor components of the interpersonal conduct that is being represented is relevant for survival, insofar as helping or harming conduct toward others has to be discriminately oriented according to the adaptive incentive value (rewarding or threatening) of the others for us.

Likewise, our study has made a contribution to text comprehension research. As mentioned, complex linguistic materials, like stories referring to valenced interpersonal events, have yet to be tested for approach/avoidance effects. As far as we know, effects of approach/avoidance, either as interference or facilitation, have not been explored in text comprehension. Although new, our predictions have been based on theoretical grounds and previous research in the field of text comprehension.

In Crawford and Cacioppo (2002) study, participants were more sensitive to spatial-valenced stimuli correlations when stimuli were negative. They explain it as a negative bias, given that it is more difficult to reverse the negative consequences of harmful events than of failed opportunities. Our results did not show a negative bias. This is to be expected if we consider that attention to positive conduct is related to approaching others in a secure way, which could have been shaped by evolution to favour the survival of cooperative individuals.

One interesting implication of this study for social cognition is that it provides psychological support for the linguistic spatial metaphor of interpersonal closeness (see Hess, 2003). Evidence is growing that this kind of sensory-motor metaphor has an underlying neural embodied basis (Isanski & West, 2010). The metaphor of "closeness" or "distance" in relationship could be based on encoded covert forward/backward motion associations with positive/negative conduct that we exchange with other individuals throughout our past of stored interactions. According to Goldman and de Vignemont (2009), the evidence of embodied simulation in social cognition is limited. Our results could offer a step forward in the realm of interpersonal cognition, providing further evidence of its embodied character.

Résumé

Les tendances à l'approche et à l'évitement de personnes de valence positive ou négative pourraient être associées au comportement interpersonnel avec ces dernières : l'action d'aider serait associée à la tendance à l'approche alors que l'action de nuire (ou refuser d'aider) serait associée à l'évitement. Nous proposons que l'encodage de cette association bénéficie d'une priorité au niveau de l'attention, étant donné que les représentations d'approche/d'évitement d'interactions antérieures réguleraient la prédisposition d'une personne à aider ou à nuire lors d'interactions subséquentes. Les participants étaient soumis à l'écoute d'interactions mettant en jeu des comportements positifs/négatifs entre deux personnes. Le verbe du comportement était ensuite présenté visuellement aux participants accompagné d'une consigne leur demandant de faire un pas vers l'avant ou l'arrière. On leur demandait ensuite d'effectuer une tâche de reconnaissance des détails secondaires de l'histoire. Dans des conditions appariées (comportement positif – pas vers l'avant, comportement négatif – pas vers l'arrière), le pas concurrent devrait perturber l'encodage de la représentation motrice du verbe de comportement et l'encodage du verbe devrait détourner les ressources attentionnelles de la consolidation des traces de mémoire d'informations moins pertinentes. Les résultats ont confirmé la déficience prévue au niveau de la tâche de reconnaissance en conditions appariées, venant appuyer le biais attentionnel à l'égard de l'encodage de la représentation motrice de l'approche ou de l'évitement du comportement interpersonnel dans le processus de la compréhension d'interactions narrées.

Mots-clés : attention, approche/évitement, narrations, comportement interpersonnel motivé, cognition incarnée.

References

Alameda, J. R., & Cuetos, F. (1995). *Diccionario de frecuencias de las unidades lingüísticas del castellano*. Oviedo: Servicio de Publicaciones de la Universidad de Oviedo.

Alluisi, E. A., & Warm, J. S. (1990). Things that go together: A review of stimulus-response compatibility and related effects. In R. W. Proctor & T. G. Reeve (Eds.), *Stimulus-response compatibility: An integrated* *perspective* (pp. 3–30). Amsterdam: North-Holland. http://dx.doi.org/10.1016/S0166-4115(08)61217-0

Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology, 59,* 617–645. http://dx.doi.org/10.1146/annurev.psych.59.103006.093639

Berkman, E. T., & Lieberman, M. D. (2010). Approaching the bad and avoiding the good: Lateral prefrontal cortical asymmetry distinguishes between action and valence. *Journal of Cognitive Neuroscience, 22,* 1970–1979. http://dx.doi.org/10.1162/jocn.2009.21317

Boulenger, V., Roy, A. C., Paulignan, Y., Déprez, V., Jeannerod, M., & Nazir, T. A. (2006). Cross-talk between language processes and overt motor behavior in the first 200 msec of processing. *Journal of Cognitive Neuroscience, 18,* 1607–1615. http://dx.doi.org/10.1162/jocn.2006.18.10.1607

Buccino, G., Riggio, L., Melli, G., Binkofski, F., Gallese, V., & Rizzolatti, G. (2005). Listening to action-related sentences modulates the activity of the motor system: A combined TMS and behavioral study. *Cognitive Brain Research, 24,* 355–363. http://dx.doi.org/10.1016/j.cogbrainres.2005.02.020

Cacioppo, J. T., Priester, J. R., & Berntson, G. G. (1993). Rudimentary determinants of attitudes. II: Arm flexion and extension have differential effects on attitudes. *Journal of Personality and Social Psychology, 65,* 5–17. http://dx.doi.org/10.1037/0022-3514.65.1.5

Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioural predispositions to approach or avoid stimulus. *Personality and Social Psychology Bulletin, 25,* 215–224. http://dx.doi.org/10.1177/0146167299025002007

Chersi, F., Thill, S., Ziemke, T., & Borghi, A. M. (2010). Sentence processing: Linking language to motor chains. *Front Neurorobot, 4,* 4. http://dx.doi.org/10.3389/fnbot.2010.00004

Crawford, L. E., & Cacioppo, J. T. (2002). Learning where to look for danger: Integrating affective and spatial information. *Psychological Science, 13,* 449–453. http://dx.doi.org/10.1111/1467-9280.00479

de Vega, M., Moreno, V., & Castillo, D. (2013). The comprehension of action-related sentences may cause interference rather than facilitation on matching actions. *Psychological Research, 77,* 20–30. http://dx.doi.org/10.1007/s00426-011-0356-1

Duckworth, K. L., Bargh, J. A., García, M., & Chaiken, S. (2002). The automatic evaluation of novel stimuli. *Psychological Science, 13,* 513–519. http://dx.doi.org/10.1111/1467-9280.00490

Eder, A. B., & Klauer, K. C. (2009). A common-coding account of the bidirectional evaluation-behavior link. *Journal of Experimental Psychology: General, 138,* 218–235. http://dx.doi.org/10.1037/a0015220

Eder, A. B., & Rothermund, K. (2008). When do motor behaviors (mis) match affective stimuli? An evaluative coding view of approach and avoidance reactions. *Journal of Experimental Psychology: General, 137,* 262–281. http://dx.doi.org/10.1037/0096-3445.137.2.262

Fletcher, C. R., & Bloom, C. P. (1988). Causal reasoning in the comprehension of simple narrative texts. *Journal of Memory and Language, 27,* 235–244. http://dx.doi.org/10.1016/0749-596X(88)90052-6

Fletcher, C. R., Hummel, J. E., & Marsolek, C. J. (1990). Causality and the allocation of attention during comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16,* 233–240. http://dx.doi.org/10.1037/0278-7393.16.2.233

Förster, J., & Stepper, S. (2000). Compatibility between approach/avoidance stimulation and valenced information determines residual attention during the process of encoding. *European Journal of Social Psychology, 30,* 853–871. http://dx.doi.org/10.1002/1099-0992(200011/12)30:6<853::AID-EJSP20>3.0.CO;2-1

Förster, J., & Strack, F. (1996). Influence of overt head movements on memory for valenced words: A case of conceptual-motor compatibility. *Journal of Personality and Social Psychology, 71,* 421–430. http://dx.doi.org/10.1037/0022-3514.71.3.421

Gallese, V. (2003). The manifold nature of interpersonal relations: The quest for a common mechanism. *Philosophical Transactions of the Royal Society of London, 358,* 517–528. http://dx.doi.org/10.1098/rstb.2002.1234

Gallese, V. (2006). Embodied simulation: From mirror neuron systems to interpersonal relations. *Empathy and Fairness*. Wiley, Chichester (Novartis Foundation Symposium 278).

Gámez, E., & Marrero, H. (2001). The role of interpersonal goals in text comprehension. *Discourse Processes, 31,* 215–240.

Gawronski, B., Deutsch, R., & Strack, F. (2005). Approach/avoidance-related motor actions and the processing of affective stimuli: Incongruency effects in automatic attention allocation. *Social Cognition, 23,* 182–203. http://dx.doi.org/10.1521/soco.23.2.182.65627

Glenberg, A. M., & Kaschak, M. P. (2002). Grounding language in action. *Psychonomic Bulletin & Review, 9,* 558–565. http://dx.doi.org/10.3758/BF03196313

Glenberg, A. M., Sato, M., Cattaneo, L., Riggio, L., Palumbo, D., & Buccino, G. (2008). Processing abstract language modulates motor system activity. *The Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 61,* 905–919. http://dx.doi.org/10.1080/17470210701625550

Goldman, A., & de Vignemont, F. (2009). Is social cognition embodied? *Trends in Cognitive Sciences, 13,* 154–159. http://dx.doi.org/10.1016/j.tics.2009.01.007

Graesser, A. C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review, 101,* 371–395. http://dx.doi.org/10.1037/0033-295X.101.3.371

Gray, J. A. (1991). The neuropsychology of temperament. Perspectives on individual differences. In J. Strelau & A. Angleitner (Eds.), *Explorations in temperament: International perspectives on theory and measurement* (pp. 105–128). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4899-0643-4_8

Havas, D. A., Glenberg, A. M., Gutowski, K. A., Lucarelli, M. J., & Davidson, R. J. (2010). Cosmetic use of botulinum toxin-a affects processing of emotional language. *Psychological Science, 21,* 895–900. http://dx.doi.org/10.1177/0956797610374742

Havas, D. A., Glenberg, A. M., & Rinck, M. (2007). Emotion simulation during language comprehension. *Psychonomic Bulletin & Review, 14,* 436–441. http://dx.doi.org/10.3758/BF03194085

Hess, J. A. (2003). Measuring distance in personal relationships: The relational distance index. *Personal Relationships, 10,* 197–216. http://dx.doi.org/10.1111/1475-6811.00046

Hommel, B., Müsseler, J., Aschersleben, G., & Prinz, W. (2001). The Theory of Event Coding (TEC): A framework for perception and action planning. *Behavioral and Brain Sciences, 24,* 849–878. http://dx.doi.org/10.1017/S0140525X01000103

Isanski, B., & West, C. (2010). The body of knowledge: Understanding embodied cognition. *APS Observer, 23,* 14–28.

Koch, S., Holland, R. W., Hengstler, M., & van Knippenberg, A. (2009). Body locomotion as regulatory process: Stepping backward enhances cognitive control. *Psychological Science, 20,* 549–550. http://dx.doi.org/10.1111/j.1467-9280.2009.02342.x

Krieglmeyer, R., Deutsch, R., De Houwer, J., & De Raedt, R. (2010). Being moved: Valence activates approach-avoidance behavior independently of evaluation and approach-avoidance intentions. *Psychological Science, 21,* 607–613. http://dx.doi.org/10.1177/0956797610365131

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1990). Emotion, attention, and the startle reflex. *Psychological Review, 97,* 377–395. http://dx.doi.org/10.1037/0033-295X.97.3.377

Logan, G. D. (2002). An instance theory of attention and memory. *Psychological Review, 109,* 376–400. http://dx.doi.org/10.1037/0033-295X.109.2.376

Long, D. L., & Lea, R. B. (2005). Have we been searching for meaning in all the wrong places: Defining the “search after meaning” principle in comprehension. *Discourse Processes, 39,* 279–298. http://dx.doi.org/10.1080/0163853X.2005.9651684

Markman, A. B., & Brendl, C. M. (2005). Constraining theories of embodied cognition. *Psychological Science, 16,* 6–10. http://dx.doi.org/10.1111/j.0956-7976.2005.00772.x

Miller, N. (1944). Experimental studies of conflict. In J. Hunt (Ed.), *Personality and the behavioral disorders* (Vol. 1, pp. 431–465). New York, NY: Ronald Press.

Rapp, D. N., & van den Broek, P. (2005). Dynamic text comprehension: An integrative view of reading. *Current Directions in Psychological Science, 14,* 276–279. http://dx.doi.org/10.1111/j.0963-7214.2005.00380.x

Rinck, M., & Becker, E. S. (2007). Approach and avoidance in fear of spiders. *Journal of Behavior Therapy and Experimental Psychiatry, 38,* 105–120. http://dx.doi.org/10.1016/j.jbtep.2006.10.001

Rothermund, K., Voss, A., & Wentura, D. (2008). Counter-regulation in affective attentional biases: A basic mechanism that warrants flexibility in emotion and motivation. *Emotion, 8,* 34–46. http://dx.doi.org/10.1037/1528-3542.8.1.34

Seibt, B., Neumann, R., Nussinson, R., & Strack, F. (2008). Movement direction or change in distance? Self- and object-related approach-avoidance motions. *Journal of Experimental Social Psychology, 44,* 713–720. http://dx.doi.org/10.1016/j.jesp.2007.04.013

Seidel, E. M., Habel, U., Kirschner, M., Gur, R. C., & Derntl, B. (2010). The impact of facial emotional expressions on behavioral tendencies in women and men. *Journal of Experimental Psychology: Human Perception and Performance, 36,* 500–507. http://dx.doi.org/10.1037/a0018169

Solarz, A. K. (1960). Latency of instrumental responses as a function of compatibility with the meaning of eliciting verbal signs. *Journal of Experimental Psychology, 59,* 239–245. http://dx.doi.org/10.1037/h0047274

Stins, J. F., Roelofs, K., Villan, J., Kooijman, K., Hagenaars, M. A., & Beek, P. J. (2011). Walk to me when I smile, step back when I'm angry: Emotional faces modulate whole-body approach-avoidance behaviors. *Experimental Brain Research, 212,* 603–611. http://dx.doi.org/10.1007/s00221-011-2767-z

Todd, R. M., Cunningham, W. A., Anderson, A. K., & Thompson, E. (2012). Affect-biased attention as emotion regulation. *Trends in Cognitive Sciences, 16,* 365–372. http://dx.doi.org/10.1016/j.tics.2012.06.003

van Dantzig, S., Pecher, D., & Zwaan, R. A. (2008). Approach and avoidance as action effects. *The Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 61,* 1298–1306. http://dx.doi.org/10.1080/17470210802027987

Wentura, D., Rothermund, K., & Bak, P. (2000). Automatic vigilance: The attention-grabbing power of approach- and avoidance-related social information. *Journal of Personality and Social Psychology, 78,* 1024–1037. http://dx.doi.org/10.1037/0022-3514.78.6.1024

Zajonc, R. B. (1998). Emotions. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed., pp. 591–632). New York, NY: McGraw-Hill.

Received May 27, 2014
Accepted November 24, 2014 ■