On the nature of automatically triggered approach-avoidance behavior

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Abstract

Theory suggests that stimulus evaluations automatically evoke approach-avoidance behavior. However, the extent to which approach-avoidance behavior is triggered automatically is not yet clear. Furthermore, the nature of automatically triggered approach-avoidance behavior is controversial. We review research on two views on the type of approach-avoidance behavior that is triggered automatically (arm flexion/extension, distance change). Present evidence supports the distance-change view and corroborates the notion of an automatic pathway from evaluation to distance-change behavior. We discuss underlying mechanisms (direct stimulus-response links, outcome anticipations, goals) as well as implications regarding the flexibility of the evaluation-behavior link.

Keywords: approach avoidance, distance change, evaluation, automatic
In order to survive, organisms need to approach rewards (e.g., food, money) and avoid punishment (e.g., predators, poverty). Such approach-avoidance (AA) behaviors differ from other behaviors in that they are directed. More specifically, approach behavior is defined as behavior directed towards positive stimuli, whereas avoidance behavior is defined as behavior directed away from negative stimuli (Elliot, 2008). Understanding the principles of approach-avoidance behavior has been an important goal of psychological research for more than a century. One question that has engaged researchers is whether affective stimuli evoke AA-behavior automatically. In addition, researchers tried to identify the types of AA-behaviors that can be triggered automatically.

In the present article, we give a brief overview of the research on the automatic pathway from evaluation to AA-behavior. Because a comprehensive review is beyond the scope of this article, we only highlight some key studies. Thereby, we aim at answering two main questions: (1) Which types of AA-behavior are triggered automatically by affective stimuli? (2) What mechanisms underlie the automatic link between affective stimuli and AA-behavior? Before discussing evidence on these two questions, we briefly describe the paradigm that is typically used to investigate the automatic pathway from evaluation to AA-behavior.

**Measuring Automatic Facilitation of Approach-Avoidance Behavior**

To study the extent to which affective stimuli automatically trigger AA-behavior, researchers primarily employ stimulus-response-compatibility tasks (SRC-tasks) with manual responses. In a seminal study by Solarz (1960), participants were asked to push and pull a movable stage mounted on a runway. On each trial, a card displaying a positive or negative word was placed on the stage. Upon appearance of the card, participants pulled the card toward them or pushed it away from them as quickly as possible. Participants were faster to pull positive words and push negative words (compatible trials) than vice versa (incompatible
trials). These findings were later replicated by asking participants to pull and push a lever in response to words appearing on a computer screen (Chen & Bargh, 1999), or by letting them move a stick-figure on the screen towards and away from a word (De Houwer, Crombez, Baeyens, & Hermans, 2001). In the remainder of this article, we refer to such effects as valence-approach/avoidance-compatibility effects (VAAC-effects).

The rationale underlying SRC-tasks is the assumption that a stimulus feature (valence) triggers a response tendency that may either facilitate (on compatible trials) or interfere (on incompatible trials) with quick responding according to the instructions. To what extent are VAAC-effects automatic? Theoretical accounts of automaticity distinguish several, independent features of automatic processes: they are considered fast, efficient, goal-independent, and/or unconscious (Bargh, 1992; Moors & De Houwer, 2006). VAAC-effects can be described as fast in the sense that stimulus valence influences even AA-responses that are emitted quickly, that is, within less than 1000 ms after stimulus presentation. To further explore the limits of VAAC-effects in terms of speed, additional studies are required in which response deadlines are imposed in SRC-tasks. VAAC-effects also do not seem to depend on the goal to let stimulus valence influence the response, because participants are asked to respond quickly and accurately on compatible as well as incompatible trials. This task should discourage participants from adopting the goal to let stimulus valence influence responses, because on incompatible trials adopting this goal interferes with the task to respond quickly. By asking participants to respond to a valence-irrelevant stimulus feature it has been shown that VAAC-effects do not depend on the goal to evaluate stimuli (Chen & Bargh, 1999). However, little is known about the impact of other types of goals. Likewise, there have been few studies on whether VAAC-effects are automatic in the sense of efficient and unconscious. In sum, results from SRC-tasks provide evidence regarding some automaticity features, but additional studies are necessary to investigate the full range of automaticity features.
The Nature of Automatically Facilitated Approach-Avoidance Behavior

Researchers disagree on the type of AA-behaviors that can be triggered automatically by affective stimuli. Often a distinction is made between two types of AA-behaviors. Both types are said to have direction (and thus qualify as AA-behaviors) but differ with regard to the feature that is used to define the direction of the behavior. The first type is defined on the basis of the involvement of certain muscles. In particular, flexing and extending the arm have been defined as AA-behaviors because the activity of these muscles in the past often co-occurred with distance decrease (pulling something toward) or increase (pushing something away) during the lifetime of an organism (Cacioppo, Priester, & Berntson, 1993). The second type is defined based on whether the behavior decreases or increases the distance between the self and an object (Seibt, Neumann, Nussinson, & Strack, 2008; Strack & Deutsch, 2004). Unlike the first type of AA-behavior, the second type does not necessarily involve specific muscle groups that are associated with distance decrease or increase. Instead, any behavior that causes changes in the distance toward an object is said to be directed and thus qualifies as an AA-behavior. Based on this distinction between two types of AA-behaviors, two hypotheses have been put forward. According to the arm flexion/extension hypothesis, only the first type of AA-behavior is activated automatically. More specifically, positive stimuli are assumed to facilitate arm flexion, whereas negative stimuli facilitate arm extension. According to the distance-change hypothesis, positive/negative stimuli will automatically activate any behavior that decreases/increases the distance to those stimuli.

Other researchers, however, have suggested that the responses in VAAC-studies are influenced by stimulus valence not because they are AA-responses but simply because these responses are valenced (Eder & Rothermund, 2008; Lavender & Hommel, 2007). That is, positive stimuli are assumed to automatically activate all positive responses (including approach responses), whereas negative stimuli would activate all negative responses (including avoidance responses). Although this evaluative coding hypothesis of VAAC-
effects still entails that affective stimuli can automatically activate AA-responses, it implies that they do so not because of the directedness of AA-behavior (i.e., the feature that sets them apart from other behavior) but because of a feature they share with other behaviors (i.e., their valence). Hence, in order to decide whether VAAC-effects tell us anything about AA-behavior specifically, we also need to evaluate the evaluative coding hypothesis. In the following sections, we briefly review the evidence related to the various hypotheses.

**Arm Flexion/Extension**

Early investigations of VAAC-effects confirmed that positive/negative stimuli automatically activate arm flexion/extension (Chen & Bargh, 1999; Solarz, 1960). Nevertheless, they did not allow for definite conclusions about the flexion/extension hypothesis, because flexion/extension was confounded with distance change. For instance, participants in Solarz’ study (1960) pulled words toward them (flexion) and pushed words away (extension). Hence, both muscle activation and distance regulation may be responsible for the effects. To isolate the effects of flexion/extension, Rotteveel and Phaf (2004) asked participants to press an upper (flexion) or lower (extension) button on a vertical stand in response to pictures presented on a screen. These movements did not change the distance between participants’ body or their hands and the stimulus on the screen. Nevertheless, participants were faster to flex the arm in response to positive pictures and to extend the arm in response to negative pictures than vice versa. These findings suggest that evaluations activate arm muscles of flexion/extension. However, these results emerged only when participants had the goal to evaluate the stimuli, but not when they responded to valence-irrelevant stimulus features. Thus, activation of arm muscles appears to be non-automatic in the sense that it depends on evaluation goals.
Distance Change

Expanding on these findings, researchers investigated whether evaluations trigger only arm flexion/extension, or any behavior that changes the distance between the self and an object. To this end, researchers manipulated the perceived or imagined distance change independently of the flexion/extension movement (Markman & Brendl, 2005; Seibt, Neumann, Nussinson, & Strack, 2008). For instance, participants were asked to pull (flexion) and push (extension) a joystick in response to affective stimuli presented on the screen. One group of participants should imagine pulling the stimulus toward them and pushing it away, whereas the other group should imagine moving their hand away from the stimulus and toward the stimulus (Seibt et al., 2008). Across studies, participants were faster to execute movements that led to a distance change compatible to stimulus valence than vice versa, regardless of whether the movement involved flexion or extension. Moreover, studies showed that affective stimuli facilitate arbitrary responses (pressing keys on a keyboard) that cause a compatible distance change, even though neither arm flexion nor extension was required (De Houwer et al., 2001). In these studies, participants moved a stick-figure on a screen towards and away from a word using the up and down arrow keys. Participants were faster to move the stick-figure towards positive and away from negative words than vice versa. Further empirical evidence indicates that affective stimuli facilitate compatible distance-change behavior even when participants do not have the goal to evaluate the stimuli (Krieglmeyer & Deutsch, 2010) as well as even when they do not have the goal to execute distance-change responses (Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010), attesting the automatic nature of this effect.

If stimulus valence facilitates distance-change behavior, the question arises which distance change at what point in time matters, immediate or ultimate distance change? For instance, ultimately escaping an attacker may require initial approach when he is blocking the exit. To investigate this question, researchers independently manipulated immediate and
ultimate distance change in an SRC-task (Krieglmeyer, De Houwer, & Deutsch, 2011). Participants moved a stick-figure on the screen towards and away from valenced words presented in the center of the screen. The stick-figure appeared either above or below the word on a pathway connecting the word to the border of the screen. The layout of the pathway was either straight or winding. When the pathway was straight, immediate distance change was equal to ultimate distance change. When the pathway was winding, immediate distance change was opposite to ultimate distance change (e.g., approaching the word initially required a movement away from the word). Results showed that stimulus valence facilitated responses that ultimately led to a compatible distance change, regardless of the direction of the immediate distance change. These findings suggest that effects of ultimate distance change dominate effects of immediate distance change. However, there may be boundary conditions of the ultimate VAAC-effect. First, ultimate consequences fully dominated behavior only if the situation was such that the ultimate consequences could be easily anticipated. If, however, anticipation was more difficult (e.g., because there was no visible pathway), immediate consequences influenced behavior to some degree. Second, the ultimate consequences occurred within seconds after the response. More delayed consequences may have a weaker impact on VAAC-effects (cf. Strack & Deutsch, 2004). Third, little is known about the extent to which ultimate VAAC-effects are automatic in the sense of fast, efficient, or independent of evaluation goals. Nevertheless, present evidence suggests that affective stimuli facilitate compatible distance-change responses, regardless of the specific muscles involved (flexion/extension) and regardless of the immediate direction of distance change.

Valence of Behavior

According to the evaluative coding hypothesis, affective stimuli do not specifically trigger AA-behavior but valenced responses in general. To test this hypothesis, Eder and Rothermund (2008) manipulated the valence of movement goals by describing lever
responses in different ways. They observed that positive stimuli facilitated responses labeled in a positive way (“toward”, “upward”), and negative stimuli facilitated responses labeled in a negative way (“away”, “downward”), regardless of whether the responses were represented as AA-responses (i.e., toward-away) or as AA-unrelated responses (i.e., upward-downward). As such, the evaluative coding hypothesis provides an alternative explanation for VAAC-effects, inasmuch as this explanation is not specific to AA-behavior.

The fact that also behaviors other than AA-behaviors can be activated automatically by valenced stimuli does not, however, exclude the possibility that VAAC-effects for AA-behaviors are (to a certain extent) driven by features unique to AA-behaviors. To test the evaluative coding hypothesis against the distance-change hypothesis, researchers independently manipulated the evaluative meaning of the responses and the direction of distance change caused by the responses (Krieglmeyer et al., 2010). Participants moved a stick-figure on a screen upward (positive response label) or downward (negative response label), depending on the valence of the word presented in the center of the screen. No reference to approach or avoidance was made. Most importantly, upward and downward movements caused a decrease or increase in the distance between the stick-figure and the word, depending on whether the stick-figure appeared above or below the word. Thus, positively labeled responses could imply approach and avoidance. Similarly, negatively labeled responses could imply approach and avoidance. This study revealed two independent effects. Most importantly, positive words facilitated responses that caused distance decrease and negative words facilitated responses that caused distance increase, irrespective of the evaluative meaning of the responses. These findings cannot be explained by the evaluative coding hypothesis, because the evaluative meaning of the responses was independent of their distance-change effects. In addition, positive words facilitated upward movements and negative words facilitated downward movements. Thus, both distance change and evaluative coding contributed to VAAC-effects. Two further studies using the same paradigm showed
that affective stimuli facilitated distance-change responses irrespective of the evaluative meaning of the responses, even when participants did not have the goal to evaluate the stimuli. In contrast, effects on valenced responses (i.e., upward/downward movements) depended on the evaluation goal. Thus, the influence of affective stimuli on AA-behavior is more automatic than the influence of affective stimuli on valenced responses.

Summary

In sum, evidence supports the conclusion that AA-behavior can be activated automatically. In particular, the effect of stimulus valence on AA-behavior is relatively fast, not dependent on the goal to let stimulus valence influence behavior, and – at least in some cases - not dependent on the goal to evaluate stimuli. These VAAC-effects are not limited to AA-behaviors that involve certain muscles (arm flexion/extension) but include any behavior that changes the distance towards a stimulus. Moreover, evidence indicates that the second type of AA-behavior (distance-change behavior) is activated more automatically than the first type of AA-behavior (arm flexion/extension) in the sense that activation does not depend on evaluation goals. Finally, if pitted against each other, effects of distance change dominate effects of arm flexion/extension.

Although valenced behaviors other than AA-behaviors can also be activated automatically by affective stimuli, VAAC-effects are partially driven by features unique to AA-behaviors. More specifically, affective stimuli facilitate compatible distance-change responses regardless of the valence of the responses. Moreover, the link between stimulus valence and distance-change responses is more automatic than the link between stimulus valence and valenced responses in the sense that the former does not depend on evaluation goals.
Underlying Mechanisms

Knowing that affective stimuli automatically trigger any behavior that causes a compatible distance change it is interesting to ask what mental constructs mediate this automatic influence. There are at least three possible answers. First, there might be a direct effect of evaluations on mental representations of distance-change responses, without any mediating steps. While working on an SRC-task, participants can learn the AA-meaning of the responses as a function of the specific context (cf. Kiesel & Hoffmann, 2004). For instance, in the experiments on immediate vs. ultimate distance change (Krieglmeyer et al., 2011), participants completed numerous trials that differed in the initial position of the stick-figure (above or below the word) and the layout of the pathway (straight or winding). Participants may have learned that an up key-press means ultimate approach when the stick-figure appears above the word and the pathway is winding, or when the stick-figure appears below the word and the pathway is straight. Given successful learning, the presentation of the context (stick-figure position and pathway) at the beginning of each trial may then induce the AA-meaning of the specific response representation (e.g., up key-press). As a consequence, stimulus valence may directly activate the contextualized response representation.

Second, anticipations of behavioral outcomes may mediate the link between evaluation and distance-change behavior. Research on the ideo-motor principle suggests that responses are caused by the anticipation of their outcomes (for an overview, see Shin, Proctor, & Capaldi, 2010). In contrast to a stimulus-response link, this view suggests a stimulus-outcome-response link. Accordingly, evaluations may result in the anticipation of compatible distance change, which in turn may activate the specific response leading to the anticipated outcome. Whether such anticipations mediate VAAC-effects has yet to be tested empirically. The literature on the ideo-motor principle provides experimental designs for such tests.

Third, goal representations may mediate the link between evaluation and distance-change behavior. In addition to the mere anticipation of outcomes, goal representations are
thought to possess some further properties such as leading to post-attainment decrements in motivation, causing gradients as a function of the distance to the goal, and inhibiting conflicting goals (Förster, Liberman, & Friedman, 2007). This view also suggests a stimulus-outcome-response link, but the representation of the outcome is thought to cause not only the activation of the response but also the effects mentioned above. It remains to be shown whether goals mediate VAAC-effects. For instance, mediation by goals would be supported if interruption of goal attainment would lead to increased accessibility of the respective goal.

**Implications and Conclusions**

Present evidence has important implications for the flexibility of the link between evaluation and AA-behavior. Whereas automaticity has often been associated with rigidity (e.g., Logan, 1988, Shiffrin & Schneider, 1977), the present findings suggest that automatic facilitation of AA-behavior can be flexible to some degree. In particular, evaluations automatically trigger responses that cause a compatible distance change, regardless of the specific muscles involved (i.e., arm flexion or extensions). Moreover, evaluations automatically trigger responses that ultimately cause a compatible distance change, regardless of the immediate distance change. These findings imply that evaluations evoke AA-responses in a flexible manner, namely those responses that are goal-conducive within the present situational constraints.

Importantly, a weak and a strong form of flexibility can be distinguished. Weak flexibility is the capacity to adapt to known variations in conditions, whereas strong flexibility is the capacity to adapt to novel variations in conditions (cf. Hassin, Bargh, & Zimerman, 2009). Up to now, empirical evidence on VAAC-effects supports only the weak form of flexibility. In all experiments using SRC-tasks, participants worked through many trials on which they executed AA-behavior under varying, but repeating conditions. For instance, in the studies on immediate vs. ultimate distance change (Krieglmeyer et al., 2011), the varying
conditions were the layout of the pathway (straight or winding) and the initial position of the stick-figure (above or below the word). Participants had ample opportunity to learn the various context-specific response-outcome links. To support the strong form of flexibility, variations in conditions must not repeat across trials but must be novel on each trial. Nevertheless, recognizing that facilitation of AA-behavior is flexible in the weak sense is an important step forward, given that some early ideas about AA-behavior proposed a rather rigid relation between evaluations and specific muscles such as the arm flexion/extension.

Research on AA-behavior has important implications for our understanding of how emotions function. Emotions have always been linked to action tendencies (Darwin, 1872; Roseman, Wiest, & Swartz, 1994). Whereas emotion researchers typically distinguish several specific action tendencies (e.g. hitting, yelling, running away), they acknowledge that behavioral tendencies of approach-avoidance lie at the core of all emotions and their associated specific action tendencies (e.g., Lang, 1995). Thus, knowledge about the principles of AA-behavior is important for our understanding of how emotions functions. For instance, our conclusion that affective stimuli evoke AA-behaviors in an automatic yet flexible manner sheds new light on the adaptive functions of emotions.
References


Footnotes

1 A reviewer raised the concern that distance change relative to the stimulus (approach/avoidance) might have been more salient than distance change relative to the upper and lower border of the screen (upward/downward). Even if this were the case, this does not pose a problem for the validity of the findings. According to the evaluative coding hypothesis, VAAC-effects are fully determined by the valence of the response labels. Participants may relabel the responses if relabeling reduces the complexity of the task. In the discussed experiments, however, relabeling the responses in terms of approach/avoidance would have increased task complexity. Instead of the simple response rule (“If word is positive press up-key, if word is negative press down-key.”), relabeling would have yielded a more complex rule (e.g., “If word is positive and the stick-figure is above word, move toward by pressing the down-key.”). Moreover, relabeling would have yielded response representations with ambivalent valence because the response representations would contain the goal (e.g., move toward) as well as the means (e.g., press down-key), which have opposite valence in half of the cases.