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Predispositions to Approach and Avoid Are Contextually Sensitive and Goal Dependent

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The authors show that predispositions to approach and avoid do not consist simply of specific motor patterns but are more abstract functions that produce a desired environmental effect. It has been claimed that evaluating a visual stimulus as positive or negative evokes a specific motor response, extending the arm to negative stimuli, and contracting to positive stimuli. The authors showed that a large congruency effect (participants were faster to approach pleasant and avoid unpleasant stimuli, than to approach unpleasant and avoid pleasant stimuli) could be produced on a novel touchscreen paradigm (Experiment 1), and that the congruency effect could be reversed by spatial (Experiment 2) and nonspatial (Experiment 3) response effects. Thus, involuntary approach and avoid response activations are not fixed, but sensitive to context, and are specifically based on the desired goal.

Keywords: approach, avoid, valence, evaluation, response

The fundamental question facing any cognitive agent might be the decision whether to approach or avoid. It can be life-threatening to approach a dangerous object, yet equally maladaptive to avoid beneficial ones. We might then expect cognitive agents to have sophisticated mechanisms for evaluating stimuli, and for initiating appropriate approach and avoid responses. It is therefore surprising that previous research suggests very unsophisticated approach and avoid responses. For example, the avoid response in a frog can consist simply of leaping to where it is darker (Lettvin, Maturana, McCulloch, & Pitts, 1959).

Previous research has suggested that people likewise have predispositions to respond in specific ways to valenced stimuli. Chen and Bargh (1999) found that when participants were asked to judge the valence (pleasant or unpleasant) of a word and then respond by using a lever, participants were faster to pull in response to pleasant words, and to push in response to unpleasant words. Chen and Bargh (1999; see also Solarz, 1960; Cacioppo, Priester, & Bernston, 1993; Forster & Strack, 1996) argued that people have a predisposition to approach positive items by pulling them closer, and to avoid negative ones by pushing them away. That is, the evaluation of the stimulus is automatically associated with a specific muscle response: flexing a bicep for an approach movement, and extending the tricep for an avoid movement.

However, at the level of the effectors, no single set of responses can be appropriate for every situation. In some cases when encountering an unpleasant stimulus, like a spider, you would be unlikely to reach out and try to push it away. You would be more likely to jump back and flex your muscles away from it. Similarly, when encountering a pleasant object, like a pizza, the first response you need in order to get it is to extend your arm to reach it and pick it up; the flexing comes later. It seems as if the appropriate initial response, of flexing or extending to pleasant and unpleasant stimuli, depends on situational demands. So if a pleasant stimulus predisposed us to flex our muscles and draw something toward us, then in a situation in which an extended reach was first necessary, the predisposition would have to be overridden. This would at least cause a delay and would defeat the value of automatic predispositions to behavior. Here we ask whether approach and avoid responses in humans are highly specified, as argued elsewhere (Chen & Bargh, 1999; Solarz, 1960; Duckworth, Bargh, Garcia, & Chaiken, 2002), or whether situational factors exert a strong influence on which behavior is activated.

In many papers that investigate how the evaluation of valenced stimuli affects subsequent flex and extend movements, the authors admit that there may be situations in which context could influence or change the behaviors that are associated with approaching and avoiding valenced stimuli, even while arguing for highly specific response activations. For example, Chen and Bargh (1999) state "it may be possible to generate quite different effects within the same paradigm. . ..different social situations call for different responses. . ..although the scope of the current experiments is not designed to address these issues, they are necessary avenues for future research." Clore and Ortony (2000) also argued for a dissociation between appraisal and specific behaviors. And recently Rotteveel and Phaf (2004) showed that tendencies for arm flexion and extension are not automatic consequences of automatic affective evaluation. They did however find a link between explicit evaluation and arm flexion and extension, and they discuss this with relation to the possible effect of situated meaning. They suggest that "if action tendencies for arm flexion and extension depend on conscious appraisals, the situated meaning and context for these movements would be incorporated into these processes."

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However, in none of these reports were there any direct tests of whether approach and avoid responses are modulated by contextual factors.

The only previous demonstration of contextual effects we are aware of is from Markman and Brendl (2005), who investigated the effects of self-representation on approach and avoid actions. They separated the location of the body from a representation of the self, provided by a participant's surname. They found that approach and avoid responses were based more upon the location of the surname than the location of the body. However, it is unclear from this demonstration whether this phenomenon is specific to self-representation, or whether the effect is more general, such that any change in participants' understanding of the meaning of their responses could change which behavior is predominately prepared.

Thus, we are in a situation in which there is a good deal of evidence for specific links between appraisal and activated responses (e.g., approach = bicep contraction), yet a general recognition that such specific links would not be appropriate in many cases. Here we test the hypothesis that the links between stimulus appraisal and automatic response activation are sensitive to current contextual factors. Specifically, we suggest that the important factor in producing the behaviors following evaluation is the effect these behaviors will have on the environment; that is, it is not the action that is important but the goal the action will achieve.

We designed a new paradigm to investigate situational effects on the link between explicit evaluation of objects and subsequent approach and avoid behavior, and to provide the first direct demonstration of a nonspatial response effect influencing which approach and avoid behaviors are prepared. In our experiments, we presented a valenced object and a neutral object and asked participants to touch one of the objects based on the evaluation of the valenced object as either positive or negative. This design departed from the use of push versus pull responses, and instead used a touch or don't touch (by touching a neutral item) response.

Most approach/avoid studies have used words or Chinese ideographs as the stimuli (Solarz, 1960; Cacioppo et al., 1993; Chen & Bargh, 1999; Wentura, Rothermund, & Bak, 2000; Neumann & Strack, 2000; De Houwer, Crombez, Baeyens, & Hermans, 2001; Duckworth et al., 2002; Markman & Brendl, 2005). The only exceptions are Castelli, Zogmaister, Smith, and Arcuri (2004) who used pictures of white men, and Rotteveel and Phaf (2004) who primarily used facial expressions, and in one experiment, used picture stimuli in addition to the facial expressions. Thus approach and avoidance has not been studied extensively with picture stimuli, and no study has shown approach/avoid effects using a variety of stimuli on the same paradigm. Therefore we included words, pictures, and facial expressions to assess whether results are comparable for different classes of stimuli.

We presented Experiment 1 to introduce our paradigm and to demonstrate that a large congruency effect is produced using this design. Experiment 1 leads up to the more important Experiments 2 and 3, in which we reversed the congruency effect by changing the meaning of the responses in a spatial (Experiment 2), and a nonspatial (Experiment 3) way. Both Experiments 2 and 3 provided strong evidence that the prepared behaviors are those that will produce the desired goal regardless of the particular action. Experiment 3 is especially strong in this respect as we know of no other demonstration of this effect on a nonspatial dimension in the approach/avoid domain.

Experiment 1

Method

Participants. Twenty undergraduates (16 female, age: M = 20.05, SD = 1.28 years) participated for course credit. All were right-handed, native English speakers, and had normal vision, normal hearing, and no neurological problems. All gave informed consent and were debriefed after the experiment.

Stimuli. Picture stimuli were taken from the International Affective Picture System (Lang, Bradley, & Cuthbert, 1999). There were 80 picture stimuli, 40 pleasant and 40 unpleasant. Pleasant pictures had an average rating of 7, and unpleasant pictures had an average rating of 3.3 (on Lang's valence scale 1–9). Average arousal ratings for pleasant and unpleasant pictures were 4.9 and 5.1, respectively (on Lang's arousal scale 1–9), and did not differ significantly. Examples of the pleasant pictures are babies, beautiful scenery, and food. Examples of the unpleasant pictures are starving children, horrific injuries, and insects. Pictures were 8 × 8 cm in size.

The 92 word stimuli, 46 pleasant and 46 unpleasant, were taken from Fazio, Sanbonmatsu, Powell, and Kardes (1986). These words had been rated for valence by participants in Fazio's study. Unpleasant words had an average rating of −2.5 and pleasant words an average rating of 2.5 on Fazio's scale from −5 (extremely unpleasant) to 5 (extremely pleasant). No ratings for arousal were given. The words *Reagan*, *Russia*, and *fraternity* were removed because it was felt that they were out of date and/or would not be relevant to current British undergraduates. They were replaced by *aloof, derelict*, and *corridor* respectively, which had near identical ratings, from the International Affective Word System (Lang et al., 1999). Examples of pleasant words included *pizza, aquarium*, and *sunshine*. Examples of unpleasant words included *knives, death,* and *cockroach.* Words were presented in lower case letters, Helvetica font, size 40, and in bold. The neutral stimulus was a green circle. This was 8 cm in diameter.

Stimuli were presented on an Elo touch systems monitor controlled by an Apple Macintosh computer. Stimuli were presented on either the left side or right side of the screen 232 mm from the center. Participants were seated approximately 50 cm from the screen.

Design. The task employed in this experiment lead to a mixed design with within-subjects factors of Valence (Pleasant/Unpleasant), Task (Congruent = approach pleasant items and avoid unpleasant items/Incongruent = approach unpleasant items and avoid pleasant items), and Stimulus Type (Word/Picture), and the between-subjects factor of Order (the order in which they completed the tasks, e.g., Congruent then Incongruent). The dependent variable was Total Time to release the button and touch the screen.

Procedure. Participants were seated in front of a touch screen monitor in the experimental room. On the table between them and the monitor was an x-keys keypad. There was a small speaker on each side of the computer monitor.

Each trial proceeded as follows: A fixation-cross appeared in the center of the screen. The participants started the trial by pressing the large key in the center of the keypad with the right hand and keeping the key depressed. After 500 ms the valenced stimulus (Picture or Word) appeared on one side of the screen and the

neutral stimulus (a green circle) appeared on the other. There was a delay of 300 ms between the onset of the visual stimuli and a tone from the speakers, indicating that the participant could now respond. This delay and tone were included to try to ensure that participants had judged the valence and decided what the response would be before letting go of the key and making the movement. The delay of 300 ms was chosen to be long enough for the participant to have started to make the judgment, but short enough to ensure the initial reaction to the valenced stimuli had not yet been overridden. The tone was a beep of 220 Hz, 38 ms in duration. If the participant released before the tone, a response on the screen would not be allowed. The participant would then have to press and release the key again before responding. This led to very long reaction times for these trials, which were automatically discarded during the iterative trimming of the data.

In the Congruent task, the participants were instructed to let go of the key, reach toward the screen with the right hand and touch the Picture/Word if they liked it (an approach movement), and touch the circle if they did not like the Picture/Word (an avoid movement). In the Incongruent task, participants were instructed to touch the Picture/Word if they did not like it (an approach movement) and touch the circle if they did like the Picture/Word (an avoid movement). When a response was made, the Picture/Word and circle disappeared and 750 ms later the fixation cross for the next trial appeared. No references to approaching or avoiding were made in the instructions.

Each participant completed four blocks: Congruent Pictures, Incongruent Pictures, Congruent Words, and Incongruent Words. In a block of trials, each stimulus was presented twice—once on each side. This led to 160 trials for each Picture block and 184 trials for each Word block. So overall, there were 688 trials (two Picture blocks consisting of 160 trials each, and two Word blocks consisting of 184 trials each). Each block took between 5 and 10 minutes to complete.

The between-subjects factor of Order was counterbalanced across participants; half of the participants ($n = 10$) did both Picture and Word blocks following Congruent instructions and then repeated them both following Incongruent instructions (Congruent Pictures, Congruent Words, Incongruent Pictures, and Incongruent Words [$n = 5$], OR Congruent Words, Congruent Pictures, Incongruent Words, and Incongruent Pictures [$n = 5$]). The remaining half ($n = 10$) completed both Picture and Word blocks following Incongruent instructions and then repeated them with Congruent instructions (Incongruent Pictures, Incongruent Words, Congruent Pictures, and Congruent Words [$n = 5$], OR Incongruent Words, Incongruent Pictures, Congruent Words, and Congruent Pictures [$n = 5$]).

Before the experiment began, participants were asked to read through the instructions, ask any questions they may have, and then sign the consent form. The experimenter demonstrated the procedure, and then the participant performed approximately 10 to 20 practice trials until it was deemed by the experimenter that they had mastered the instructions.

Incorrect responses cannot be determined for Experiments 1 and 2. This is because participants are responding based on their personal classification of that stimulus in that instant. There are no right or wrong responses as such. It is possible for participants to make a mistake when responding and for example classify something as pleasant, be instructed to touch it, but accidentally touch the neutral stimulus. Participants were asked about this and a few participants reported making such mistakes, but these errors were rare and occurred in only a few trials out of the hundreds completed.

Results

Prior to analysis, response time distributions were iteratively trimmed to include scores within three standard deviations of the mean, for each condition and for each participant. Release Time (the time taken to release the key) and Movement Time (the time taken to reach toward and touch the screen) were recorded. Total Time was the sum of the Release Time and the Movement Time. Our analysis concentrated on Total Time, as this avoided the possibility of tradeoffs that might not be seen if Release or Movement Times were analyzed separately: for example, a slow Release Time that incorporated movement planning and a correspondingly fast Movement Time (Meegan & Tipper, 1998).

A repeated measures analysis of variance (ANOVA) was conducted on Total Time with Valence (Pleasant/Unpleasant), Task (Congruent/Incongruent), and Stimulus Type (Picture/Word) as within-subjects factors, and Order (Incongruent trials then Congruent trials/Congruent trials then Incongruent trials) as a between-subjects factor.

The most crucial comparison revealed a significant main effect of Task. As predicted, the Congruent condition yielded faster reaction times than the Incongruent condition, Congruent $M = 883$ ms, $SD = 159$, Incongruent $M = 997$ ms, $SD = 260$), $F(1, 18) = 8.04$, $p < .05$. So participants were faster to approach the pleasant stimuli and avoid the unpleasant stimuli than they were to approach the unpleasant stimuli and avoid the pleasant stimuli. These results are presented in Table 1.

There was also a significant interaction of Valence by Task, $F(1, 18) = 13.49$, $p < .01$. This simply means that Approach responses (912 ms) were faster overall than Avoid responses (968 ms), $F(1, 18) = 13.49$, $p < .01$. Post hoc tests (One Way ANOVA) showed that for the Congruent responses, Approaching Pleasant (840 ms) was faster than Avoiding Unpleasant (927 ms), $F(1, 18) = 14.51$, $p < .01$, and for the Incongruent responses, Approaching Unpleasant (985 ms) was descriptively faster than Avoiding Pleasant (1,009 ms), although this specific comparison did not reach significance.

There was a significant interaction of Order by Task, $F(1, 18) = 13.73$, $p < .01$, Total Times were slower with the first set of instructions (Congruent or Incongruent) than the second, suggesting improvement with practice.

Lastly there was a main effect of Stimulus Type, $F(1, 18) = 5.99$, $p < .05$. Participants were faster to respond to Words than to Pictures (Word $M = 904$ ms, $SD = 202$, Picture $M = 976$ ms, $SD = 237$). There were no other significant effects involving

Table 1
Total Times in Experiment 1, M *(*SD*)*

	Pleasant	Unpleasant
Congruent	840 (138)	927 (168)
Incongruent	1009 (251)	985 (271)

Stimulus Type, suggesting that our findings are comparable for both Words and Pictures.

The Release Time and Movement Time data were then analyzed separately for the critical main effect of Task. These data sets were iteratively trimmed in the same manner applied to the Total Time data. Both Release Time and Movement Time variables showed the pattern seen in Total Time; the analysis revealed that for Release Time, Congruent trials (230 ms) were descriptively faster than Incongruent trials (266 ms), but this did not reach significance, $F(1, 18) = 1.71$, $p = .208$. For the Movement Time, Congruent trials (609 ms) were significantly faster than Incongruent trials (685 ms), $F(1, 18) = 9.23$, $p < .01$.

Discussion

Experiment 1 showed a large congruency effect in which participants were faster to approach pleasant and to avoid unpleasant items, and were relatively slower to avoid pleasant and approach unpleasant items. Experiment 1 demonstrated that large and robust approach and avoid effects can be observed on our touchscreen paradigm, and suggests this paradigm is therefore a suitable tool for further investigation of the approach and avoid responses.

In the next experiment, we address more specifically the claim that evaluation of a stimulus as positive or negative generates a specific pattern of muscle responses; that is, positive evaluations and approach tendencies produce flexing, and that negative evaluations and avoid tendencies produce extending. We argue against this and propose that the generated response is more complex than this and depends on abstract factors, because, as argued in our introduction, inflexible response associations would be problematic. Instead, we propose that upon encountering a valenced object, the behaviors needed to approach and avoid are rapidly determined for that situation. Thus we are suggesting that the behaviors that are unintentionally, and in that sense, automatically produced following evaluation are not confined to push and pull actions, but consist of a wide array of possible responses, specific to each situation, which will produce the intended goal. We designed Experiment 2 to test this idea more definitively.

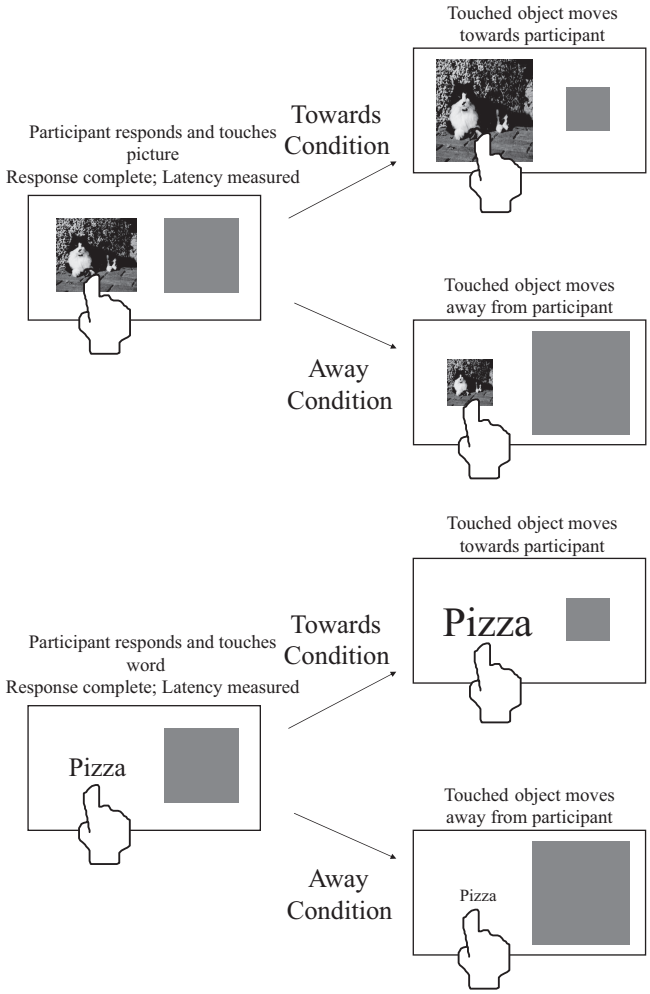

Figure 1. Illustration depicting the Response Effect in the Toward and Away conditions, for Pictures (top panel) and Words (lower panel).

Experiment 2

In Experiment 2 we needed to have the same physical response associated with two different outcomes consistent with an approach or an avoid response. We did this by extending the method of Experiment 1, so that responses included one of two possible consequences following the touch of an object on the touchscreen. First, in the "Toward" conditions, the touched object increased in size (as if approaching), and the untouched one shrank (as if moving away). Alternatively, in the "Away" conditions, the consequences were reversed: the touched object shrank (as if being pushed away) and the untouched one increased in size. This consequence of responding, or the *Response Effect,* therefore changes the semantics of the response, without changing the physical response itself. This means that we can compare "approach" and "avoid" actions, in which physically identical responses are made to physically identical stimuli (See Figure 1).

In the Toward condition we expected the normal congruency effect to occur as the Response Effect is consistent with the response made. In the Away condition we expected the Response Effect, and the changed meaning of the response, to reverse the normal congruency effect. Such an outcome would show that situational factors, and specifically, the consequences of the response are important in the link between stimulus evaluation and subsequent approach-avoid behavior. Alternatively, an outcome in which the congruency effect does not differ as a function of Response Effect would be consistent with inflexible predispositions to respond to positive and negative stimuli that do not take situational effects into account.

Method

Participants. Twenty-four undergraduates (22 female, age: $M = 19.96$, $SD = 1.16$ years) participated for course credit. All were right-handed, native English speakers, and had normal vision, normal hearing, and no neurological problems. All gave informed consent and were debriefed after the experiment.

Stimuli. Stimuli were the same as in Experiment 1 with the exception that a gray square was now used as the neutral stimulus instead of the green circle. The gray square was 8×8 cm in size.

Design. The design was identical to Experiment 1 with the added between-subjects factor of Response Effect (Toward or Away).

Procedure. The procedure was the same as in Experiment 1 with one exception. When a response was made, one of two effects occurred, depending on which version of the experiment the participant was doing. In the Toward version, whichever stimulus (Picture/Word or square) the participant touched got larger and seemed to get closer to them. So if they touched the Picture/Word it became larger and the square became smaller. If they touched the square, the square became larger and the Picture/Word became smaller. In the Away version, whichever stimulus the participant touched got smaller, as if pushed away from them. So if they touched the Picture/Word it got smaller and the square got bigger, and if they touched the square it got smaller and the Picture/Word got bigger (see Figure 1). Animation of the untouched image was vital to the design of the experiment. For example, when participants touched the neutral stimulus, and it changed in size, importantly there was also an effect on the valenced stimulus, making it get smaller in the Toward condition and bigger in the Away condition. This design allowed identical animations for different responses. For example, the Approach Toward condition would have the same animation as the Avoid Away condition.

The size changes occurred immediately after the participant's response. Details of the size changes are as follows: Picture stimuli started as 8 × 8 cm. They either increased in size to 12 × 12 cm, or decreased in size to 2.7 × 2.7 cm. Word stimuli started as 40 pt and then increased to 80 pt, or decreased to 20 pt font sizes. This resulted in Words appearing approximately 0.8 cm high, and increasing to 1.6 cm high, and decreasing to 0.4 cm high.

In this experiment, the experimenter made sure the participants were aware of the Response Effects in the different conditions by modifying the instructions. So in the Away condition participants were now asked to *push* the stimuli away or to *push* the square away, highlighting the consequence of their response. In the Toward condition, participants were still asked to *touch* the stimuli.

So in the Toward version, the instructions were the same as in the previous experiment: In the Congruent task participants were instructed to "touch the Picture/Word if you like it, and touch the square if you do not like the Picture/Word." In the Incongruent task participants were instructed to "touch the Picture/Word if you do not like it, and touch the square if you do like the Picture/Word." Participants were also told that when they touched something it would get bigger and the other item would get smaller.

In the Away condition, participants in the Congruent condition were instructed to "Push the Picture/Word away if you like it, and push the square away if you do not like the Picture/Word." In the Incongruent condition participants were instructed to "Push the Picture/Word away if you do not like it, and push the square away if you do like the Picture/Word." Participants were also told that when they pushed something away, it would get smaller and the other item would get bigger.

Results

Response times were calculated as in Experiment 1. Prior to analysis, Total Time distributions were iteratively trimmed to include scores within three standard deviations of the mean, for each condition and for each participant. An ANOVA was conducted with Valence (Pleasant/Unpleasant), Task (Congruent = approach pleasant items and avoid unpleasant items/Incongruent = approach unpleasant items and avoid pleasant items), and Stimulus Type (Word/Picture) as within-subjects factors, and Response Effect (Toward or Away) and Order (Incongruent trials then Congruent trials/Congruent trials then Incongruent trials) as between-subjects factors.

The important interaction of Task by Response Effect was significant, $F(1, 20) = 8.77$, $p < .01$. Post hoc tests (One Way ANOVA) showed that the congruency effect remained for the Toward version, $F(1, 10) = 3.68$, $p = .084$, but reversed for the Away version, $F(1, 10) = 5.11$, $p < .05$ (this is presented in Figure 2, and broken down by Valence in Table 2). This result demonstrates that involuntary approach and avoid response activations are not fixed, but are sensitive to context.

Beyond the theoretically crucial interaction of Task by Response Effect, there were several other significant effects, which do not particularly bear on our hypotheses. There was a significant interaction of Valence by Task, $F(1, 20) = 6.79$, $p < .05$. As in Experiment 1, this means that Approach responses (918 ms) were faster overall than Avoid responses (942 ms), $F(1, 20) = 6.79$, $p < .05$. Post hoc tests (One Way ANOVA) show that averaged over the Response Effect, for the Congruent responses, Approaching Pleasant (920 ms) was faster than Avoiding Unpleasant (950 ms), $F(1, 20) = 5.51$, $p < .05$, and for the Incongruent responses, Approaching Unpleasant (915 ms) was descriptively faster than Avoiding Pleasant (935 ms), but this did not reach significance.

The interaction of Task by Order was significant, $F(1, 20) = 9.04$, $p < .01$, reflecting the fact that participants' reaction times were usually faster on the second block.

The main effect of Response Effect was almost significant, $F(1, 20) = 5.79$, $p = .064$, reflecting that participants were faster to respond in the Toward condition, $M = 859$ ms, $SD = 190$ (where the response and Response Effect matched), than in the Away condition, $M = 1{,}001$ ms, $SD = 217$ (where the response and Response Effect did not match). There were no other significant effects.

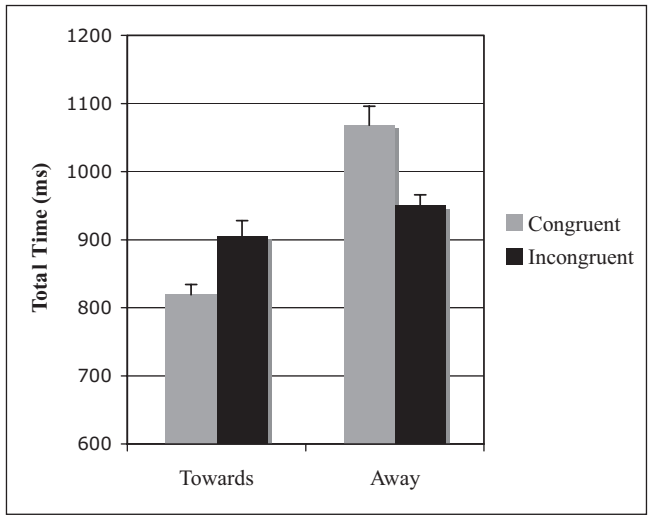

Figure 2. Mean Total Times (ms) for Congruent and Incongruent responses for both Toward and Away conditions.

Table 2
Total Times in Experiment 2, M *(*SD*)*

	Towards condition		Away condition	
	Pleasant	Unpleasant	Pleasant	Unpleasant
Congruent	806 (141)	827 (139)	1036 (253)	1073 (259)
Incongruent	903 (235)	901 (217)	966 (175)	930 (137)

Once again we analyzed the Release Time and Movement Time data separately for the critical effect; in this experiment, this was the interaction of Task by Response Effect. Again, the pattern seen in Total Time was also seen in the component Release and Movement Time.

Discussion

The results of Experiment 2 revealed that following evaluation, the predisposition to respond can be affected by consequences of the physical action and therefore is not necessarily an inflexible valence-specific physical response. To review this crucial finding, recall that in the Toward version of the task, the Response Effect was consistent with the response. For example, when participants responded by touching an item, the effect of the response was that the item then "approached" them. As in Experiment 1, participants in the Toward version were faster on the Congruent trials than on the Incongruent trials. In the Away version, the Response Effect was inconsistent with the response. Now, for example, when participants responded by touching an item, the effect was that the item was "pushed away," and so avoided. In the Away conditions, the congruency effect was now reversed. Comparing Toward and Away conditions, it is clear that what was crucial was not the physical response (e.g., touching), but the effect that response had (bringing the stimulus closer or farther away). This demonstrates that approach and avoid responses generated in response to evaluating a stimulus are not fixed and inflexible, but vary with situational factors. That is, the behaviors that are unintentionally primed will not always be a specific movement related to the valence, but whatever movement will produce the desired goal.

Experiment 3

Our results are consistent with the findings of Markman and Brendl (2005), who demonstrated that congruency effects depend upon people's representations of themselves in space rather than their physical location. In our Experiment 2, a spatial effect was used to signify that the valenced stimuli were approaching or avoiding the participant. Although there was no explicit reference to self-representation, and no intentional manipulation on this dimension, it could be argued that increasing or decreasing the distance between the stimulus and the self does change the meaning of the response with respect to the self (Markman & Brendl, 2005). That is, are the links between stimulus appraisal and response activation limited to the effects of increasing or decreasing the distance between the viewer and the stimulus? Or might appraisal activate responses, which could change the stimulus in some other desirable way? Thus we designed Experiment 3 with a nonspatial desirable or undesirable outcome. This would extend Markman and Brendl's conclusion to show that *nonspatial* consequences that are not associated with any apparent movement toward or away from any aspect of the self, can influence the congruency effect (Markman & Brendl, 2005).

Therefore, in Experiment 3, we sought to show that adding a nonspatial Response Effect could reverse the expected congruency effect. As in the previous experiments, we required participants to approach and avoid happy and angry faces. The nonspatial response effect was a change in the expression of the face coupled with a noise. There was a desirable outcome—faces became happier (angry faces turned mildly happy, and happy faces turned even happier) and were paired with a pleasant tone. There was also an undesirable outcome—faces became angrier (angry faces turned more angry, happy faces turned mildly angry) and were paired with an unpleasant tone. In this way, the response effect could give meaning to the response, as something that produced desirable or undesirable consequences. We predicted that the normal pattern of Congruency (approach happy/avoid angry) would be modulated by Response Effect. Specifically, we predicted (1) that response times on Congruent trials (approach happy/avoid angry) paired with a desirable outcome would be faster than Incongruent trials (approach angry/avoid happy) paired with an undesirable outcome. However, (2) response times on Congruent trials paired with an undesirable outcome would be slower than on Incongruent trials paired with a desirable outcome.

Method

Participants. Twelve undergraduates (9 female, age: M = 20.33, SD = 1.61 years) participated for course credit. All were right-handed, native English speakers, had normal vision, normal hearing, and no neurological problems. All gave informed consent and were debriefed after the experiment.

Stimuli. Visual Stimuli were taken from the Calder faces set (Calder et al., 2000). Four male faces and four female faces were used. Sound stimuli were as follows: The pleasant tone was a chime—an interval of a perfect fourth, tonic at 440 hz. The unpleasant tone was a buzz—simultaneous square waves at 196 and 415 hz. Each tone sounded for approximately 150 ms.

Stimuli were presented on an Elo touch systems monitor controlled by an Apple Macintosh computer. Stimuli were presented on either the left side or right side of the screen 232 mm from the center. Participants were seated approximately 50 cm from the screen.

Design. The task employed in this experiment led to a design with within-subjects factors of Valence (Happy/Angry), Task (Congruent = approach happy faces and avoid angry faces/ Incongruent = approach angry faces and avoid happy faces), and Response Effect (Valid or Invalid). In the Valid conditions the response and Response Effect matched: in the Congruent conditions (approaching happy faces and avoiding angry faces), there was a desirable effect—the faces get happier and the tones are pleasant. Congruent responses are reinforced with desirable effects, and Incongruent responses are reinforced with undesirable effects. In the Invalid conditions, the Response Effect opposed the response congruency, so that when participants completed Congruent responses, they experienced undesirable effects, but when they completed Incongruent responses they experienced desirable effects.

As in previous experiments, the dependent variable was Total Time to release the button and touch the screen.

Procedure. A white fixation-cross (font size 24) was presented in the center of a gray background. Participants started each trial by pressing down the large key on the keypad and keeping it held down. Immediately, an emotional face (happy or angry) appeared on one side of the screen and a neutral face (of the same person) appeared on the other side of the screen. After 300 ms, there was a tone from the speaker indicating that the participant could now let go of the key and respond by touching the screen. In this experiment, if the participants released the key before the tone, there was an error message on the screen telling the participant that they had released too early. They then had to wait for a 5-s countdown before they could respond to that trial. These trials were discarded.

In this experiment, the instructions were to always touch the emotional face (Congruent Happy, Incongruent Angry) or to always touch the neutral face (Congruent Angry, Incongruent Happy). No mention of approaching or avoiding was made. When the participants made the response there were two effects—a change in facial expression and an accompanying noise (see Figure 3 for an example).

In the Valid conditions, the response and Response Effects match—when approaching happy faces and avoiding angry faces, the Congruent conditions, there is a desirable effect—the faces get happier and the tones are pleasant. When approaching angry faces and avoiding happy faces, the Incongruent conditions, there is an undesirable effect—the faces get angrier and the tones are unpleasant.

In the Invalid conditions the response and Response Effects do not match—when approaching happy faces and avoiding angry faces, the Congruent conditions, there is an undesirable effect—the faces get angrier and the tones are unpleasant. When approaching angry faces and avoiding happy faces, the Incongruent conditions, there is a desirable effect—the faces get happier and the tones are pleasant.

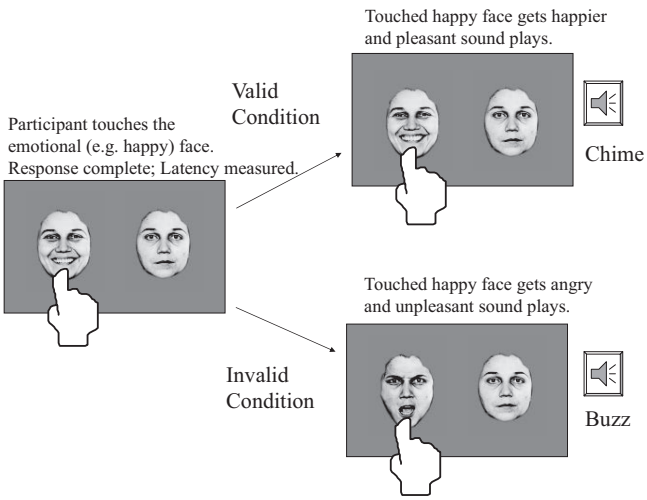

Figure 3. A diagram showing the consequences of responding when touching Happy faces. Participants have approached the Happy face, a Congruent movement. In the Valid condition, they gain desirable consequences—the face gets happier and a pleasant tone sounds. In the Invalid condition they get undesirable consequences—the face gets angry and an unpleasant tone sounds.

Participants completed four blocks: a block where they always touched the emotional face, and one where they always touched the neutral face, with Valid response effects. These blocks were also completed with Invalid response effects. These were counterbalanced across participants. There were 128 trials per block, leading to 512 trials in total for each participant.

As in Experiment 2, the Response Effects were made clear to the participant. Participants were told that the effects that occurred on each trial were fixed and predictable, and that they would be able to tell which effect would occur before making the response. Before each block, participants were told the effects that would occur for responses to Happy and Angry faces. The Response Effects occurred immediately after the participant touched the screen. The facial effect remained on the screen for 500 ms. The fixation-cross for the next trial was then presented.

In this experiment, the trial could not end with an incorrect response. If the participant touched the incorrect stimulus, nothing would happen. She would still need to touch the correct stimulus in order to complete the trial. This correction led to very long reaction times that were automatically discarded in the iterative trimming of the data.

Results and Discussion

Response times were calculated as in Experiment 1. Total Time distributions were iteratively trimmed to include scores within three standard deviations of the mean, for each condition and for each participant. An ANOVA was conducted with Valence (Angry/Happy), Task (Congruent = approach happy faces and avoid angry faces/Incongruent = approach angry faces and avoid happy faces) and Response Effect (Valid/Invalid) as within-subjects factors.

The important interaction of Task by Response Effect was significant, $F(1, 11) = 6.21$, $p < .05$. This shows that the congruency effect remained for the Valid conditions but reversed for the Invalid conditions. Figure 4 shows that the effect is equally large in each condition. Table 3 shows the breakdown of this effect by valence.

In the Valid conditions the Response Effect was consistent with the response. So participants completed Congruent trials with desirable consequences and completed Incongruent trials with undesirable consequences. Response times in these Valid conditions were faster on the Congruent trials than on the Incongruent trials.

In the Invalid conditions the Response Effect was inconsistent with the response. Now, participants completed Congruent trials with *undesirable* consequences and completed Incongruent trials with *desirable* consequences. The importance of the consequences is seen in that for Invalid conditions, Incongruent trials were faster than Congruent trials.

The main effect of Valence was significant, $F(1, 11) = 10.92$, $p < .01$. Participants were faster to respond to the Happy faces than to the Angry faces, (Happy $M = 714$ ms, $SD = 158$; Angry $M = 750$ ms, $SD = 159$). There were no other significant effects.

Once again Release Time and Movement Time data were analyzed separately for the crucial interaction of Task by Validity.

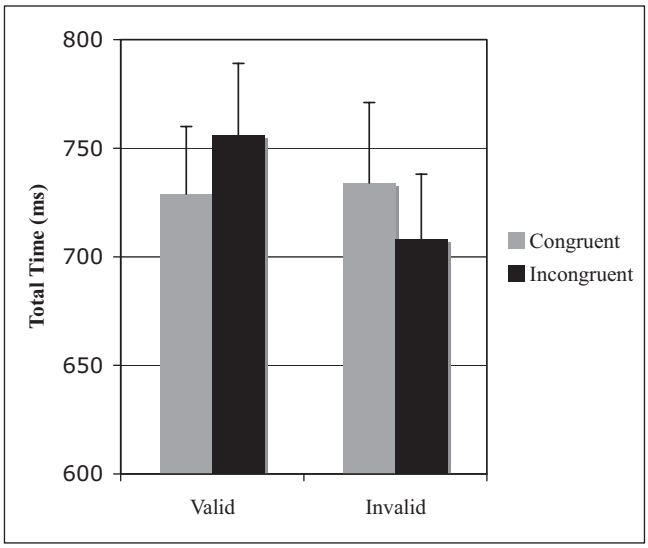

Figure 4. Mean Total Times (ms) for Congruent and Incongruent responses for both Valid and Invalid conditions.

Again, the pattern seen in Total Time was also seen in the components Release Time and Movement Time.

Experiment 3 showed that the congruency effect reversed with the addition of a nonspatial Response Effect. In the Valid conditions, when the Response Effect reinforced the initial response, the original congruency effect seen in Experiment 1 was found. Conversely, in the Invalid conditions, when the Response Effect opposed response congruency, participants were now faster in the Incongruent condition than in the Congruent condition. This shows a good degree of flexibility in the responses that are prepared. The participant quickly learns which behaviors will produce the desired outcome and then these behaviors are primed upon evaluation leading to a speeded response.

General Discussion

It has been hypothesized that evaluation of an item as positive or negative, primes particular muscles and behaviors so that these behaviors can be executed rapidly and efficiently, (e.g., Chen & Bargh, 1999). Specifically it was suggested that in the presence of positive stimuli, a flexing or pulling action is primed, and in the presence of negative stimuli, an extending or pushing action is primed.

Our experiments have shown that situational effects can influence which behaviors are primed. In particular, approach and avoid responses are activated in a highly flexible manner; according to the way they will change the relationship between the observer and the stimulus. We have provided the first demonstration of a nonspatial effect influencing approach and avoid behaviors, as well as showing the influence of a spatial effect, and we have done so with a variety of valenced stimuli.

Our results are consistent with a position advocated by Brendl (2001). He presented the hypothesis that congruency effects occur between stimulus and goal and not between stimulus and motor response, and that this occurs across many domains. Both our Experiments 2 and 3 provide evidence for this hypothesis. In Experiment 2, we showed that the goal was the important driving factor in the behaviors that were prepared. For example, in the Away condition when an unpleasant item was evaluated, the behavior that was prepared was to touch the unpleasant item because the effect of touching it was to push it away. Thus the prepared action was the one that would produce the desired effect. Experiment 3 provided even stronger evidence for this hypothesis and did so using a nonspatial effect. In this experiment, we showed that the congruency effect was between movement and goal (the final facial expression), and not between movement and stimulus valence (initial facial expression). The nonspatial aspect removed any aspect of pushing items away or causing items to get closer, thus showing that the effect goes beyond any relation to spatial goals. This is the first demonstration of the stimulus-goal compatibility effects in the domain of approach/avoid responses.

The influence of a response effect has also been demonstrated in nonemotional tasks such as the Simon effect, in which the consequences of a response become associated with the response (e.g., Grosjean & Mordkoff, 2002). Hommel (1993) showed that the Simon effect was determined by how people understood the effect of their responses. If they were instructed to press a key so as to make a light flash on the side contralateral to the key, then the Simon effect was based on the location of the light, not the key. Thus they showed that it was the meaning of the response, the intended action goal that mattered, rather than the actual response itself.

There are a few studies that have found results supporting the interaction of approach and avoid behaviors with contextual factors. In particular there is evidence that making an approach or avoid action can affect evaluation of concurrent stimuli. Neumann and Strack (2000, Experiment 3) used a concentric circle effect to give the impression of movement toward or away from a computer screen upon which words were presented. They showed that positive words were categorized more rapidly than negative words if participants had the impression that they were moving toward the computer screen, whereas negative words were categorized more rapidly than positive words if participants had the impression they were moving away from the screen. The effect is in the complementary direction to ours—apparent approaching or avoiding affects speed of evaluation.

Likewise, Brinol and Petty (2003) showed that head shaking (avoidance) and nodding (approach) affects arguments differently depending upon the social context. They showed that head nodding increased confidence, and head shaking decreased confidence, in one's own thoughts. When participants were exposed to a strong persuasive version of an argument, and so had favorable thoughts, nodding increased persuasion and shaking reduced it. When participants were exposed to a weak argument, and so had unfa-

Table 3
Total Times in Experiment 3, M *(*SD*)*

	Valid condition		Invalid condition	
	Happy	Angry	Happy	Angry
Congruent	664 (109)	792 (162)	705 (182)	764 (180)
Incongruent	786 (179)	727 (141)	698 (144)	716 (158)

vorable thoughts, nodding reduced persuasion and shaking increased it.

Again Brinol and Petty's (2003) effect is in the complementary direction to ours, demonstrating how ongoing (or recent) responses can bias stimulus evaluation. But despite the important differences between findings of Brinol and Petty (2003), and Neumann and Strack (2000), and our experiments, in both the paradigms and focus of investigation, these studies provide support for the importance of situated meaning on evaluation and associated approach and avoid movements, and together they suggest that it can occur in a bidirectional way.

A few other results are consistent with our findings on response effects and approach/avoid reactions. Wentura, Rothermund, and Bak (2000, Experiment 3) presented words and nonwords on a computer screen, and participants were instructed to react only to the words. A key was placed on the screen below the word. The withdraw group had to press the key permanently and withdraw their finger on presentation of a word. Following withdrawal, an increase in distance was simulated by reducing letter size. The touch group had to hold a finger on the key, ready to press it when a word appeared. Following a key press, a decrease in distance was simulated. Results showed that response times were faster to negative words in the withdraw condition and faster to positive words in the touch condition. So the affective congruency effect was observed, even though the release of the button involved an arm flexion, and the button press involved an arm extension. The apparent movement could have been responsible for this effect, but because this response effect was not varied systematically, tests for an influence were not possible.

Our results are also consistent with research on reflexive responses that require no explicit evaluation, such as the early demonstration by Wickens (1938), who showed that reflexive responses can be quite flexible and contextually sensitive. Wickens (1938) had participants rest their hand palm downward upon an electrode that transmitted an electric shock to the fingertip. Participants removed their fingers from the electrode as quickly as possible in response to the electric shock. To do this they extended their fingers. To test whether participants produced a specific motor action (extend to avoid) or a more general avoidance response (whatever action would allow them to avoid), Wickens turned the participant's hand over so that the electrode was still touching the palm, but the palm was now facing upward. In this case, exhibiting the original extend response would actually drive the finger toward the electrode. Wickens showed that with this new positioning, participants now flexed their fingers to avoid the shock even though this was the opposite movement to the previous avoid response. He concluded that the response that was learned was defined by the spatial layout of the task, not by specific muscular movements made in the first part of the experiment.

Our experiments specifically look at explicit evaluation and how situational factors can affect subsequent approach and avoidance tendencies. Investigation of automatic evaluation is beyond the scope of this paper. But future research could explore the impact of instructions and situated meaning in producing congruency effects within the automatic domain.

So the importance of response effects has been demonstrated in nonemotional tasks and in reflexive responses requiring no explicit appraisal. We have directly tested the influence of spatial and nonspatial response effects in explicit affective judgment tasks, and have demonstrated the importance of situated meaning in the preparation of approach and avoid responses.

Our results demonstrating a flexible and effect-contingent set of approach and avoid behaviors do not rule out the possibility of a "default" set of responses, such as those suggested by Chen and Bargh (1999). The tendency to pull in attractive stimuli and hold aversive ones at arm's length might be default options, but if so, our findings show that these defaults can be overridden based on the experience of how responses affect stimulus-observer relationships. Alternatively, it may be that the instructions in Chen and Bargh (1999) to "pull the lever toward you" and "push the lever away from you" could have contributed to the congruency effects they observed, and that there are no defaults. Perhaps if the instructions had been "pull the lever away from the word" and "push the lever toward the word" then the congruency effect would reverse. This would be consistent with our experiments, but we have not directly tested this particular hypothesis.

Particularly interesting findings include similar results for a variety of different stimuli—pictures, words, and emotional faces. A congruency effect, and an influence of the response effect, showing a reversal of the congruency effect due to situational factors, was found for all types of stimuli. Finding effects for pictures, words, and faces suggests that predispositions to approach and avoid occur for faces, which are processed quite rapidly, and for stimuli such as detailed pictures and words, which need a semantic retrieval based on previous experiences and associations. The similar results found regardless of stimulus modality suggest that the responses that are activated are unlikely to be based upon specific visual forms, but upon an amodal semantic evaluation of the stimulus.

We propose that upon encountering, and explicitly evaluating, a valenced object, the behaviors needed to approach and avoid (to obtain desirable outcomes and avoid undesirable outcomes) are rapidly determined for that situation. These behaviors are then more easily and quickly executed, due to the strong predisposition to approach pleasant objects and avoid unpleasant objects. So it is not necessarily a particular muscle movement that is primed upon explicit evaluation, but whichever action will produce the desired outcome or goal.

Many studies use flexing and extending positions to induce approach or avoid tendencies (Cacioppo et al., 1993; Forster, Higgins, & Idson, 1998; Neumann & Strack, 2000; Forster, Grant, Idson, & Higgins, 2001; Forster, 2003; Friedman & Forster, 2005). The results of our experiments suggest that it is important to consider the strong influence of context, in which behaviors will be understood as approach or avoid by the participants, and therefore which approach/avoid feelings and tendencies will be produced by performing particular flex and extend movements. Our results suggest that in some circumstances extending can be an approach behavior and flexing can be an avoid behavior and so it is vital not to assume that flexing will produce approach feelings and extending avoid feelings. This should be taken into account when designing and interpreting experiments in this domain.

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