Journal of Personality and Social Psychology
2014, Vol. 107, No. 6, 978–993

0022-3514/14/$12.00 http://dx.doi.org/10.1037/pspa0000017

Too Close for Comfort: Stimulus Valence Moderates the Influence of Motivational Orientation on Distance Perception

Dario Krpan and Simone Schnall
University of Cambridge

The relationship between approach and avoidance motivational orientations and valenced stimuli has previously been discussed in relation to physical distance. However, it has remained unclear whether approach and avoidance can actually change how people perceive the physical distance to valenced stimuli. Drawing on research on motivational orientation and valence as well as the motivated perception account, we predicted that valenced stimuli incompatible with motivational orientation would be perceived as closer than compatible stimuli because they motivate the goal of resolving the inconsistency arising from discrepant affective information. This prediction was supported in a series of 4 experiments. Findings were consistent across different manipulations of motivational orientation, including motor movements (Experiments 1 and 2) and cognitive procedures (Experiments 3 and 4), and across different types of stimuli, including abstract words (Experiments 1, 2, and 4) and photos of concrete objects (Experiment 3). Experiment 4 further investigated the mechanism behind the influence of incompatibility versus compatibility between motivational orientation and valence on distance perception. The findings showed that, relative to compatibility, incompatibility resulted in participants solving more anagrams, presumably because the goal-related motivational state gave rise to a general state of activation. Furthermore, perceptual estimates were correlated with the activity of the Behavioral Inhibition System (BIS) and the activity of the Behavioral Activation System (BAS) relative to the BIS, further suggesting that goal-related motivation may be associated with perception. Overall, the present research adds to a growing body of evidence suggesting that visual perception is shaped by motivational considerations.

Keywords: approach, avoidance, motivated perception, economy of action, distance

The everyday physical environment is full of many kinds of visual stimuli. Despite their diversity, all these stimuli fit into three basic evaluative categories. They can be classified as positive, negative, or neutral (Neumann, Förster, & Strack, 2003). For example, people evaluate stimuli such as a banknote as positive, a gun as negative, and something with no affective value, such as a carpet, as neutral (Lang, Bradley, & Cuthbert, 2005). Although these evaluations can be conscious and deliberate, they are usually automatic and take place outside of awareness (Bargh, 1997; Bargh & Chartrand, 1999). Indeed, people are able to infer the valence of subliminally presented stimuli even when they are unable to access their meaning (Bargh, Litt, Pratto, & Spielman, 1989), suggesting that valence is a basic dimension of how people interpret their environment.

People's relationship to positive and negative stimuli is determined by two basic motivational orientations—approach and avoidance (Elliot, 2006, 1999; Elliot & Covington, 2001). Approach is a preparedness to attain a stimulus in the environment, whereas avoidance is a preparedness to move away from it (Strack & Deutsch, 2004). According to the compatibility hypothesis (Neumann et al., 2003), positive stimuli are compatible with motivational orientation of approach and facilitate approach responses, whereas negative stimuli are compatible with avoidance and facilitate avoidance responses. Although approach and avoidance responses may take various forms depending on the nature of the stimulus, for approach the most basic version is to pull a stimulus toward oneself, and for avoidance it is to push a stimulus away from the self (Cacioppo, Priester, & Berntson, 1993). Indeed, Chen and Bargh (1999; see also Solarz, 1960) showed that people are faster to respond to positive stimuli by performing the compatible behavior of pulling relative to pushing, and this relationship reverses when responding to negative stimuli.

Although stimulus valence affects motor responses related to motivational orientation, this influence can also operate the other way around because motor movements and cognitive procedures that evoke motivational orientation influence how people process and respond to valenced stimuli (e.g., Cacioppo et al., 1993; Centerbar & Clore, 2006; Duclos et al., 1989; Förster & Strack, 1996; Friedman & Förster, 2002, 2005a; Stepper & Strack, 1993; Strack, Martin, & Stepper, 1988; Wells & Petty, 1980). Indeed, the compatibility hypothesis further suggests that evoking valence-compatible motivational orientation facilitates how people process and respond to valenced stimuli compared with incompatibility (e.g., Förster & Strack, 1996; Neumann et al., 2003). For example, inducing approach via arm flexion, a motor movement similar to "pulling," facilitated categorization of compatible positive words (Neumann & Strack, 2000). In contrast, inducing avoidance via arm extension, a motor movement similar to "pushing," facilitated

Dario Krpan and Simone Schnall, Department of Psychology, University of Cambridge.

We thank James Griffiths for help with data collection for Experiment 4.

Correspondence concerning this article should be addressed to Dario Krpan, Department of Psychology, University of Cambridge, Downing Street, Cambridge, CB2 3EB, United Kingdom. E-mail: dk413@cam.ac.uk

categorization of compatible negative words. Furthermore, evoking motivational orientation using similar procedures influenced people's consumption of delicious cookies (Förster, 2003). People ate more when motivational orientation (approach) was compatible with the positive valence of the cookies than when it was incompatible (avoidance). Thus, evoking valence-compatible motivational orientation can facilitate cognitive processing of affective stimuli and make people more likely to undertake the behaviors that these stimuli afford.

Because approach motivational orientation is associated with behaviors such as pulling that bring a stimulus physically closer to the person, it can also be defined as a preparedness to decrease the distance between a person and a stimulus (Strack & Deutsch, 2004). Given that positive stimuli are compatible with approach, decrease of physical distance usually occurs in relation to positive stimuli. Indeed, people are more inclined to decrease the distance between themselves and positive stimuli compared with incompatible negative stimuli (Seibt, Neumann, Nussinson, & Strack, 2008; Van Dantzig, Pecher, & Zwaan, 2008). However, because avoidance motivational orientation is associated with behaviors such as pushing that bring a stimulus physically farther from the person, it can also be defined as a preparedness to increase the distance between a person and a stimulus (Strack & Deutsch, 2004). Given that negative stimuli are compatible with avoidance, people are more inclined to increase the distance between themselves and negative stimuli compared with incompatible positive stimuli (Seibt et al., 2008; Van Dantzig et al., 2008).

Although approach (vs. avoidance) can be described as a tendency to decrease (vs. increase) the distance to a compatible stimulus, an open question is whether evoking motivational orientation in response to a valenced stimulus can actually shape how people perceive the distance to that stimulus. More precisely, does approach make positive stimuli appear as closer than negative stimuli, or as further away? Similarly, does avoidance make negative stimuli appear as further away than positive stimuli, or as closer?

So far, the influence of motivational orientation on visual perception of valenced stimuli has been poorly understood and relevant theoretical accounts have not yielded clear predictions. For example, Förster and Dannenberg (2010; see also Förster, 2012) discussed the relationship between approach versus avoidance orientation and psychological distance, including temporal, social, spatial, and hypothetical distance. They proposed that approach may be more important when people process psychologically distant stimuli, whereas avoidance may be more important when processing psychologically close stimuli. However, they did not provide a specific direction regarding the effect, that is, whether stimuli should be seen as closer, or as farther. To approach this question, we next examine why motivational orientation and stimulus valence would interact in influencing a seemingly unrelated process such as visual perception.

Physiological and Psychological Influences on Visual Perception

Traditional theories of perception have assumed that visual processing is not influenced by top-down cognitive processes and is driven by physical properties of the environment (Pylyshyn, 1999, 1984). However, a recent theoretical account has proposed that perception is not a purely low-level phenomenon but is guided by different bodily and experiential factors (Proffitt & Linkenauger, 2013; Proffitt, 2006). Of key importance are physiological states that determine people's potential to pursue actions in their environment. For example, when energetic requirements for walking increase, people perceive distances as longer because they are less able to traverse them (Proffitt, Stefanucci, Banton, & Epstein, 2003). Conversely, when people consume a glucose-containing drink they see hills as less steep because they have more energy to climb up (Schnall, Zadra, & Proffitt, 2010). Thus, visual perception reflects energetic costs associated with behavioral goals in the physical environment and serves as an indicator of people's potential to meet these goals (Proffitt, 2006).

Furthermore, a related line of research has suggested that visual perception may not only reflect people's potential to pursue actions in their environment, but may also be influenced by various motivational factors that arise in the process of pursuing a goal (Balcetis & Cole, 2014; Bruner & Goodman, 1947; Veltkamp, Aarts, & Custers, 2008). More specifically, evoking motivation to pursue a goal makes objects instrumental in pursuing the goal seem closer, or larger. For example, Balcetis and Dunning (2010) showed that the goal of assuaging thirst makes a bottle of water appear as closer compared with the absence of this goal (see also Veltkamp et al., 2008). Furthermore, Veltkamp et al. (2008) found that evoking the goal of performing neutral behaviors such as gardening by associating these behaviors with positive affect makes the stimuli instrumental for accomplishing these behaviors (e.g., shovel) seem larger compared with when no such goal is evoked. Other goals that have been found to influence the perception of size and distance are avoiding physical threat (Cole, Balcetis, & Dunning, 2013) or identity threat (Xiao & Van Bavel, 2012; see also Cesario & Navarrete, 2014), attaining social affiliation (Fay & Maner, 2012), doing puzzles (Aarts, Custers, & Veltkamp, 2008), and pursuing the enjoyment of eating (Van Koningsbruggen, Stroebe, & Aarts, 2011).

Although most of the research on motivated perception has investigated behavioral goals that are attained by undertaking specific actions regarding physical objects or human beings, perception is also influenced by more cognitive goals[1] for which the desired cognitive state cannot necessarily be attained via a specific behavior. For example, Balcetis and Dunning (2007) showed that visual perception can be influenced by the goal to resolve cognitive dissonance. Participants who by choice walked across a college quad in an embarrassing costume experienced cognitive dissonance and as a result perceived the quad as shorter than those who did not experience dissonance. Thus, it is the motivation to resolve the dissonance between participants' voluntary choice to perform the behavior and their actual willingness to do so that influenced their perception (Balcetis & Dunning, 2007). Furthermore, Cole, Balcetis, and Zhang (2013) experimentally manipu-

[1] We use the term *cognitive* goals when referring to goals that relate to the attainment of a certain cognitive state, such as the absence of cognitive dissonance (Balcetis & Dunning, 2007), rather than to a specific behavior, such as the action of drinking water to assuage thirst. Therefore, we use this term to distinguish between goals that cannot be clearly operationalized through a specific behavior compared with those that can. However, the term should not be taken literally because all goals are cognitive such that their end-point involves the attainment of a desirable cognitive state.

lated motivation of physically fit versus unfit participants to walk to a finish line and assessed how visually distant the line appeared. Motivation to walk to the finish line on its own did not influence how participants perceived the line. Instead, it was regulatory conflict arising in participants who had strong motivation to reach the line but weak physical capacity to do so that made the line appear as closer. Therefore, the goal to resolve this conflict may have induced a motivational state that changed distance perception.

Researchers have proposed that the motivation to pursue certain goals influences visual perception because it facilitates goal attainment. For example, for behavioral goals (e.g., assuaging thirst), seeing a goal-instrumental stimulus (e.g., a bottle of water) as closer or larger may energize the person to approach this stimulus (Balcetis & Dunning, 2010) or enable the person to select it among other goal-irrelevant stimuli by making it visually salient (Veltkamp et al., 2008). Furthermore, if the goal is to escape from a threatening stimulus (e.g., a spider), seeing the stimulus as closer may energize an immediate escape response (Cole, Balcetis, & Dunning, 2013). When it comes to more cognitive goals, however, the functional role of visual perception is less clearly defined. Some evidence suggests that seeing distances as shorter has a role of achieving a certain cognitive state. For example, when the goal is to resolve cognitive dissonance, seeing distances as shorter can serve "to regulate away the aversive intrapsychic state of dissonance" (Balcetis & Dunning, 2007, p. 920). This research suggests that the motivation to pursue goals engages visual perception, and that perceptual biases may in turn have a functional role in attaining goals. However, given that valenced stimuli are frequently instrumental in goal pursuit and may also be used as rewards to motivate neutral goals (see Veltkamp et al., 2008), it is necessary to discuss whether valence itself influences perception.

Do Valenced Stimuli Engage Motivated Perception?

Although valenced stimuli may have an important role in goal pursuit, valence itself may not motivate perception when not associated with a goal. For example, people usually evaluate money as a positive stimulus even if it is presented as a photograph and there is no chance of receiving it (Lang et al., 2005). However, when people are given a chance to win a $100 bill and a specific behavior needs to be undertaken to get the money, the bill is perceived as closer than when winning it is not an option (Balcetis & Dunning, 2010; Cole & Balcetis, 2013). Furthermore, delicious foods such as desserts are usually evaluated as positive stimuli (Lang et al., 2005). However, a muffin, which falls within this category of foods, is perceived as larger only when the goal of eating enjoyment was previously activated, compared with when it was not, and this effect occurs only for restrained eaters but not for normal eaters (Van Koningsbruggen et al., 2011). Negative valence has also been shown to influence perceived distance, but only when associated with a specific goal, such as escaping from a threatening stimulus (Cole, Balcetis, & Dunning, 2013; Vasey et al., 2012). Thus, it is possible that positive and negative stimuli influence visual perception only in the context of goal pursuit.

Even if positive and negative stimuli influence visual perception when instrumental in goal pursuit, this influence should cease after the goal has been accomplished. Indeed, research on motivated perception suggests that evoked goals influence visual perception because of the motivation to attain them (for a review see Balcetis & Cole, 2014). However, goal-associated motivation vanishes after goal attainment (Förster, Liberman, & Friedman, 2007), suggesting that positive or negative stimuli loom closer or larger only as long as one has not acted upon them. Thus, although a $100 bill that can be won is perceived as closer than the bill that cannot be won (Balcetis & Dunning, 2010), it is likely that this perceptual effect disappears after the winning. Overall, given that positive and negative stimuli may influence visual perception only in specific circumstances, it is plausible that stimulus valence alone does not engage motivated perception.

Motivated Perception in the Context of Valence and Motivational Orientation

Even if perception and valence are not directly linked, inducing motivational orientation may influence how valenced stimuli are perceived if incompatibility evokes a goal-related motivational state compared with compatibility. When affective information signaled by valenced stimuli is compatible with underlying motivational orientation, the organism can effectively process these stimuli and respond to them if action becomes necessary (see Neumann et al., 2003; Neumann & Strack, 2000). However, incompatibility decreases the processing efficiency and reduces the organism's capacity to effectively respond to valenced stimuli. Such a state is maladaptive because it decreases the organism's capacity to meet environmental challenges. Therefore, it is possible that incompatibility motivates the goal to resolve the inconsistency arising from discrepant affective information and restore the organism's capacity to effectively process external stimuli and respond to them. Indeed, this goal may have had an important adaptive role throughout human evolutionary past, when quick and effective processing of affective stimuli such as resources and predators was essential for survival.

Given that we have proposed that incompatibility between motivational orientation and valence evokes motivation to resolve the inconsistency arising from discrepant affective information, it is important to clarify what "resolving the inconsistency" may involve. Because incompatibility decreases the organism's capacity to effectively process perceived stimuli and respond to them if action becomes necessary (Neumann et al., 2003; Neumann & Strack, 2000), it is possible that it interferes with the prediction and planning of action that is constantly going on in the brain (e.g., Clark, 2013; Jeannerod, 1997, 2001). For example, avoidance orientation is a preparedness to move away from a stimulus in the environment, whereas positive stimuli incompatible with this motivational orientation are usually approached (Strack & Deutsch, 2004). Thus, if an avoidance-oriented person is observing a positive stimulus, the appropriate behaviors to be performed regarding the stimulus in case an opportunity for action arises may be less clear. In line with this assumption, it is possible that resolving the inconsistency arising from incompatibility between motivational orientation and valence involves establishing more clear behavioral plans that could be used if the situation calls for action. Thus, one way to resolve the inconsistency could be by extracting additional visual information from perceived incompatible stimuli that would help to reintegrate these stimuli within the current behavioral schemes and also make their processing more efficient. As a result, even if resolving the inconsistency itself may be a more cognitive goal because it does not necessarily involve specific behaviors, it is likely that attaining this goal serves action in a broad sense because it enables the organism to effectively respond to external environment once an opportunity for action arises.

Additional theoretical accounts suggest that inconsistency resolution may indeed more generally serve action. For example, the predictive coding account proposes that brains are "prediction machines that support perception and action by constantly attempting to match incoming sensory inputs with top-down expectations or predictions" (Clark, 2013, p. 181). Furthermore, one of the brain's main functions is to minimize prediction errors to maintain the organism's capacity to act. Thus, in the context of predictive coding, inconsistency caused by discrepant affective information may be interpreted by the brain as a prediction error that needs to be corrected to enable adaptive behavioral responses. Furthermore, the action-based model of dissonance (Harmon-Jones, Amodio, & Harmon-Jones, 2009) suggests that resolving inconsistencies stemming from discrepant cognitions may serve action in a broad sense to either facilitate a specific action regarding the inconsistency or simply free up an organism to act effectively in other domains. Although dissonance-related research usually investigates discrepancies between more complex information (e.g., between knowledge that smoking is harmful and an incompatible belief that smoking is good), it is possible that the action-based model also applies to discrepancies between more basic affective information conveyed by motivational orientation and valence. In summary, different theoretical accounts suggest that motivation to resolve cognitive inconsistencies is important in maintaining the person's capacity for action.

Research has shown that incompatibility between motivational orientation and valence indeed evokes a goal-related motivational state directed at inconsistency resolution. Building on the feelings-as-evidence model (Clore & Gasper, 2000), Centerbar, Schnall, Clore, and Garvin (2008; see also Clore & Schnall, 2008) proposed that people rely on bodily experiences associated with motivational orientation to validate the affective valence of stimuli. Thus, evoking motivational orientation compatible with a positive or negative stimulus confirms that this stimulus is indeed positive or negative. However, when motivational orientation is incompatible with a stimulus, it fails to provide the confirmatory evidence and "motivates an attempt to extract meaning from incoherent affective cues" (Centerbar et al., 2008, p. 572). In line with this assumption, participants who performed muscle contractions incompatible with valenced words from a scrambled sentences task wrote longer and less sophisticated narratives regarding a life event associated with a neutral word compared with participants in compatible conditions. This finding suggests that participants in incompatible conditions were less able to generate meaningful narratives and were motivated to do so by generating additional information, adding to the length of their narratives. Furthermore, this finding is in line with our assumption that the inconsistency stemming from incompatible affective information is itself motivating, and the organism may need additional information to resolve it.

If incompatibility between motivational orientation and valence indeed instigates a goal-related motivational state relative to compatibility, then stimuli incompatible with motivational orientation should be perceived as closer than compatible stimuli. This prediction is in line with the motivated perception account that posits that motivation makes goal-related stimuli appear as closer, or larger (e.g., Balcetis & Cole, 2014; Balcetis & Dunning, 2007; Bruner & Goodman, 1947; Veltkamp et al., 2008). Perceiving an incompatible stimulus differently may in turn have various functions within the goal of resolving the inconsistency arising from discrepant affective information. For example, such a perceptual bias may assist the person in extracting detailed information necessary to establish optimal behavioral plans regarding perceived stimuli that could be used if an opportunity for action arises. Indeed, relative to seeing them as further away, perceiving stimuli as subjectively closer is associated with a more detail-oriented processing style (for a review, see Förster & Dannenberg, 2010; Trope & Liberman, 2010). Thus, motivated perception in the context of resolving the inconsistency may in turn have more distal implications for action, given that inconsistency resolution may ultimately enhance the person's capacity to act, as we have argued.

Although previous research has not directly established that incompatible stimuli are perceived as closer than compatible stimuli, research on visual attention, which is usually considered "the first step in perception" (Bodenhausen & Hugenberg, 2009, p. 3), indicates that this indeed may be the case. Gawronski, Deutsch, and Strack (2005; see also Rothermund, 2003) showed that stimuli incompatible with motivational orientation induced through motor actions have stronger attention-grabbing power than compatible stimuli. This means that incompatible stimuli are visually more salient than compatible stimuli, and may also be perceived as closer or larger because one of the key assumptions regarding motivated perception is that seeing objects as larger, or closer makes them visually more salient relative to the surroundings (e.g., Veltkamp et al., 2008). Furthermore, Gawronski et al. (2005) showed that incompatible stimuli have stronger attention-grabbing power than compatible stimuli because they require more attentional resources. Thus, incompatible stimuli may be perceived as closer than compatible stimuli given that motivated perception researchers propose that stimuli that are perceived as larger or closer require more processing resources compared with other stimuli (Van Koningsbruggen et al., 2011). Thus, we predicted that inducing motivational orientation will make incompatible valenced stimuli appear as closer than compatible stimuli.

Overview of the Current Research

We conducted four experiments to investigate whether motivational orientation influences perceptual estimates of valenced stimuli. As suggested by research showing that incompatibility between motivational orientation and valence evokes a goal-related motivational state (Centerbar et al., 2008) and by the motivated perception account positing that goal-related motivation influences visual perception (e.g., Balcetis & Dunning, 2007), Experiments 1 to 3 tested whether stimuli incompatible with motivational orientation are perceived as closer than compatible stimuli. More specifically, Experiments 1 and 2 investigated how motivational orientation induced by arm flexion and extension (Cacioppo et al., 1993) influences visual perception of valenced words. Furthermore, Experiment 3 tested how motivational orientation induced by conceptual activation of approach and avoidance (Friedman & Förster, 2005a, 2005b) influences the perception of valenced photographs. Experiment 4 then explored the presumed mechanism behind the effect. Because we hypothesized that incompatibility between motivational orientation and valence influences perceptual estimates because of evoking a goal-related motivational state, this final experiment investigated whether the motivational state is reflected in spontaneously generated motivated behavior.

Experiment 1

To provide initial support for the hypothesis regarding the influence of motivational orientation on the perception of valenced stimuli, Experiment 1 used the most commonly used manipulation of approach and avoidance devised by Cacioppo et al. (1993). Approach is induced by pressing slightly against the underside of the desk, thus enacting the behavior of pulling, whereas avoidance is induced by pressing toward the edge or against the surface of the desk, enacting the behavior of pushing. Rather than requiring conscious awareness of the contingency between pushing or pulling and the stimulus, these arm positions evoke motivational orientation by contractions of extensor or flexor muscles. While engaging in this behavior participants estimated the distance to valenced words selected from the Affective Norms for English Words (ANEW; Bradley & Lang, 1999). We predicted that words incompatible with motivational orientations evoked by arm positions (approach and negative, or avoidance and positive) would be seen as closer than compatible words (approach and positive, or avoidance and negative).

Method

Participants and design. Eighty participants (59% female, $M_{\text{age}} = 21.76$ years) were recruited on the campus of the University of Cambridge using convenience sampling and were randomly assigned to experimental conditions. Data from three participants were excluded: one participant failed to comply with the experimental procedure, one participant admitted substance abuse, and one participant was excluded because of an error during the procedure. The design involved *motivational orientation* (approach vs. avoidance) and *stimulus valence* (positive vs. negative) as between-subjects factors, and *spatial distance* (20 cm, 35 cm, 45 cm, 50 cm, 60 cm, 85 cm, 95 cm, or 110 cm) as a within-subjects factor.

Stimuli. Sixteen abstract nouns, five to eight letters long, were selected from the ANEW (Bradley & Lang, 1999). Eight words were positive (*paradise*, *comedy*, *vacation*, *pleasure*, *success*, *victory*, *delight*, and *cheer*) as indicated by valence ratings equal to 8.00 or above on a scale from 1 = *negative* to 9 = *positive*, and eight words were negative (*failure*, *funeral*, *poverty*, *hatred*, *torture*, *tragedy*, *disaster*, and *misery*) as indicated by valence ratings equal to 2.00 or below (Bradley & Lang, 1999). All words were printed on sheets of white cardboard, using font type *Leelawadee*, size 150 pt. As shown by an independent *t* test, positive ($M = 5.83$, $SD = 0.46$) and negative words ($M = 5.66$, $SD = 0.74$) did not differ in arousal ratings, $t(11.73) = 0.56$, $p = .585$ (Bradley & Lang, 1999).[2]

Procedure. After providing informed consent participants sat at a white desk. Using the manipulation by Cacioppo et al. (1993), participants in the approach condition were instructed to press slightly against the underside of the desk, enacting the behavior of pulling, whereas those in the avoidance condition pressed toward the edge of the desk, enacting the behavior of pushing. While assuming the arm position, participants estimated the distance between a card with their own name that was placed immediately in front of them (as in Markman & Brendl, 2005) and the stimulus (see Figure 1). To get used to the distance estimation procedure, participants completed a practice block by estimating the distance between their name and an empty sheet of white cardboard, identical to the sheets on which the stimuli were printed, randomly placed on the desk two times.

In the experimental block, participants estimated the distance between their name and eight words from the appropriate valence category presented at eight predetermined locations, one at a time. The experimenter adjusted each word to correspond to a predetermined location while participants, who had their eyes closed, thought that he was measuring the distance between their name and the word. A variation of the perceptual matching task (Linkenauger, Witt, Bakdash, Stefanucci, & Proffitt, 2009; Stefanucci & Geuss, 2009) was used to assess distance estimates. The experimenter stood behind the desk and held a measuring tape that he adjusted to correspond to perceived distance according to participants' instructions by stretching it in a direction parallel to participants' eyes and the edge of the desk. Only the back of the tape (with no measurement units) was visible to them. Finally, participants completed a follow-up questionnaire assessing *mood* (happy, anxious, stressed, depressed, angry, and sad) and *effort* of arm positions on a scale from 1 = *not at all* to 5 = *a great degree*, and *general affect* on a scale from 1 = *very negative* to 5 = *very positive* to control for potential confounds. Then participants were debriefed and probed for suspicion. No participants showed any awareness of the hypothesis.

Results

Participants' distance estimates in centimeters were transformed into ratios of relative distance by dividing each estimated distance by its corresponding actual distance. A two-way analysis of variance (ANOVA) showed that motivational orientation and stimulus valence as between-subjects factors interacted in influencing distance estimates $F(1, 73) = 4.72$, $p = .033$, $\eta_p^2 = .06$. Simple effects analyses suggested that approach-oriented participants perceived negative words (incompatibility) as closer than positive words (compatibility), but this difference did not reach the conventional significance level, $p = .188$ (see Figure 2). Furthermore, avoidance-oriented participants perceived positive words (incompatibility) as marginally closer than negative words (compatibility), $p = .085$. Thus, the simple effects analyses showed that the significant interaction effect was accounted for by participants on average seeing incompatible words as closer than compatible words, in line with our predictions. Main effects of motivational orientation, $F(1, 73) = 1.87$, $p = .176$, $\eta_p^2 = .03$, or stimulus valence, $F(1, 73) = 0.08$, $p = .781$, $\eta_p^2 < .01$, were not significant.

To ensure that mood, effort of arm position, and overall affect did not confound the results, we performed identical two-way ANOVAs while including these variables as covariates, one at a

[2] Because Levene's test for equality of variances was significant, $p = .014$, the reported *t* test does not assume equal variances.

time.[3] For each analysis the interaction between motivational orientation and valence remained robust, thus indicating no confounding effects, all *ps* $< .041$.

Discussion

Overall, the findings of Experiment 1 provided initial evidence that, relative to compatibility, incompatibility between motivational orientation and valence leads to a decrease in perceived distance. As predicted, motivational orientation and valence interacted in influencing distance estimates. This effect was driven by participants perceiving incompatible words as closer than compatible words, presumably because incompatibility motivated the goal of resolving the inconsistency between discrepant affective information (e.g., Centerbar et al., 2008) that was reflected in their visual perception, whereas compatibility marked an absence of the goal. This finding is in line with the motivated perception account, which posits that motivation associated with a goal makes goal-related stimuli seem closer, or larger (Balcetis & Dunning, 2007; Veltkamp et al., 2008). Self-reported affect or perceived effort of performing approach and avoidance movements did not confound the results.

Although Experiment 1 provided initial support for our hypothesis that incompatibility decreases perceived distance compared with compatibility, this effect was significant only when both motivational orientations were considered together, as captured by the interaction. However, when incompatibility was assessed for each motivational orientation separately, the findings were inconclusive because the differences between perceptual estimates to positive versus negative words did not reach conventional significance levels. Therefore, we conducted a second experiment using a more powerful research design.

Experiment 2

To provide a stronger test for our hypothesis regarding the influence of motivational orientation on the perception of valenced stimuli, Experiment 2 used stimulus valence as within-subjects rather than between-subjects variable. Furthermore, we included neutral words as stimuli to clarify how motivational orientation influences the perception of positive or negative words relative to a baseline. We again predicted that pairing approach with negative words, or avoidance with positive words (incompatibility) would decrease perceived distance compared with pairing approach with positive words, or avoidance with negative words (compatibility).

Figure 1. Experimental setting in Experiments 1, 2, and 4.

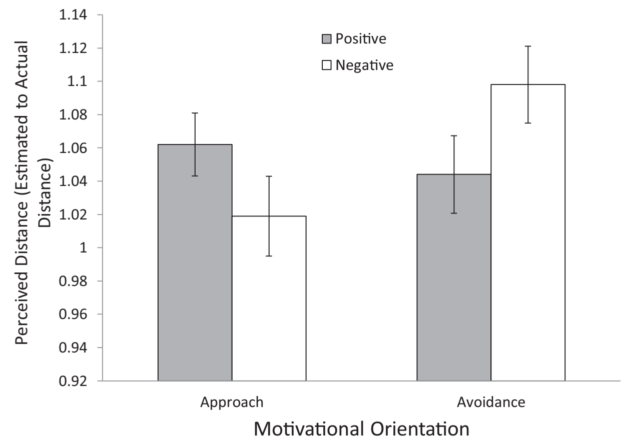

Figure 2. Relative distance estimates as a function of motivational orientation and word valence in Experiment 1. Error bars correspond to ±1 *SE* of the mean.

Method

Participants and design. Forty-two participants (62% male, M_{age} = 38.95 years) were recruited as in Experiment 1 and randomly assigned to either the approach or avoidance condition. Data from two participants were excluded because of failure to comply with experimental instructions, leaving 20 participants in each condition. The study design involved *motivational orientation* (approach vs. avoidance) as between-subjects factor, and *stimulus valence* (positive, neutral, or negative) and *spatial distance* (25 cm, 50 cm, 75 cm, 100 cm, 125 cm, or 150 cm) as within-subjects factors.

Stimuli. Seven positive (*paradise*, *comedy*, *vacation*, *pleasure*, *success*, *victory*, and *delight*) and negative words (*failure*, *funeral*, *poverty*, *hatred*, *torture*, *tragedy*, and *disaster*) were selected using identical criteria as in Experiment 1. Furthermore, seven neutral words (*context*, *gender*, *manner*, *theory*, *moment*, *industry*, and *poetry*) with average valence ratings of roughly 5.50 (Bradley & Lang, 1999) were used. Again words were presented on sheets of white cardboard. An independent *t* test (equal variances not assumed) showed that positive (M = 5.79, SD = 0.48) and negative words (M = 5.73, SD = 0.77) did not differ in arousal ratings, $t(10.08) = 0.18$, $p = .859$ (Bradley & Lang, 1999).

Procedure. Except for few alterations, the experimental procedure was identical to Experiment 1. In the practice block, we used three words from different valence categories instead of empty sheets of cardboard. In the subsequent experimental block participants estimated the distance between their name and six words from each valence category presented at six predetermined locations, one at a time. The words were presented randomly rather than being grouped according to valence. Thereafter, participants completed a follow-up questionnaire assessing their *mood*, *general*

[3] Mood items were combined into a composite score, with happiness reverse coded (α = .78).

feeling, *effort*, and *pleasantness* of arm positions using identical response scales as in Experiment 1 to assess potential confounds. In the end, they were debriefed and probed for suspicion. Nobody showed any awareness of the hypothesis.

Results

Participants' distance estimates in centimeters were transformed into ratios of estimated distance to actual distance, as in Experiment 1.[4] A mixed ANOVA with motivational orientation as between-subjects factor and stimulus valence and spatial distance as within-subjects factors showed that motivational orientation and stimulus valence interacted in influencing distance estimates $F(2, 74) = 30.67$, $p < .001$, $\eta_p^2 = .45$. Simple effects analyses further showed that approach-oriented participants perceived negative words as closer than positive words, $p < .001$, whereas avoidance-oriented participants perceived positive words as closer than negative words, $p < .001$ (see Figure 3). Thus, as predicted, words incompatible with motivational orientation were perceived as closer than compatible words. Furthermore, approach-oriented participants perceived neutral words as farther than negative words, $p = .013$, and as marginally closer than positive words, $p = .091$, whereas avoidance-oriented participants perceived neutral words as farther than positive words, $p = .001$, and no differently than negative words, $p = .619$.[5] There were no main effects of motivational orientation, $F(1, 37) = 0.02$, $p = .904$, $\eta_p^2 < .01$, or stimulus valence, $F(2, 74) = 1.06$, $p = .353$, $\eta_p^2 = .03$.

To ensure that mood, overall positive feeling, and effort or pleasantness of arm position did not confound the results, we performed an identical mixed ANOVA while including these variables as covariates, one at a time.[6] For each analysis the interaction between motivational orientation and valence remained highly robust, thus indicating no confounding effects, all ps $< .001$.

Discussion

Experiment 2 consolidated the findings of the previous experiment and provided more conclusive support regarding our prediction that incompatibility between motivational orientation and valence decreases perceived distance relative to compatibility. More specifically, valence moderated the effect of motivational orientation on visual perception of words. When approach was paired with negative valence, or avoidance with positive valence (incompatibility), participants perceived the words as closer than when approach was paired with positive valence or avoidance with negative valence (compatibility). Furthermore, incompatibility exerted a stronger impact than compatibility on perceived distance relative to neutral words. Neither motivational orientation nor valence changed perceived distances on their own. Self-reported affect and perceived effort or pleasantness of performing approach and avoidance movements did not account for the effects. This suggests that our findings cannot be explained by participants' conscious awareness of their emotional or bodily states and instead, that they likely involve automatic processes (Bargh, 1997).

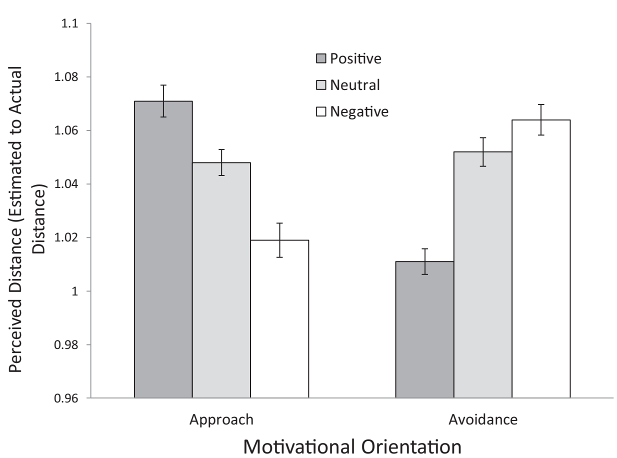

Figure 3. Relative distance estimates as a function of motivational orientation and word valence in Experiment 2. Error bars correspond to ±1 *SE* of the mean calculated using procedure by Cousineau (2005).

Experiment 3

Experiment 3 was designed to substantiate the finding from Experiment 2 using a different approach and avoidance manipulation, and different stimuli. A maze task developed by Friedman and Förster (2005a, 2005b; see also Krpan & Schnall, 2014) was used to induce motivational orientation through cognitive activation of approach and avoidance behaviors, and valenced photographs were selected from the International Affective Picture System (IAPS; Lang et al., 2005). The photographs were used because Gable and Harmon-Jones (2008) suggested that appetitive positive stimuli (e.g., a photo of an ice cream) may differently influence perception than nonappetitive positive stimuli such as the words used in Experiments 1 and 2. Furthermore, we included a control condition to assess whether perceptual differences for valenced stimuli exist in a neutral state, or occur only when combined with motivational orientation. Because we have argued that positive or negative stimuli should not engage motivated perception when not instrumental in goal pursuit, we predicted that these stimuli should not be perceived differently than neutral stimuli in the control condition. Finally, to ascertain that there was no experimenter bias in the distance estimates, participants engaged in the perceptual matching task themselves rather than instructing the experimenter to perform it for them. We expected that photographs incompatible with motivational orientation would be perceived as closer than compatible photographs.

Method

Participants and design. Seventy-two participants (60% female, $M_{age} = 32.07$ years) were recruited as in the previous

[4] Data from one participant who was identified as an outlier were excluded from statistical analyses. Inspecting the boxplots of his distance estimates for each of 18 experimental words yielded eight values that were more than three interquartile ranges above the upper quartile. Furthermore, his average distance estimates for neutral, negative, or positive words were also more than three interquartile ranges above the upper quartile.

[5] Because we did not have specific predictions regarding neutral words, simple effects analyses involving these words used Bonferroni adjustment.

[6] Mood items were combined into a composite score as in Experiment 1 ($\alpha = .87$). Given that one participant failed to answer five out of six items assessing mood, his overall mood score could not be computed.

experiments. Data from seven participants were excluded. Five of them either failed to solve the maze task or did not solve it within the 3 min time limit (see Friedman & Förster, 2001), and two failed to comply with experimental instructions, thus leaving 20 participants in the control, 21 in the approach, and 24 in the avoidance condition. The design involved *motivational orientation* (approach, avoidance, and control) as between-subjects factor, and *stimulus valence* (positive, neutral, or negative) and *spatial distance* (30 cm, 55 cm, 70 cm, or 80 cm) as within-subjects factors.

Stimuli. Twelve colored photographs (7230 — delicious meal, 7330 — ice cream, 8500 — gold bars, 8501 — money, 1050 — snake, 1525 — attacking dog, 6260 — aimed gun, 6350 — knife attack, 7041 — wooden baskets, 7161 — yellow pole, 7179 — rug, and 7185 — geometric form) were selected from the IAPS (Lang et al., 2005).[7] Four positive photographs had valence ratings equal to 7.00 or above on a scale from 1 = *negative* to 9 = *positive*; four negative photographs had valence ratings equal to 3.50 or below; and four neutral photographs had valence ratings of roughly 5.00. All photographs were printed on sheets of photographic paper size A4 and presented to participants on a transparent plastic stand perpendicular to the surface of the desk.

Procedure. The experimental procedure was similar to that used in Experiment 2 except for a few alterations. Motivational orientation was induced through the maze task (Friedman & Förster, 2005a, 2005b; Krpan & Schnall, 2014) before (rather than during) the distance estimation task. Participants in the approach condition were instructed to lead a mouse in the center of a paper-and-pencil maze toward a piece of cheese, whereas those in the avoidance condition led the mouse away from an owl. Participants in the control condition were instructed to connect the letter A in the center of the maze with the letter B outside of it. Thereafter, participants estimated the distance between their name and an empty sheet of photographic paper in a practice block consisting of three trials. Then they undertook the experimental block and estimated the distance to the stimuli presented randomly at four predetermined locations, one at a time. For each trial participants adjusted the measuring tape by stretching it in a direction parallel to the edge of the desk in front of them, with numbers facing away, to correspond to perceived distance. To minimize the possibility that stimuli presented at identical locations were perceived differently because of confounding visual cues and not because of their valence, these stimuli were matched according to their composition. Therefore, the following pictures were paired: 8500, 1050, and 7041; 8501, 6350, and 7179; 7230, 1525, and 7161; and 7330, 6260, and 7185. After the distance estimation task, participants completed a follow-up questionnaire assessing their *mood*, *general affect*, and the *experience of the experiment* with the scales used previously. At the end, they were debriefed and probed for suspicion. No participants showed any awareness of the hypothesis.

Results

Participants' distance estimates were transformed into ratios of estimated distance to actual distance as in the previous experiments. A mixed ANOVA with motivational orientation as between-subjects factor, and valence and spatial distance as within-subjects factors showed that motivational orientation and stimulus valence interacted in influencing distance estimates, $F(4, 124) = 3.65$, $p = .008$, $\eta_p^2 = .11$. Simple effects analyses further showed that, as predicted, approach-oriented participants perceived negative photographs (incompatibility) as closer than positive photographs (compatibility), $p = .004$, whereas avoidance-oriented participants perceived positive photographs (incompatibility) as closer than negative photographs (compatibility), $p = .027$ (see Figure 4). Furthermore, approach-oriented participants perceived neutral photographs as marginally farther than negative photographs, $p = .070$, and no differently than positive photographs, $p = 1.000$, whereas avoidance-oriented participants perceived neutral photographs no differently than positive, $p = .484$, or negative photographs, $p = 1.000$.[8] As predicted, in the control condition, there was no difference between neutral and positive, $p = .541$, neutral and negative, $p = .702$, or positive and negative photographs, $p = .309$. There were no main effects of motivational orientation, $F(2, 62) = 0.17$, $p = .847$, $\eta_p^2 = .01$, or stimulus valence, $F(2, 124) = 0.85$, $p = .430$, $\eta_p^2 = .01$. Potential confounding effects of mood, overall affect and experience of the experiment were analyzed as in Experiment 2 but the interaction between motivational orientation and valence remained highly robust, thus indicating no influence of those confounds, all ps $< .010$.[9]

Discussion

The findings of Experiment 3 complement the findings of the previous experiments, by showing that valence moderated the influence of motivational orientation on distance perception when photographs of concrete objects were used as stimuli and when approach and avoidance were induced by a cognitive rather than enacted manipulation. In line with predictions and results from Experiments 1 and 2, incompatible photographs were perceived as closer than compatible photographs. Furthermore, incompatibility exerted a somewhat stronger impact on perceived distance relative to neutral photographs than compatibility, which yielded only insignificant effects. Perceptual differences for valenced photographs occurred only when participants were either approach or avoidance-oriented, but not in the control condition. This further supports our prediction that stimulus valence alone does not engage motivated perception. Because the findings were not confounded by mood or affect, Experiment 3 in combination with the previous two experiments suggests that the impact of motivational orientation on distance estimates can be generalized to various types of valenced stimuli, including abstract words and concrete physical objects.

Experiment 4

Building on the earlier experiments that established how motivational orientation influences distance perception relative to stim-

[7] Because the experiment was conducted in the United Kingdom, photograph 8501 depicting US dollars was replaced by a similar photograph depicting British pounds.

[8] Because we did not have specific predictions regarding neutral words in the approach or avoidance condition, simple effects analyses involving these words used Bonferroni adjustment. Because this adjustment is highly conservative, some of these analyses produced p values equal to 1, a significance level that would be rare in statistical analyses without such adjustment.

[9] Mood was calculated as in the previous experiments ($\alpha = .80$).

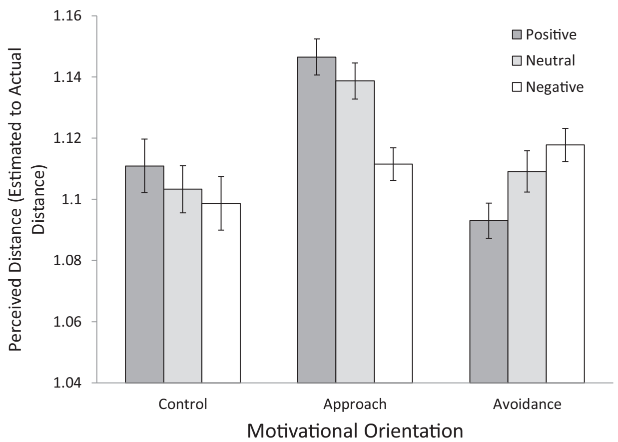

Figure 4. Relative distance estimates as a function of motivational orientation and photograph valence in Experiment 3. Error bars correspond to ±1 *SE* of the mean calculated using procedure by Cousineau (2005).

uli valence, Experiment 4 investigated the potential mechanism behind this influence. Based on previous work (e.g., Balcetis & Dunning, 2007; Centerbar et al., 2008; Harmon-Jones et al., 2009), we propose that stimuli incompatible with motivational orientation are seen as closer than compatible stimuli because they motivate the goal of resolving the inconsistency arising from discrepant affective information. For example, when an avoidance-oriented person sees a positive stimulus, such as a delicious cake, the person's motivational orientation clashes with the affective value of the stimulus. This disrupts the ability to appropriately process the stimulus, creating an epistemic disadvantage that may decrease the person's capacity to effectively respond to the stimulus and the surrounding environment (e.g., Centerbar et al., 2008; Neumann & Strack, 2000). Therefore, a person in this state may be motivated to resolve the epistemic inconsistency by extracting further meaning from the stimulus, which may be necessary in establishing appropriate behavioral responses to be undertaken if an opportunity for action arises. Because the motivated perception account proposes that goal-related motivation influences visual perception, and that perception in turn has a function within goal pursuit (e.g., Balcetis & Dunning, 2007; Veltkamp et al., 2008), seeing an incompatible stimulus as closer may serve various functions. For example, this perceptual bias may allow the person to examine the stimulus in detail and extract the information necessary for enhancing the capacity to process the stimulus and respond to it more effectively.

Because we propose that the goal motivated by incompatibility is a cognitive goal that cannot be defined in terms of behavior regarding perceived stimuli, it is not possible to directly assess this goal to support the mechanism behind our previous findings. Instead, in Experiment 4 we assessed whether the goal-related motivational state will result in a general state of activation and influence a spontaneously generated behavior unrelated to perceived stimuli. In Centerbar et al. (2008), compatibility between motivational orientation and valence led participants to write more cognitively complex and linguistically sophisticated narratives in a memory task than incompatibility. In contrast, incompatibility resulted in longer narratives, thus indicating greater activation in terms of the quantity of writing behavior. The authors proposed that this less efficient but more activated behavior reflected participants' goal-related motivational states evoked by incompatibility relative to compatibility. To assess whether incompatibility in Experiment 4 had similar behavioral consequences, we investigated how many anagrams participants would be willing to solve at the end of the experiment in a paradigm designed to measure behavioral activation (see Albarracín, Hepler, & Tannenbaum, 2011). Rather than using complex anagrams with multiple solutions that measure cognitive flexibility (e.g., Förster, Friedman, Özelsel, & Denzler, 2006), we used relatively easy to solve four-letter anagrams. Participants were given a choice to solve any number of anagrams they wished, ranging from 0 to all 46; solving more anagrams involved staying longer than they were paid for in the study. We predicted that participants in incompatible conditions would both see distances as shorter and solve more anagrams that those in compatible conditions, presumably as a result of activation of a goal-related motivational state.

Given that, in line with the motivated perception account, we proposed that visual perception is guided by goal-related motivation, we further investigated whether participants' perceptual estimates reflect the activity of the two basic motivational systems that guide motivation in the context of goals—the Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS; Gray, 1982; Gray & McNaughton, 2000). The BAS regulates behaviors aimed at approaching positive stimuli or actively avoiding negative stimuli by moving away from them (Pickering & Smillie, 2008). Thus, it is sensitive to stimuli related to rewards and to cessation of punishment. Although the BIS is relatively more difficult to understand because its definition has changed over time (see Gray, 1982; Gray & McNaughton, 2000), its general function is to inhibit behavior when stimuli in the environment afford conflicting behavioral responses (e.g., both approach and avoidance responses; McNaughton & Corr, 2008; see also Amodio, Master, Yee, & Taylor, 2008). Furthermore, the BIS is sensitive to signals of punishment and is associated with passive avoidance, which refers to withholding behaviors that could have potentially risky consequences. Given that the BIS and BAS have not been previously investigated in relation to distance perception, it is difficult to make specific predictions regarding the two systems in the context of the present research. However, if visual perception is indeed regulated by goal-related motivational states, then it should be related to activity of either BIS or BAS because these two systems comprise the core elements of motivation (Corr, 2008a). Thus, we tested whether participants' distance estimates predict subsequently assessed activity of the BIS and BAS as measured by the BIS/BAS scale, the most common and well-validated measure of the two systems (Carver & White, 1994). Furthermore, we investigated whether distance estimates predict activity of the BAS relative to BIS because the Joint Subsystems Hypothesis (Corr, 2001, 2004) proposes that BIS and BAS may be functionally interdependent.

Method

Participants and design. One hundred twenty participants were recruited from a participant pool consisting of university students and staff members as well as volunteers not related to the university (54% female, M_{age} = 22.23 years). Data from four participants were excluded either because of difficulties with the maze task or failure to comply with experimental instructions. The design involved *motivational orientation* (approach, avoidance) and *stimulus valence* (positive, negative) as between-subjects factors, and *spatial distance* (20 cm, 25 cm, 30 cm, 35 cm, 40 cm, 45 cm, 50 cm, or 55 cm) as within-subjects factor.

Stimuli. Identical positive and negative words as in Experiment 1 were used as stimuli. Furthermore, eight neutral words (*context*, *gender*, *manner*, *theory*, *moment*, *contents*, *industry*, and *poetry*) were adopted from Experiment 2 or selected using identical criteria.

Procedure. All participants first completed the maze task inducing either approach or avoidance as in Experiment 3. As part of the practice block, participants estimated the distance between themselves and an empty sheet of cardboard two times. Then they estimated the distance between themselves and either eight positive or eight negative words, and additionally, eight neutral words that were used as baseline values for distance calculation. The procedure used to estimate the distance was identical as in Experiments 1 and 2, with the experimenter adjusting the tape according to participants' instructions. We used neutral words as baseline to accurately capture the effect of the experimental manipulation on the perception of positive and negative words and to further increase the power of detecting the relationship between distance estimates and the BIS or BAS activity. After the distance estimation task, participants completed a battery of tasks including the BIS/BAS scale, fillers, and finally the anagram task.[10] In the end, all participants completed a follow-up questionnaire assessing their *mood* and *general affect* as in Experiment 3.

Results

Incompatibility versus compatibility and distance. An ANOVA showed that estimated distance for neutral words did not differ across the four experimental groups, $p = .933$, justifying their use as baseline. Therefore, participants' distance estimates were transformed into ratios of estimated distance for valenced versus neutral words that were used in all subsequent analyses involving distance.[11] A two-way ANOVA with stimulus valence and motivational orientation as between-subjects factors was performed, showing the same interaction on perceived distance as in the earlier experiments, $F(1, 111) = 66.18$, $p < .001$, $\eta_p^2 = .37$. Replicating the earlier findings, approach-oriented participants perceived negative words (incompatibility) as closer than positive words (compatibility), $p < .001$, whereas avoidance-oriented people perceived positive words (incompatibility) as closer than negative words (compatibility), $p < .001$ (see Figure 5). Again there was no main effect of motivational orientation, $p = .151$, or stimulus valence, $p = .812$. The effect of the interaction between motivational orientation and valence remained robust after controlling for mood, $F(1, 107) = 61.52$, $p < .001$, $\eta_p^2 = .37$.[12]

Anagrams. To investigate whether motivational orientation and valence interacted in influencing the number of anagrams participants attempted to solve, we performed a two-way ANOVA with the two variables as between-subjects factors.[13] Furthermore, because participants' knowledge of English (native vs. nonnative) predicted the number of anagrams solved, $F(1, 113) = 11.29$, $p = .001$, $\eta_p^2 = .09$, the ANOVA also contained this variable as a covariate.[14] The interaction effect was significant, $F(1, 110) = 5.73$, $p = .018$, $\eta_p^2 = .05$.[15] Simple effects analyses further showed that participants in the avoidance condition solved marginally more anagrams after perceiving positive (incompatibility) than negative words (compatibility), $p = .067$ (see Figure 6). However, in the approach condition, participants who perceived negative words (incompatibility) tended to solve more anagrams than those who perceived positive words (compatibility), but this effect was not significant at the conventional significance level, $p = .127$. Therefore, in line with predictions, participants in incompatible conditions attempted to solve more anagrams than those in compatible conditions.

[10] Participants also completed the line bisection task (Nash, McGregor, & Inzlicht, 2010) that intends to measure patterns of prefrontal asymmetry linked to approach versus withdrawal. To investigate whether participants' scores on this task were correlated with their distance estimates, we performed a correlation analysis that showed that the two variables were not correlated, $r = -.022$, $p = .818$. However, we decided not to further discuss the findings within the present article because firm evidence showing that the line bisection task indeed captures prefrontal asymmetry linked to approach versus withdrawal has not yet been provided. The only study to investigate this so far has been conducted by Nash et al. (2010). However, their finding represents a trait-level correlation (between baseline EEG asymmetry and line bisection), and it does not address the key question of whether rightward bisection bias represents a more approach-oriented state relative to withdrawal.

[11] We identified one extreme value that was more than three interquartile ranges above the upper quartile by using a boxplot to inspect participants' average distance estimates. Thus, data from one participant were excluded from statistical analyses involving distance estimates.

[12] Mood was calculated as in the previous experiments ($\alpha = .85$). Given that three participants failed to answer five out of six items assessing mood, their overall mood score could not be computed. Unlike in Experiment 1 that used a similar research design, general affect was influenced by the interaction between motivational orientation and stimulus valence, $F(1, 112) = 9.29$, $p = .003$, $\eta_p^2 = .08$, with participants in incompatible conditions feeling more positive than those in compatible conditions. Thus, it could not be used as a control variable in statistical analyses involving the interaction between motivational orientation and valence because of the issue of multicollinearity. Given that affect was assessed after the anagram task, and that it was related to the number of anagrams solved, $r = .184$, $p = .049$, we suspect that solving more anagrams made participants feel better and hence influenced their affective state.

[13] One participant attempted to solve all 46 anagrams. However, only 18 of these solutions were recognizable English words. Therefore, data from this participant were excluded from analyses involving anagrams.

[14] When participants' knowledge of English was not included in the analysis as a covariate, the interaction effect was also significant although somewhat weaker, $F(1, 111) = 4.31$, $p = .040$, $\eta_p^2 = .04$. Furthermore, the difference between avoidance-oriented people who perceived positive ($M = 40.46$, $SD = 5.41$) and negative words ($M = 35.90$, $SD = 11.41$) in the number of anagrams solved remained marginally significant, $p = .088$. Although approach-oriented participants tended to solve more anagrams after perceiving negative ($M = 38.83$, $SD = 11.27$) than positive words ($M = 35.57$, $SD = 10.89$), this effect was again not significant, $p = .226$.

[15] Because the assumption of normality was violated, we calculated the interaction effect using identical variables in a robust regression analysis bootstrapped with 10,000 resamples. The interaction effect was again significant, $B = -8.62$, 95% Bias-Corrected CI [−15.666, −1.575], $p = .015$, and the pattern of findings almost identical as in the ANOVA analysis, showing that the analysis was robust despite the assumption of normality not being met. To further strengthen our claim that incompatibility between motivational orientation and valence leads to more anagrams solved than compatibility, we also assessed whether participants in incompatible conditions solved more anagrams than those in compatible conditions by using the nonparametric Mann-Whitney test. The result was significant, $p = .017$, further supporting our prediction that incompatibility should increase the number anagrams solved compared with compatibility.

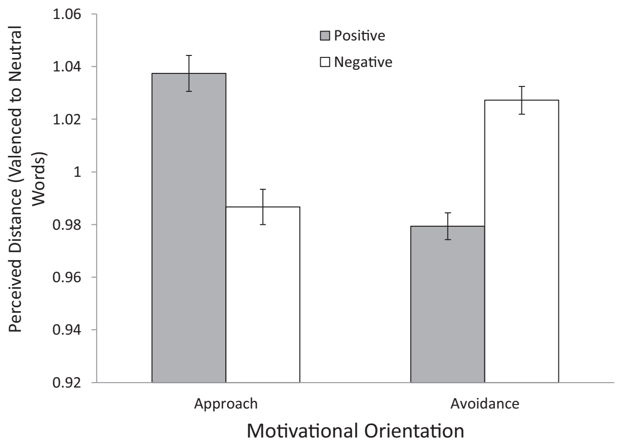

Figure 5. Relative distance estimates as a function of motivational orientation and word valence in Experiment 4. Error bars correspond to ±1 *SE* of the mean.

Perceived distance and BIS/BAS activation. To investigate whether perceived distance predicted the activity of BIS, BAS, or BAS relative to BIS, we performed correlational analyses.[16] As can be seen from Table 1, distance estimates were positively related to BIS activity, showing that participants who perceived valenced words as farther also tended to report higher BIS scores relative to those who perceived them as closer. Furthermore, distance estimates were negatively related to BAS versus BIS activity, showing that participants who perceived valenced words as closer had relatively higher BAS activity than participants who perceived the words as farther. However, distance estimates were not reliably related to BAS activity. Although we did not make any specific predictions regarding the direction of relationship between BIS/BAS scores and perceptual estimates, these findings are in line with our hypothesis that visual perception is regulated by goal-related motivation and should be associated with either of the two basic motivational systems.

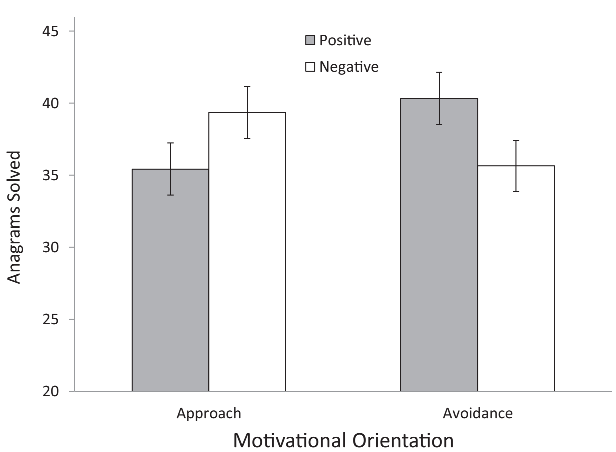

Figure 6. Number of anagrams participants attempted to solve as a function of motivational orientation and word valence while controlling for participants' knowledge of English (Experiment 4). Error bars correspond to ±1 *SE* of the mean.

Table 1
Zero Order Correlations Between Participants' Distance Estimates (Valenced to Neutral Words) and the Activity of the Behavioral Inhibition System (BIS), Behavioral Activation System (BAS), and BAS Relative to BIS

Variable	1	2	3	4
1. Perceived distance		.276**	−.118	−.326***
2. BIS	.276**		.193*	−.815***
3. BAS	−.118	.193*		.411***
4. BAS relative to BIS	−.326***	−.815***	.411***	

* $p = .039$. ** $p = .003$. *** $p < .001$ (all *p*s two-tailed).

Discussion

Experiment 4 replicated our earlier findings regarding the influence of motivational orientation on visual perception of valenced words. Again, participants who engaged in approach behavior perceived negative words (incompatibility) as closer than positive words (compatibility). However, those who engaged in avoidance behavior saw positive words (incompatibility) as closer than negative words (compatibility). Furthermore, besides influencing perceptual estimates, incompatibility between motivational orientation and valence influenced the number of anagrams participants were willing to solve at the end of the experiment. Indeed, participants in incompatible conditions solved more anagrams than those in compatible conditions. This finding is in line with our assumption that incompatibility motivates the goal of resolving the inconsistency between discrepant affective information (e.g., Centerbar et al., 2008; Harmon-Jones et al., 2009; Neumann & Strack, 2000) and evokes a state of general activation (see Albarracín et al., 2011).

Besides investigating the influence of incompatibility between motivational orientation and valence on perceptual estimates and the anagram task, Experiment 4 tested whether perceptual estimates are associated with participants' BIS and BAS scores, as well as the relative difference in activity of the two systems. We predicted that, if visual perception is guided by goal-related motivation as suggested by the motivated perception account (Balcetis & Dunning, 2007, 2010; Veltkamp et al., 2008), then it should be related to either BIS or BAS activity because the two systems comprise the core mechanism of motivation (Corr, 2008a). Indeed, perceptual estimates were positively related to BIS scores. Thus, people who saw valenced words as farther had more activated BIS than those who saw them as closer. Furthermore, perceptual estimates were negatively related to BAS scores relative to BIS, showing that valenced words appeared as closer to those who had more active BAS in comparison with BIS. Thus, basic motivational systems may also have an important role in visual perception.

[16] The activity of BAS relative to BIS was calculated as in Smith and Bargh (2008), by subtracting BIS scores from BAS scores.

General Discussion

Across four experiments, we found that compared with compatibility, incompatibility between motivational orientation and valence decreased perceived distance. Neither motivational orientation nor valence influenced perceived distance on their own, suggesting that the two variables play a role in distance perception only in relation to one another. These findings were consistent across different manipulations of motivational orientation, including motor movements (Experiments 1 and 2) and cognitive procedures (Experiments 3 and 4), and across different types of stimuli, including abstract words (Experiments 1, 2, and 4) and photos of concrete objects (Experiment 3). These findings suggest that motivational orientation impacts visual perception of valenced stimuli regardless of whether they only carry a positive or negative meaning or are also associated with positive or negative physical consequences.

To explain the influence of incompatibility on visual perception relative to compatibility, we propose that incompatible stimuli motivate the goal of resolving the inconsistency arising from discrepant affective information conveyed by motivational orientation and valence (see Centerbar et al., 2008; Harmon-Jones et al., 2009; Neumann & Strack, 2000). The goal-related motivational state in turn makes incompatible stimuli appear as closer than compatible stimuli, as suggested by the motivated perception account (see Balcetis & Dunning, 2007, 2010; Veltkamp et al., 2008). Because we propose that incompatibility motivates the type of goal that cannot necessarily be attained by performing a behavior regarding perceived stimuli, we could not directly assess this goal to support the mechanism behind the present findings. Instead, we assessed the goal indirectly by investigating whether the motivational state it presumably evoked gave rise to a general state of activation (see Albarracín et al., 2011). To capture this state, we gave participants the option to solve simple anagrams for no additional payment. As predicted, participants in incompatible conditions on average solved more anagrams than those in compatible conditions, suggesting that the goal associated with incompatibility evoked a general state of activation.

Although our findings suggest that incompatibility produces activation that can make participants more willing to perform a variety of behaviors, this does not mean that incompatibility makes participants more willing to perform behaviors regarding perceived stimuli themselves. Indeed, a novel contribution of the present research is to show that incompatibility can enhance a general tendency for action even when participants are not given the option to act on the valenced stimuli. However, when acting is an option, participants' activation of behavior regarding valenced stimuli may not follow the same pattern. For example, Förster (2003) showed that people are more likely to eat delicious foods when they are approach-oriented (compatibility) relative to avoidance-oriented (incompatibility). This finding could be interpreted as showing that in contrast to incompatibility, compatibility results in more active behavior toward positively valenced stimuli. However, the present findings indicate that incompatibility between avoidance and positive valence may at the same time evoke a more general tendency to act. Thus, future research will need to investigate whether incompatibility decreases the likelihood of acting on positive stimuli while making people more generally activated and likely to perform other behaviors. The degree of general activation may further depend on whether positive stimuli are simply given to participants and no additional actions are required to receive them, as in Förster (2003), or they need to be acquired by performing well on a secondary task. Overall, the present findings suggest that the relationship between compatibility versus incompatibility and behavior may be more complex than previously assumed.

Besides investigating whether incompatibility activated behavior relative to compatibility, the present research assessed whether perceptual estimates themselves reflected the activity of the two basic motivational systems (Gray, 1982; Gray & McNaughton, 2000) to further support the claim that perception is linked to goal-related motivation (Balcetis & Dunning, 2007, 2010; Veltkamp et al., 2008). We found that participants' perceptual estimates predicted the subsequently assessed activity of the BIS as measured by the BIS/BAS scale (Carver & White, 1994), showing that participants who perceived valenced words as closer had less activated BIS than those who perceived them as farther. In addition, participants who perceived valenced words as closer had more active BAS relative to BIS than those who perceived them as farther. These findings provide additional evidence suggesting that visual perception of distance may indeed be closely associated with motivation within the context of goal pursuit.

Motivational Orientation and Visual Perception

Because the present research deals with visual perception, it is necessary to place the findings into the broader context of the relevant perception literature. The present research builds upon the general notion that visual perception is not a purely low-level phenomenon but is influenced by various bodily and experiential factors, as suggested by the two related streams of research: the economy of action account (Proffitt & Linkenauger, 2013; Proffitt, 2006) and the motivated perception account (Balcetis & Cole, 2014; Bruner & Goodman, 1947). More specifically, the present findings closely align with the motivated perception account. Indeed, it proposes that visual perception can be influenced by motivational states involved in goal pursuit in such a way that goal-related stimuli are perceived as closer, or larger (e.g., Balcetis & Cole, 2014; Veltkamp et al., 2008). In line with this notion, the present findings suggest that motivation associated with the goal to resolve the inconsistency arising from incompatible affective information makes incompatible stimuli appear as closer than compatible stimuli. Given that this goal cannot be clearly operationalized through specific behaviors regarding perceived stimuli, the present research further supports the notion that distance perception is affected by cognitive goals, which have so far been somewhat underresearched. Other cognitive goals that were previously found to affect perceptual estimates involve resolving cognitive dissonance (Balcetis & Dunning, 2007) or regulatory conflict (Cole, Balcetis, & Zhang, 2013).

Another important contribution of the present research to the motivated perception account is showing that distance perception is affected by processes that have been frequently defined as fundamental in regulating human everyday functioning. Indeed, approach and avoidance motivational orientations are assumed to be among the core processes that guide the processing of information from external environment as well as human automatic behavior (Strack & Deutsch, 2004). Thus, the present research suggests that the role of approach versus avoidance in regulating human functioning may extend beyond evaluation of affective stimuli or guidance of human behavior, and may involve shaping visual perception. This further raises the importance of determining whether approach versus avoidance regulate evaluation of affective stimuli and behavior toward them through visual perception.

Alternative Explanations

Although we claim that visual perception in the present research was influenced by the goal to resolve the inconsistency arising from affective information that is discrepant with motivational orientation, the present findings could potentially be explained in an alternative way. A critic may argue that positive and negative stimuli themselves motivated specific approach- or avoidance-related goals. Because either approach or avoidance cues such as the maze task may signal the state where goals associated with compatible valenced stimuli have been attained (see Baas, De Dreu, & Nijstad, 2011), evoking compatible motivational orientations may have resulted in cessation of goal-related motivation. However, when combined with incompatible motivational orientations, goals evoked by valenced stimuli may have remained active and influenced perceptual estimates compared with compatible stimuli. Although this explanation sounds plausible, it is unlikely that it can adequately explain the present findings because Experiment 3 showed that neither positive nor negative stimuli were perceived as closer than neutral stimuli for participants in the control condition. Thus, it is unlikely that either positive or negative stimuli evoked goal-related motivational states, because these states would in turn be reflected in biased perceptual estimates.

Even if we propose that visual perception in the present research was shaped by goal-related motivation, it is possible that the relationship between these two variables is more complex and can be further explained by other mechanisms associated with perception and goal pursuit. For example, we have argued that seeing an incompatible stimulus as closer may allow the person to extract more detailed information from the stimulus, which may in turn benefit inconsistency resolution by allowing the organism to construct efficient behavioral plans regarding the stimulus and process it more effectively. Indeed, research has suggested that perceiving distances as closer in terms of space, time, or social closeness is related to detail-oriented perceptual and conceptual processing (see Förster & Dannenberg, 2010; Trope & Liberman, 2010). Thus, we expect that looking at incompatible stimuli may also result in focusing on their details and processing them in terms of more detailed information. However, the relationship between distance perception and perceptual or conceptual processing appears to be bidirectional, which means that manipulating the dimension of distance changes processing style and vice versa (Förster & Dannenberg, 2010). Therefore, it remains unclear whether the goal-related motivation instigated by incompatibility first evokes detail-oriented processing, which in turn makes stimuli appear as closer to facilitate focusing on details, or this motivational state first decreases perceived distance, which then evokes detail-oriented processing. Our position is that the effects of incompatibility between motivational orientation and valence on distance perception and processing style co-occur, and that distance perception and processing style functionally interact in extracting visual information necessary for resolving the inconsistency.

Motivational Orientation and Physical Distance Regarding Perception Versus Action

Given that the present research investigated the relationship between motivational orientation and physical distance, it is important to relate our findings to research investigating this relationship in domains other than perception. Approach and avoidance have indeed been frequently related to the dimension of physical distance. However, this relationship involved people's tendencies to decrease or increase the distance between themselves and perceived stimuli rather than perceived distance. For example, approach motivation has been defined as a behavioral tendency to decrease the distance between a person and a stimulus, whereas avoidance has been defined as a tendency to increase this distance (Seibt et al., 2008; Van Dantzig et al., 2008). Therefore, when it comes to people's action tendencies, defining approach and avoidance in terms of physical distance produces a relatively clear distinction. However, the present research shows that, when it comes to visual perception, defining approach and avoidance in terms of physical distance is somewhat more complex. Indeed, when either approach or avoidances are paired with compatible stimuli, the result is an increase in perceived distance compared with pairing them with incompatible stimuli. Therefore, to avoid conceptual misunderstandings in the future, researchers need to be careful when defining approach versus avoidance in terms of physical distance, and specify that this definition is not general but applies only in the context of action tendencies.

Limitations and Unresolved Questions

To understand the value of the present research, it is also necessary to understand its limitations. One of the limitations is that we did not directly investigate specific functional benefits of perceiving incompatible stimuli as closer in resolving the inconsistency between motivational orientation and valence. For example, we propose that this perceptual bias may allow the person to examine an incompatible stimulus in detail (e.g., Förster & Dannenberg, 2010) and enhance the ability to construct efficient behavioral plans regarding the stimulus and process it more effectively. Therefore, if biased perception indeed assists in resolving the inconsistency, then perceiving incompatible stimuli as closer should in some way benefit how people process these stimuli and respond to them. However, it is also possible that decrease in perceived distance has either a more complex functional role or does not serve any function and is simply a byproduct of motivation or related processes evoked by incompatibility. Thus, a challenge for future research will be to examine the function of visual perception in resolving the inconsistency arising from incompatible affective information, which may also enhance the understanding of how visual perception benefits attaining other cognitive goals, such as resolving cognitive dissonance (Balcetis & Dunning, 2007).

Another limitation of the present research is the difficulty to explain why the BIS seems to be more involved in distance perception than the BAS, as our findings suggest, as well as the difficulty to explain the specific pattern of relationship between perceptual estimates, BIS, and relative difference between BIS and BAS activity. The goal of our research was indeed to investigate whether the two core motivational systems play some role in visual perception to further support the claim of the motivated perception account that goal-related motivation is important in perception. However, we did not focus on explaining the specific pattern of findings because the literature available on BIS and BAS (for a comprehensive overview, see Corr, 2008b) is not sufficient for us to provide any clear explanations. Therefore, investigating the more specific role of BIS and BAS in visual perception of distance may be a fruitful topic for future research given the current state of knowledge on the topic.

The final limitation to be discussed in the context of the present research is also considered a general limitation of research investigating top-down influences on visual perception. Indeed, critics have argued that physiological and motivational influences on distance or size estimates can be explained by various cognitive processes such as judgment rather than by changes in visual perception itself. For example, Durgin et al. (2009; see also Durgin, Klein, Spiegel, Strawser, & Williams, 2012) criticized the well-established findings regarding the effect of wearing a heavy backpack on hill slant perception (e.g., Bhalla & Proffitt, 1999; Schnall et al., 2010) for being susceptible to demand characteristics. The authors claimed to show that the backpack manipulation made the hill appear as steeper not because it reduced participants' potential to climb up, but because participants were able to understand the hypothesis and adjusted their responses accordingly. Similarly, Firestone and Scholl (2014) proposed that the effect of holding a wooden rod across one's chest on the perception of aperture width originally demonstrated by Stefanucci and Geuss (2009) can be accounted for by participants' knowledge of the hypothesis rather than by changes in visual perception.

Although the present research was not designed to directly tackle the issues raised by Durgin et al. (2009) or Firestone and Scholl (2014), it is highly unlikely that the present findings can be explained by experimenter demand characteristics. Indeed, we probed all the participants for suspicion regarding the study objective, and none of them had any insights indicating that they understood our hypotheses or experimental manipulations. Furthermore, our experiments had relatively complex design and the predictions were not intuitive so they could be easily understood by people other than specialists in the field who know the relevant literature. Therefore, we have no reason to believe that the present findings reflected processes other than perception. This notion is further supported by previous findings showing that motivational orientation and valence interacted in influencing more basic cognitive processes such as visual attention (Gawronski et al., 2005).

Conclusion

The present research showed that visual perception of valenced stimuli is linked to basic motivational orientations that guide human functioning. Given that numerous stimuli in the real world carry either positive or negative valence, and that motivational orientation can be subtly induced in multiple everyday situations, this finding suggests that people's visual experience of the world is much more dynamic than the physical environment itself would indicate. Therefore, investigating how exactly these fluctuations in visual experience influence people's day to day living has the potential of revealing a hidden dimension of humans' relationship with the world: Objects in the everyday environment sometimes appear farther than they are. At other times, however, they are just too close for comfort.

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Received December 17, 2013
Revision received October 3, 2014
Accepted October 21, 2014 ■