Published in final edited form as:
Psychol Bull. 2010 September ; 136(5): 875–893. doi:10.1037/a0020495.

Implicit Affective Cues and Attentional Tuning: An Integrative Review

Ronald S. Friedman and
Department of Psychology, University at Albany, State University of New York

Jens Förster
Department of Psychology, University of Amsterdam

Abstract

A large and growing number of studies support the notion that arousing positive emotional states expand, and that arousing negative states constrict, the scope of attention on both the perceptual and conceptual levels. However, these studies have predominantly involved the manipulation or measurement of conscious emotional experiences (e.g., subjective feelings of happiness or anxiety). This raises the question: Do cues that are merely associated with benign versus threatening situations, but that do not elicit conscious feelings of positive or negative emotional arousal, independently expand or contract attentional scope? Integrating theoretical advances in affective neuroscience, positive psychology, and social cognition, it is proposed that rudimentary intero- and exteroceptive stimuli may indeed become associated with the onset of arousing positive or negative emotional states and/or with appraisals that the environment is benign or threatening and thereby come to moderate the scope of attention in the absence of conscious emotional experience. Specifically, implicit "benign situation" cues are posited to broaden, and implicit "threatening situation" cues to narrow, the range of both perceptual as well as conceptual attentional selection. An extensive array of research findings involving a diverse set of such *implicit affective cues* (e.g., enactment of approach and avoidance behaviors, incidental exposure to colors signaling safety versus danger) is marshaled in support of this proposition. Potential alternative explanations for and moderators of these attentional tuning effects, as well as their higher-level neuropsychological underpinnings, are also discussed along with prospective extensions to a range of other situational cues and domains of social cognitive processing.

Decades of research have suggested that affective experiences, such as emotional feelings and moods, influence not only the content, but the structure of thought, shaping *how* individuals think as opposed to merely *what* they think (see Schwarz & Clore, 2007). Among the primary sources of inspiration for this work has been the Easterbrook hypothesis (Easterbrook, 1959), which has traditionally been interpreted as suggesting that anxious emotional states, characterized by high physiological arousal as well as negative valence (see Larsen & Diener, 1992), narrow the scope of perceptual attention (Cacioppo, Berntson, & Crites, 1996). In line with this seminal proposition, a number of studies have shown diminished accuracy in detecting

Correspondence concerning this article should be addressed to Ronald S. Friedman, Department of Psychology, University at Albany, 1400 Washington Avenue, Albany, NY 12222. rfriedman@albany.edu or to J.A.Forster@uva.nl.
Mailing Address: Ronald S. Friedman, Department of Psychology, University at Albany, 1400 Washington Avenue, Albany, NY 12222, Tel: (518) 442-4858, Fax: (518) 442-4867, rfriedman@albany.edu

peripheral visual targets and/or increased response time to such targets under a number of anxiety-provoking circumstances (e.g., Burke, Heuer, & Reisberg, 1992; Callaway & Dembo, 1958; Reeves & Bergum, 1972; Weltman, Smith, & Edstrom, 1971). Relatedly, it has been found that increased anxiety is associated with an enhanced focus on the local features of composite visual stimuli, and reduced attention to how these features are globally configured. More colloquially, anxiety predicts a tendency to miss the forest for the trees (Derryberry & Tucker, 1994; Tyler & Tucker, 1981).

Assuming that high-arousal negative emotional states indeed constrict attentional scope, the question inevitably arises: How might emotional arousal moderate the breadth of attentional selection when it involves a positive as opposed to negative valence, for instance, when it involves elation rather than tension? According to Tucker and his colleagues (Derryberry & Tucker, 1994; Tucker & Williamson, 1984), narrowed attention is adaptive under threatening circumstances as it facilitates concentration on the problem at hand and potential means of solution. However, it is suggested that when the individual is no longer in a noxious situation, broadened, as opposed to constricted, attention is adaptive as it increases the likelihood of detecting novel incentives and enables individuals to update mental representations of their external environment. The positive states of emotional arousal that are elicited when threats have passed and/or opportunities have arisen are hypothesized to mediate this expansion of attentional scope.

Similar arguments have been advanced by a number of theorists. For instance, Fredrickson (1998, 2001) has suggested that the broadening of attention that accompanies positively valenced emotional states prompts individuals to engage in atypical patterns of thought and action. This facilitates building an expanded repertoire of responses (e.g., knowledge and skills) and resources (e.g., social connections) that can aid in survival when threats inevitably arise. Likewise, Schwarz (1990; 1994) has proposed that emotions and moods have evolved to convey information regarding the nature of the situation. Whereas negative emotional states signal danger and motivate the individual to focus on avoiding or escaping threats, positive emotions signal that the current situation is safe and that no particular course of action is required. This safety signal prompts individuals to adopt an explorative mindset, in which they broaden their attention to encompass novel ideas and incentives (cf. Carver, 2003). Whereas these theories do not clearly differentiate between effects of high and low-arousal emotional states, it is reasonable to assume that their predictions should be most strongly borne out with respect to high-arousal states, as these provide the most salient and unambiguous signals that danger looms or, conversely, that “the coast is clear”.[1]

A noteworthy aspect of these convergent theoretical approaches to the influence of emotion on attentional scope is that they embrace a broader view of attention than has typically been associated with the Easterbrook hypothesis. Specifically, they suggest that states of emotional arousal not only moderate the scope of attention on the perceptual level, but on the conceptual or representational level, influencing the breadth of activation of stored mental representations in long-term memory (LTM; cf. Anderson, Bjork, & Bjork, 1994; Anderson & Neely, 1996). For instance, according to Tucker’s model (e.g., Derryberry & Tucker, 1994), high-arousal positive emotions not only entail processing a more extensive range of sensory stimuli at a

[1]As suggested by an anonymous reviewer, the proposition that high-arousal positive emotional states signal safety is ostensibly at odds with the observation that such states may be elicited by high-risk thrill-seeking behaviors (e.g., mountain climbing, skydiving). However, the positive arousal experienced during engagement in thrill-seeking activities may not result from interpreting them as threatening per se, but rather, from construing them as challenging and stimulating (Blascovich & Tomaka, 1996), as signifying courage and self-efficacy, and/or as fostering enlightenment and humility (Brymer & Oades, 2009; Reyna & Farley, 2006). Moreover, following goal attainment (e.g., after a successful alpine ascent or parachute landing), high-arousal positive emotions should powerfully signal to individuals that they are out of harm’s way (see the *Complications and Unresolved Questions* section for additional discussion of the potential moderating role of goal attainment on attentional tuning processes).

given moment, but cognitive activation of a more extensive range of memory constructs, in particular, those with lower *a priori* accessibility in a given context (i.e., remote associates; Mednick, 1962). In complementary fashion, high-arousal negative emotions constrain both the scope of sensory processing (*à la* Easterbrook) as well as the activation potential of non-dominant associates in LTM.

An abundance of research findings have been consistent with the abovementioned predictions regarding the moderating influence of emotional states on attentional scope. For example, in support of the contention that high-arousal positive emotions increase the breadth of perceptual attention, Fredrickson and Branigan (2005) recently discovered that experimentally-induced states of amusement, relative to a neutral affective state, engendered a tendency to categorize composite visual figures (e.g., a set of small triangles arranged in the shape of a square) on the basis of their global form as opposed to their local components (see also, Basso, Schefft, Ris, & Dember, 1996; cf. Gasper, 2004; Gasper & Clore, 2002). Relatedly, Rowe, Hirsh, and Anderson (2007) found that happy mood impairs the ability to selectively respond to a centrally-presented target stimulus surrounded by response-incompatible distractor stimuli (e.g., a target letter N flanked by Hs). This suggests that high-arousal positive emotion expanded the breadth of visual selective attention, bolstering the likelihood that spatially-disbursed flanker stimuli would fall within the attentional "spotlight" and thereby interfere with responses to central targets (see also, Fenske & Eastwood, 2003; Schmitz, DeRosa, & Anderson, 2009).

Numerous studies have also supported the notion that high-arousal positive emotion broadens, and that high-arousal negative emotion constricts, the scope of conceptual or representational attention (see Baas, De Dreu, & Nijstad, 2008, for a review). For example, in a seminal study by Isen and Daubman (1984), participants were asked to rate the goodness-of-fit of a range of exemplars to a number of familiar categories. Results revealed that happy mood led to relatively inclusive categorization of weak exemplars (e.g., "cane" as a type of "clothing", "camel" as a type of "vehicle"). This suggests that positive emotional arousal increases the breadth of conceptual attention, facilitating working memory access to shared exemplar features and enabling activation and/or construction of more inclusive mental categories. Isen and her colleagues (see Isen, 2000, for a review) have also put forth considerable evidence demonstrating increased creativity during happy moods, for instance, showing that happiness helps individuals escape functional fixity, enabling them to use an object with a pre-established function in a novel manner, and enhances the originality of their free associations (Isen, Daubman, & Nowicki, 1987; Isen, Johnson, Mertz, & Robinson, 1985). Inasmuch as breaking mental set and generating remote associations demand recruiting comparatively inaccessible information from long term memory (Schooler & Melcher, 1995), Isen's results convergently support the notion that happiness expands the focus of conceptual attention, facilitating internal selection and activation of mental representations with low *a priori* accessibility (see also, Ashby, Isen, & Turken, 1999; Dreisbach, 2006; Dreisbach & Goschke, 2004; Rowe et al., 2007).

A range of studies may also be seen as consistent with the hypothesis that high-arousal negative emotions narrow attentional scope. As discussed earlier, a considerable amount of research supports Easterbrook's contention that aversive arousal constricts the range of perceptual selection. Beyond this, as pointed out by Derryberry and Tucker (1994), the classic drive-theoretical studies of Spence and his colleagues (1958), in which anxiety and stress were found to undermine the ability to retrieve remotely associated words, are consistent with the view that high-arousal negative emotions additionally constrict the scope of conceptual attention. This notion also finds support in the more recent work of Mikulincer and his colleagues (Mikulincer, Kedem, & Paz, 1990a; Mikulincer, Paz, & Kedem, 1990b), who using a goodness-of-fit task akin to that employed by Isen and Daubman (1984), discovered that anxiety was

associated with a tendency to exclude fringe exemplars from category membership. This suggests that aversive emotional states may narrow conceptual attention, impeding cognitive activation of features that fringe exemplars share with prototypical category members.

Implicit Affective Cues and Attentional Tuning

In sum, a wide array of studies support the notion that arousing positive emotional states broaden, and that arousing negative states constrict, the scope of attention on both the perceptual and conceptual levels. However, the emotional states manipulated or measured in these studies invariably entailed conscious feelings of happiness or anxiety. This leaves open an intriguing question: Does attentional tuning also occur in response to cues that are merely associated with relatively benign versus threatening situations but that do not elicit conscious experiences of joy or dread?

Upon consideration, the potential for attentional tuning to occur in the absence of subjective emotional experience is likely to develop over time as a range of intero- and exteroceptive cues form predictive associations with the onset of arousing positive or negative emotional states and/or with the appraisal that the current situation is benign or threatening. Restated, a number of contextual cues may come to serve as conditioned stimuli that gradually gain the power to independently expand or contract the scope of attention. However, this ostensibly unobjectionable proposition introduces another complication: If an intero- or exteroceptive cue is habitually associated with perceived safety versus threat and/or with the elicitation of positive versus negative arousal, shouldn't exposure to this cue eventually suffice to produce conscious emotional experience? Is it possible to expose individuals to a safety or threat-related cue without causing them to *feel* safe or threatened? Bearing upon this question, Öhman and Soares (1994) found that individuals with specific phobias showed selective elevation of skin conductance responses (SCRs) to suboptimally presented images of their particular fear objects (e.g., snakes, spiders). These heightened SCRs were paralleled by greater self-reported arousal and a diminished feeling of being "in control", suggesting that participants felt more tense following exposure to a threat cue, the identity of which they could not consciously recognize (see also, Öhman, Flykt, & Lundqvist, 2003).

Of course, although Öhman and his colleagues' results do suggest that conscious emotional feelings may be elicited by the most subtle of cues, they do not necessarily imply that all cues habitually associated with or representative of benign versus threatening situations necessarily evoke subjective feeling states. As argued by Ellsworth (1994), emotions involve multiple distinct processes that tend to be elicited in situations implicitly or explicitly deemed pertinent to the individual's goals. These include affect, appraisal of the valence of a stimulus (its "goodness" or "badness")[2], as well as "…physiological arousal, expressive behavior such as facial expressions, impulses to instrumental behaviors, and some sort of subjective feeling…" (Ellsworth, 1994, p. 227). Although these processes are clearly correlated, they vary in their time course, may be set in motion by distinct appraisals or environmental cues, and are posited to operate in parallel, often prior to the development of any subjectively identifiable emotion. In line with, and extending this perspective, LeDoux (e.g., 1996 e.g., 2000) has shown that subcortical pathways (between the sensory thalamus and amygdala) enable the brain to rapidly initiate defensive responses (e.g., freezing behavior, changes in blood pressure, release of stress hormones) to primitive threat cues (e.g., snake-like images). Notably, by circumventing the neocortex, these "quick and dirty" (LeDoux, 1996, p. 163) pathways also

[2]Ellsworth (1994) herself used the term "affect" to denote subjective emotional experience. We digress from this usage here and embrace the definition advanced by Clore and his colleagues (Clore & Colcombe, 2003; Clore & Ortony, 2000; Ortony, Clore, & Collins, 1988; Schwarz & Clore, 2007), in which affect refers simply to the registration in the organism of a stimulus' positivity or negativity. According to this definition, whereas all emotional experiences are affective responses (i.e., responses to a valenced object or event), affective responses need not include emotional experience (Schwarz & Clore, 2007).

bypass conscious awareness. Presumably, this is adaptive inasmuch as it helps prepare us for action "…before we completely recognize what it is we are reacting to or what we are feeling…" (LeDoux, 1994, p. 56).

In sum, the conceptual and empirical dissociability of multiple components of emotion lends credence to the possibility that some subset of these components may be triggered without co-activating the "subjective feeling" component. Most pertinent to the present discussion, it bolsters the likelihood that stimuli that do not involve emotional feelings, but that are merely associated with benign versus threatening situations, tune attention in a manner analogous to conscious states of positive or negative emotional arousal. Such stimuli will henceforth be referred to as *implicit affective cues*. Here, the use of the term "affective" does not imply that such cues must be intrinsically perceived as positively or negatively valenced, but only that they routinely signal safety or danger and thereby stand to cue processes associated with appraisals of goodness or badness, presumably including attentional tuning. Moreover, given their putative function as conditioned stimuli, it is assumed that such cues may prompt attentional tuning in the absence of any conscious indication that the current situation is indeed relevant to the individual's goals. Rather, due to their habitual association with perceptions of actual safety or threat, these cues should gain the power to independently initiate the changes in attentional structure posited to accompany these perceptions. That is, they may broaden or narrow the scope of attention in the absence of any conscious construal that the situation is truly benign or threatening, and thereby, absent any conscious feelings of positive or negative emotional arousal. As such, they may be described as "implicit."

In the sections that follow, we highlight some of the research that we and others have conducted over the last decade to address whether implicit affective cues, so defined, moderate the scope of perceptual and conceptual attentional selection independent of subjective emotional experience. Discussion is focused on the three most extensively investigated varieties of safety and threat-related cues: approach and avoidance motor actions, "virtual" enactment of approach and avoidance behaviors, and incidental exposure to colors habitually associated with benign versus threatening situations. Table 1 summarizes the experimental procedures used in the studies reviewed.

Approach and avoidance motor actions

According to Cacioppo and his colleagues (Cacioppo, Priester, & Berntson, 1993; Priester, Cacioppo, & Petty, 1996), arm flexor contraction (i.e., pulling the arm toward the body) is habitually associated with acquiring or consuming desired objects and is temporally coupled with the offset of pain (e.g., as when removing one's hand from a hot stove), whereas arm extensor contraction (i.e., pushing the arm away from the body) is more frequently associated with attempts to reject or restrain noxious objects and is temporally coupled with pain onset (e.g., as when touching a hot stove). The results of several studies are consistent with this proposition. For instance, Förster (2004) found that participants evaluated appetizing foods (e.g., chocolate) more favorably when they flexed their arms while making the evaluation and evaluated unpalatable foods (e.g., kidney meat) more unfavorably when they extended their arms during evaluation (see also, Centerbar & Clore, 2006; Chen & Bargh, 1999; Neumann & Strack, 2000; Solarz, 1960; cf. Markman & Brendl, 2005; Rotteveel & Phaf, 2004). Arm flexion also increased, whereas arm extension decreased, actual consumption behavior (Förster, 2003). In light of such findings, Friedman and Förster (2000) hypothesized that mere enactment of arm flexion versus arm extension might, by dint of the learned associations between these motor actions and relatively benign versus threatening situations, suffice to moderate the scope of attention in a manner analogous to that posited to accompany conscious states of positive versus negative emotional arousal.

To test this hypothesis, Friedman and Förster (2000) had participants engage in isometric arm flexion versus extension by having them press their dominant hands slightly upward versus downward against a countertop, respectively. To ensure that any effects of these motor actions did not result from inferring their meaning (i.e., as involving approach/avoidance; see Olson & Hafer, 1990), participants were given a cover story suggesting that the actions were meant to activate the brain hemispheres contralateral to their arm contractions. In an initial experiment, while engaging in either arm flexion or extension, participants were administered part of the Snowy Pictures Test (SPT; Ekstrom, French, Harman, & Dermen, 1976). This task involves identifying images of familiar objects (e.g., a sailboat, a typewriter) obscured within patterns of visual noise or "snow". Items on the SPT provide the visual system with fragmented proximal stimuli that it must integrate to form an identifiable percept. A broader scope of visuospatial attention should enable a greater number of the available visual cues to be processed in identifying each SPT image, thereby enhancing task performance (cf. Miyake, Witzki, & Emerson, 2001). Consistent with predictions, it was found that individuals who engaged in arm flexion, relative to arm extension, correctly named significantly more of the target objects. These findings were conceptually replicated in two experiments using the Gestalt Completion Task (GCT; Ekstrom, et al., 1976), another measure in which individuals are required to perceptually "close" and identify a series of fragmented visual images. Notably, these studies incorporated self-report measures of subjective emotional feelings, including general mood ("How do you feel right now?") as well as several distinct emotion states (e.g., "calm", "content", "disappointed", "discouraged", "happy", "relaxed", "tense", and "worried"). There was no indication that arm flexion or extension reliably influenced these emotional states (see also, Neumann & Strack, 2000). Moreover, the effects remained reliable statistically controlling for self-reported task enjoyment as well as the subjective effortfulness of the motor actions. Together, these and kindred results (see Friedman & Förster, 2000) offered the first empirical support for the notion that implicit "benign situation", relative to "threatening situation", cues expand the breadth of perceptual attentional selection.

Enactment of approach and avoidance motor actions has also been found to analogously moderate the scope of conceptual or representational attention. For instance, Förster, Friedman, Özelsel, and Denzler (2006) tested the effects of arm flexion versus extension on conceptual attention via a part-list cuing procedure (Nickerson, 1984; Roediger & Neely, 1982). In these tasks, participants are asked to memorize a series of categorized word lists in which each word belongs to one of limited number of semantic categories (e.g., colors, sports). Following the encoding phase, a sample of words from each category are re-presented and participants are instructed to use these words as retrieval cues for the remainder of the words on the list. Previous research has found that the greater the number of cues from a given category that are presented as retrieval cues, the greater the deficit in recalling the remaining the words in that category (e.g., Rundus, 1973; Watkins, 1975). Anderson and Neely (1996) have provided an attention-based account for such part-list cuing inhibition, suggesting that when a list item is presented as a retrieval cue, this initially prompts retrieval of the mental representation of this cue in LTM. The process of retrieving the cue entails selectively attending to this representation on the conceptual level, which in turn serves to inhibit activation of remaining non-cue items from the same category. It may be inferred from this reasoning that implicit safety, relative to danger, signals should diminish part-list cuing inhibition by mitigating this tendency for cue retrieval to narrow the scope of conceptual attention. In support of this hypothesis, Förster et al. (2006) found that although part-list cuing effects were robust for individuals who performed arm extension during retrieval, they were virtually nonexistent for those who engaged in arm flexion (see Friedman and Förster, 2002, for related findings).

In addition to mitigating retrieval blocking, an expanded scope of conceptual attention should also enhance creativity by enabling activation in LTM of the comparatively inaccessible knowledge that facilitates the generation of innovative solutions (Mednick, 1962; see also,

Carson, Peterson, & Higgins, 2003; Martindale, 1995; Schooler & Melcher, 1995). For instance, consider this well-known creative insight problem:

> A dealer in antique coins got an offer to buy a beautiful bronze coin. The coin had an emperor's head on one side and the date 544 B.C. stamped on the other. The dealer examined the coin, but instead of buying it, he called the police. Why? *Solution*: The year 544 B.C. predates the birth of Christ; therefore, a coin from that year would not be inscribed with an abbreviation for "Before Christ."

Here, although the meaning of the abbreviation B.C. is common knowledge, it is typically low in accessibility in this context compared to the more pragmatic fact that B.C. refers to years prior to 1 A.D. Presumably, a broader scope of conceptual attention would facilitate activation of the literal meaning of B.C., rendering the solution apparent.

Assuming that insight problem solving profits from expanded conceptual scope, it follows that implicit affective safety, relative to danger, cues should prove beneficial on tests of creative insight. To assess this prediction, Friedman and Förster (2002) asked participants to engage in either arm flexor or extensor contraction while completing the "coin" problem above along with a number of other well-validated insight problems (see Metcalfe & Wiebe, 1987; Schooler, Ohlsson, & Brooks, 1993). As predicted, individuals who engaged in approach motor actions significantly outperformed those who engaged in avoidance motor actions. Friedman and Förster (2002) conceptually replicated these effects of interoceptive safety and danger signals on creative thought using a modified version of the alternative uses test (Torrance, 1966). Specifically, while engaging in either arm flexion or extension, participants were given one minute to generate as many creative uses for a brick as they could think of, refraining from typical uses or uses that were virtually impossible. The creativity of their responses was rated by a set of independent judges. Results revealed that participants who performed arm flexion, compared to those who performed arm extension, produced relatively creative uses, statistically controlling for the raw number of responses generated (i.e., fluency). In tandem with Friedman and Förster's (2002) initial findings regarding creative insight, these results suggest that implicit safety, relative to danger, cues broaden the scope of conceptual attention so as to enable greater access to the remote associates required to produce novel solutions.

In view of this litany of beneficial effects of approach versus avoidance motor actions, the question naturally arises as to whether arm flexor contraction indeed broadens attentional scope as opposed to merely bolstering motivation. To rule this out, Friedman and Förster (2000) conducted a study in which individuals performing either arm flexion or extension were asked to complete a set of analytical reasoning problems including the following (Green, Brownstein, Wolf, & Weiner Green, 2000).

> George adores classical music. He always prefers Beethoven to Bartok and Mahler to Mozart. He always prefers Haydn to Hindemith and Hindemith to Mozart. He always prefers Mahler to any composer whose name begins with B, except Beethoven, and he always chooses to listen to a composer he prefers. George's brother gives him one album by each of the composers mentioned. Which of the following correctly states the order in which George may play some of the records?
>
> (A) Beethoven, Bartok, Mozart
>
> (B) Haydn, Hindemith, Mozart
>
> (C) Beethoven, Mahler, Bartok
>
> (D) Hindemith, Mahler, Mozart
>
> (E) Haydn, Hindemith, Mahler

[*Solution*: B]

Unlike cued retrieval or creativity, analytical problem solving entails honing conceptual attention upon the available information and employing deductive reasoning to draw conclusions from this information (Amabile, 1996). A broadening of attention that brings to mind material that is not directly associated with the premises given and their logical implications only stands to foster distraction and thereby impair performance. Critically, Friedman and Förster (2000) found that approach, relative to avoidance, motor actions undermined, rather than improved, analytical problem solving. This suggests that interoceptive safety (i.e., "no problem"), relative to danger (i.e., "problem"), cues do not merely enhance motivation, but expand the scope of conceptual attention, thereby facilitating performance on tasks that profit from "going beyond the information given" (Bruner, 1973), and diminishing performance on tasks that require focal attention to central details (see also, Riis & Schwarz, 2003; cf. Bless, Clore, Schwarz, Golisano, Rabe, & Wölk, 1996).[3]

Virtual enactment of approach and avoidance behaviors

As in the case of interoceptive stimuli such as arm flexion and extension, a wide range of exteroceptive cues are also habitually associated with the anticipation or experience of benign versus threatening circumstances. Therefore, consistent with the foregoing reasoning, such cues should also suffice to moderate the scope of attentional selection, independent of conscious emotional arousal. To test this, Friedman and Förster (2001) had participants complete simple maze tasks in which a mouse had to be led through a maze either to find a piece of cheese or to escape a hovering owl (see Figure 1). It was assumed that this "virtual" enactment of approach and avoidance (i.e., "promotion" and "prevention"; Higgins, 2000) behaviors would not elicit changes in subjective emotions or mood, inasmuch as it only involved "acting" on behalf of a minimally-drawn cartoon figure. However, it was hypothesized that maze completion would suffice to activate semantic and procedural representations associated with self-regulation within relatively benign versus dangerous situations and thereby moderate the scope of attention in a fashion analogous to approach and avoidance motor actions or high-arousal positive and negative emotional experiences.

A number of studies have supported this notion. For instance, in one recent experiment, Förster et al. (2006) administered variants of these approach and avoidance mazes to participants and then had them complete a perceptual task adapted from Navon (1977). Specifically, individuals were sequentially presented with each of a set of large letters made up of smaller letters, for instance, a large L composed of little Ts (cf. Derryberry & Reed, 1998; Pomerantz, 1983). All of the stimuli contained either the letters H or L, with each letter appearing at the global level on half of the trials and appearing at the local level on the remaining half. Participants were asked to indicate whether each composite stimulus contained an H or an L by pressing the appropriate response key as quickly as possible. On this task, broader perceptual scope is indicated by relatively faster responses to letters appearing as global targets, whereas narrower perceptual scope is reflected in relatively faster responses to the same letters appearing as local targets. In line with predictions, approach maze completion was indeed associated with attentional broadening on this task, whereas avoidance maze completion engendered relatively narrow attention, a tendency to focus on the "trees" rather than the "forest" (see also, Förster & Higgins, 2005). Critically, this manipulation showed no reliable influence on self-reported emotional feelings or mood, supporting the contention that they operate merely as implicit affective cues. Moreover, as there was no main effect of the manipulation on response time

[3]In several experiments using approach and avoidance motor actions (see e.g., Friedman & Förster, 2000), motivation to work on the task at hand was also assessed via self-report. Along with their aforementioned failure to reveal effects of these motor actions on mood or specific emotional experiences, these studies also showed no reliable effects of approach and avoidance motor actions on general task motivation.

(i.e., both mazes speeded responses, albeit to different targets), it is unlikely that these effects resulted from between-groups differences in task motivation. Compatible results regarding the effects of these "virtual" approach and avoidance manipulations on perceptual scope have also been found using the SPT, which as discussed earlier, may be construed as requiring an expansion of visuospatial attention to encompass the fragmentary cues needed to identify each degraded image (Friedman & Förster, 2001).

In addition to these findings relating to perceptual attention, the results of several other studies using variants of the maze task have supported the notion that exteroceptive cues associated with benign situations expand, and that cues associated with threatening situations constrict, the scope of conceptual selection. For instance, Friedman and Förster (2001) administered cheese or owl mazes to participants followed by a word-fragment completion task in which each fragment (e.g., FL_CH) was printed twice in a given row. Fragments could be completed using at least two different German words (e.g., *Fluch* [a curse] and *flach* [shallow]). It was assumed that in finding multiple solutions for a given fragment, the first solution that comes to mind is highest in accessibility. Generating subsequent solutions therefore requires expanding the scope of representational attention to activate less accessible solutions, a process that may be additionally impeded by the narrowing of conceptual attention upon stored representations of the initial solutions; Anderson & Neely, 1996; Smith, 1995). For instance, an initial solution of "curse" may activate words such as "spell" or "witch", thereby directing attention away from semantically-unrelated constructs, including the solution, "shallow". This blocking effect should be enhanced by narrowed conceptual scope and alleviated by broader conceptual scope. Based on this logic, it was predicted that completion of the approach, relative to the avoidance, maze should increase the number of second solutions offered for each fragment. These predictions were supported; moreover, they have been conceptually replicated using a kindred, albeit distinct, retrieval blocking paradigm (Förster et al., 2006, Experiment 3).

More recent evidence for the hypothesized influence of exteroceptive cues on conceptual breadth has been found using a Stroop task (Stroop, 1935). In this well-known task, individuals are presented with color words and asked to name as quickly as possible the color of the ink in which the words are printed. The ink may be either congruently or incongruently colored. For instance, the word "red" may be printed in red ink (congruent) or in green ink (incongruent). When the word is incongruently colored, there is a prepotent tendency to erroneously name the color word itself rather than the color of the ink, for example, to respond with "red" rather than "green" when the word "red" appears in green ink. Incongruent Stroop trials can be seen as requiring selection between multiple action tendencies of the one that is lower in *a priori* accessibility. As such, the broadening of conceptual attention hypothesized to accompany approach, relative to avoidance, cuing should prove beneficial on such trials by spreading activation to the less accessible response and thereby decreasing the time needed to enact this response (i.e., to name the incongruent color). In line with this reasoning, individuals who completed the cheese maze subsequently displayed better performance on incompatible Stroop trials than those who completed the owl maze (Friedman & Förster, 2005). Response time on compatible trials was uninfluenced by implicit affective cues, suggesting that the aforementioned effects were not simply due to differences in task motivation.

Notably, as with manipulations of approach and avoidance motor actions, completion of the cheese and owl mazes has also been found to influence creativity, with approach, relative to avoidance, maze completion promoting the ability to generate innovative uses for a common object, controlling for sheer response fluency (Friedman & Förster, 2001). Moreover, avoidance, relative to approach, maze completion has correspondingly been found to bolster analytical problem solving (Förster & Friedman, 2009). In sum, there is converging evidence for the notion that semantic and procedural representations of benign versus threatening

situations may be contextually primed by implicit affective cues and subsequently moderate the scope of attention in a manner akin to that of more explicit safety or danger signals.

Colors

A flurry of recent studies has suggested that distinct colors may implicitly signal the presence or absence of danger and thereby constrict or expand the scope of attention much as do other implicit safety or danger cues. Much of this work has been undertaken or inspired by Elliot and Maier (2007), who proposed that the color red signals danger in achievement contexts. According to Elliot and Maier, red is commonly used by academic instructors to mark students' errors. Moreover, it is generally employed in signs warning of impending or prospective danger (e.g., stop signs, hazard warnings, and flares). As noted by ethologists, the faces and bodies of primates also redden when they are angry or likely to attack. Therefore, although red may have an entirely different meaning in certain contexts (e.g., sexual availability in a red-light district; Elliot & Niesta, 2008), Elliot and Maier (2007) argue that at least when achievement is at stake, exposure to red implicitly evokes a motivation to avoid threats, thereby narrowing the scope of attention, and undermining task performance.

In an initial test of this hypothesis, Elliot, Maier, Moller, Friedman, and Meinhardt (2007, Experiment 1) manipulated color exposure by placing either a red, green, or black "participant number" on each page of a workbook and then drawing participants' attention to these numbers. Green was selected as a primary color control and black was selected as an achromatic control. Participants were then given five minutes to solve a series of moderately challenging, single-solution anagrams, strings of jumbled letters (e.g., "NIDRK") that must be rearranged to form lexically correct words. Presumably, a broadening of conceptual attention should facilitate anagram performance by increasing the accessibility of letter combinations that may be used to form words and by increasing orthographic priming of solution words (e.g., DRINK) by fragments of the initial string (e.g., "DRK") or by fragments generated during the mental manipulation of the letters (e.g., "DRI"). In line with these assumptions, Elliot et al. (2007) found that participants whose attention was directed to red, as compared to green or black numbers, solved significantly fewer anagrams, suggesting that by dint of its association with danger, the color red constricted attentional scope and thereby impaired performance. Critically, there was no evidence that color influenced mood, supporting the notion that red color acts as an implicit affective cue.

Elliot, Maier, and their colleagues (2007) subsequently replicated this basic finding using other achievement tasks that stand to benefit from broadened, and suffer from narrowed, conceptual attention. For instance, they found that presentation of a red, as opposed to green or white, background on a test cover sheet, was associated with impaired performance on verbal analogy problems (i.e., Word A: Word B = Word C: Word ?). As discussed by Friedman and Förster (2000; 2002), problems of this sort require an expansion of representational attention to encompass potentially correspondent attributes and relations associated with the two conceptual domains under comparison (i.e., domain A-B and domain C; cf. Gentner, 1983). Elliot et al. (2007) also empirically assessed their hypothesis using a number sequence task. In these tasks, participants are presented with a series of number strings (i.e., *a, b, c,…x, ?*) and they must find the general rule governing the relationship between the numbers in each string so as to infer the next number that should appear in the sequence (Korossy, 1998). An expanded scope of attention may aid performance on such tasks by allowing individuals to hold larger sub-sequences of the given number string in mind while simultaneously generating or testing potential rules. Once again, the color red was found to undermine performance on this task, consistent with the notion that it reduces attentional breadth.

Additional evidence for the attentional tuning effects of red was recently put forth by Maier, Elliot, and Lichtenfeld (2008). After exposing participants to swaths of red versus gray on their

test covers, Maier et al. administered a measure of the breadth of perceptual attention developed by Kimchi and Palmer (1982) and recently employed by Fredrickson and Branigan (2005) and Gasper (2004; Gasper & Clore, 2002) to explore the effects of mood on attentional structure. As alluded to earlier, in this measure, participants are presented with composite target figures, for instance, a group of small triangles arranged in the form of a square, and asked to choose whether the target is more similar to another composite figure that matches the target on the global level (e.g., a square composed of small squares) or on the local level (e.g., a triangle composed of small triangles). Supporting the notion that the color red narrows the scope of perceptual attention, Maier et al. (2008) found that individuals exposed to red, compared to gray, were significantly more likely to categorize target figures on the basis of their local, rather than global, form. Moreover, inasmuch as this categorization task only requires participants to indicate their preferences—there are no (in)correct responses—Maier et al.'s (2008) results argue against the possibility that red simply undermines task motivation.

In a follow-up study, Maier and his colleagues (2008) readministered this measure of perceptual scope and subsequently had participants complete a number sequence task (see above). Their results replicated earlier findings of both constricted perceptual attention as well as impaired sequence task performance, following exposure to red, and additionally revealed that the former effect statistically mediated the latter. This further bolsters the proposition that the deleterious effects of red on intellectual performance documented by Elliot and Maier result from an underlying moderation of the scope of attentional selection, as opposed to decreased motivation or self-efficacy.

Although Elliot and Maier's research has primarily focused on the effects of red as a danger cue, their conceptual framework clearly suggests that when colors implicitly signal safety (i.e., "no problem"), they should expand, rather than constrict, the scope of attention, thereby influencing achievement task performance in a manner opposite that of red. This suggestion was recently tested by Mehta and Zhu (2009), who observed that the color blue is typically associated with peace and tranquility (as in the common expression, "nothing but blue skies ahead"), and should therefore serve as a "benign situation" cue. In an extensive series of studies, they have shown that exposure to blue enhances creativity, which as discussed earlier, may be seen as profiting from an expanded breadth of conceptual attention. For instance, Mehta and Zhu (2009) found that participants who were incidentally exposed to a blue, relative to a red or white, computer background generated more creative uses for a brick, controlling for sheer fluency (cf. Friedman and Förster, 2000; 2002). Likewise, they found that when given drawings of several different toy parts and asked to design a new children's toy using the parts depicted, participants generated what were judged to be more original and novel designs when the parts were colored blue as opposed to red. These findings suggest that exposure to blue broadened the scope of conceptual selection, facilitating access to the relatively inaccessible cognitive material required to produce creative alternatives.

Mehta and Zhu (2009) also tested the notion that safety-related colors expand the breadth of conceptual selection using a Remote Associates Test (RAT; Mednick, 1962). On each trial of this classic insight task, participants are presented with a set of words and asked to identify the single word with which these initial words are associated (e.g., SHELF READ END; *Answer*: BOOK). A broader scope of conceptual attention has been posited to bolster RAT performance by enhancing the likelihood that the cognitively inaccessible solution words will be retrieved from LTM (Bowden & Jung-Beeman, 2003; Martindale, 1995; Schooler & Melcher, 1995; see also, Seibt & Förster, 2004). Consistent with predictions, Mehta and Zhu (2009) found that participants exposed to the color blue, relative to red or white, correctly solved more RAT items.

Notably, in several of their studies, Mehta and Zhu (2009) also conceptually replicated the findings of Elliot, Maier, and their colleagues regarding the attention-moderating effects of the color red. For instance, in a separate between-participants condition of the abovementioned RAT study, Mehta and Zhu administered a proofreading task in which participants had to judge whether pairs of identical or slightly different names or addresses were the same or not. They found that participants exposed to red outperformed those exposed to blue or white, suggesting that the color red honed the "spotlight" of attention upon low-level perceptual details and thereby enhanced the ability to detect small discrepancies between otherwise identical visual stimuli.

In addition to these findings demonstrating that blue and red differentially tune the scope of attention, the proposition that these colors convey different signals regarding the nature of the current situation has also received empirical support. For instance, Elliot, Maier, Binser, Friedman, and Pekrun (2009) found that participants, to whom body motion sensors were attached, tended to lean away from a test cover to a greater degree when it was colored red as compared to green or gray. This tendency toward physical avoidance is consistent with the hypothesis that red implicitly signals danger. Likewise, Mehta and Zhu (2009) observed that participants exposed to red expressed greater concern with avoiding mistakes than those in an achromatic control group, implying that red may, on some level, elicit a construal of the experimental task as relatively threatening (cf. Elliot et al., 2007). In contrast, participants exposed to blue expressed less concern with avoiding mistakes, suggesting that blue at least implicitly promotes a construal of the task as relatively benign. Moreover, these self-reported concerns (i.e., avoidance motives) statistically mediated the beneficial effects of red on proofreading and those of blue on RAT performance. Together, these results support the contention that red elicits attentional narrowing by signaling danger (i.e., "problem") whereas blue elicits attentional broadening by signaling safety (i.e., "no problem"). Furthermore, in line with the overarching proposition that colors serve as implicit "tuning" cues, none of the aforementioned studies revealed any evidence that color exposure influenced self-reported emotional experience.

Complications and Unresolved Questions

In sum, nearly a decade of experimental research using at least three distinct types of implicit affective cues (arm motor actions, virtual enactment of approach and avoidance behaviors, and incidental color exposure) has produced results consistent with the notion that safety cues expand, whereas danger cues constrict, the scope of attentional selection. Despite these advances, a number of important questions regarding the impact of implicit affective cues on attention structure remain to be addressed. Just as earlier studies were collectively inspired by a set of converging empirical and theoretical contributions (e.g., Derryberry & Tucker, 1994; Fredrickson, 1998; Schwarz, 1990), recent developments in both social psychology and cognitive neuroscience are now opening up a range of intriguing avenues for future research on implicit affective cues and attentional tuning.

The role of motivational state

As reviewed above, a substantial corpus of research suggests that high-arousal positive emotional states (e.g., happiness) broaden the scope of attention. However, Gable and Harmon-Jones (2008; Harmon-Jones & Gable, 2009), have recently argued that the positive emotions investigated in these prior studies may be viewed as consummatory states, states elicited following goal attainment. They suggest that when positive states of emotional arousal are appetitive rather than consummatory, that is, when they reflect hedonically pleasant feelings of desire to attain a particular goal (e.g., food or sexual reward), they may in fact constrict, rather than expand attentional scope, as this would prevent distraction during goal pursuit (cf. Tucker & Williamson, 1984).

To test this hypothesis, Gable and Harmon-Jones (2008, Study 1) induced either consummatory or appetitive positive emotional states in a between-participants experimental design. Specifically, participants in the consummatory (i.e., low approach motivation) group were shown an amusing film about cats, whereas those in the appetitive (i.e., high approach motivation) group were shown a film depicting mouth-watering desserts. Afterward, all participants were administered Kimchi and Palmer's (1982) measure of perceptual breadth, which as described earlier, assesses whether individuals tend to match composite figures based on global versus local structural similarities. Intriguingly, despite the fact that both films were found to evoke equal amounts of overall positive emotional arousal, appetitive positive emotion indeed engendered a narrower focus of perceptual attention than consummatory positive emotion. In subsequent studies, Gable and Harmon-Jones (2008, Studies 2–4; Harmon-Jones & Gable, 2009) confirmed that appetitive positive emotion constricts the scope of perceptual attention relative to a neutral control group and additionally found that the effect was most pronounced among individuals high in trait approach motivation, those who should experience the strongest desire to obtain appetitive stimuli (Gable & Harmon-Jones, 2008, Study 3).

Although it is only in its early stages, Gable and Harmon-Jones' work stands to force a reexamination of the vast literature concerning influence of arousing positive emotional states on attention structure. Assuming appetitive positive states indeed constrict the scope of perceptual attention, they should undermine, rather than bolster, performance on closure tasks such as the SPT and GCT, slow responses to global structural details, yet increase resistance to distraction from irrelevant flanker stimuli. Moreover, it remains an empirical question as to whether the effects of appetitive positive states on conceptual attention mirror their effects on perceptual attention. For instance, Gable and Harmon-Jones' findings may imply that whereas consummatory positive emotion expands access to cognitive material with low *a priori* accessibility and bolsters creativity, appetitive positive affect may "choke off" access to remote associates and impair the ability to generate innovative alternatives or insightful solutions.

Most pertinent to the topic at hand, assuming these implications are borne out empirically, it suggests that approach-related implicit affective cues may exercise a very different influence on the breadth of attention depending upon whether they are more closely linked to goal attainment (i.e., consumption) or goal seeking (i.e., appetition). Upon examination, it is possible that the implicit "benign situation" cues discussed earlier may all be relatively associated with goal attainment: *In vivo* enactment of arm flexion is used to draw rewards (e.g., food) toward the body after they have been obtained. The approach maze task employed in prior research is readily solvable, suggesting that the manipulation entails anticipation of "virtual" reward acquisition. Finally, the color blue represents tranquility, suggesting that goals have been met and problems solved. Therefore, in light of Gable and Harmon-Jones' analysis, it will be important to examine whether implicit affective cues predominantly associated with the desire to attain rewards, rather than with anticipated or actual reward attainment, engender a narrower, as opposed to broader, scope of attentional selection.

It is possible that existing implicit affective cue manipulations may be modified for the purpose of empirically addressing this question. For instance, a less readily solvable "cheese" maze might disproportionately activate the concept of wanting, rather than obtaining reward. Likewise, since the color red signals desire, not danger, in sexual contexts (Elliot & Niesta, 2008), exposure to "sexual red" (e.g., via presentation of photos of red lipstick or women's garments to heterosexual males) may serve as an appetitive as opposed to consummatory cue. As with studies examining the effects of safety or danger cues, research exploring the attentional tuning effects of such "desire" cues must also attempt to determine whether they influence the scope of attentional selection independent of subjective emotional experience (e.g., feelings of eagerness or enthusiasm). Moreover, such research must rule out the possibility that these cues are not only associated with desire, but with craving or frustration,

as this might suggest that they merely function as "problem" signals (Harmon-Jones & Gable, 2009).

The role of relative hemispheric activation

According to Tucker and his colleagues (Derryberry and Tucker, 1994; Luu, Tucker, & Derryberry, 1998; Tucker & Williamson, 1984), states of emotional arousal essentially moderate the scope of attention by shifting the balance of cognitive processing between the left and right hemispheres. More specifically, elated states entail activation of a *phasic arousal* system that originates in the brain stem (specifically, the locus coeruleus) and projects via noradrenergic pathways to the limbic system and cortex. This system ultimately engages right hemispheric attentional control systems, which are posited to enact a *habituation bias*, broadening attentional scope on both the perceptual and conceptual levels. In contrast, tense arousal states entail engagement of a *tonic activation* system that is grounded in mesencephalic nuclei (nigral and ventral tegmental) and projects to the limbic system and cortex via dopaminergic pathways. This system ultimately activates left hemispheric systems that enact a *redundancy bias*, narrowing the scope of attentional selection.

Tucker's theory accords well with research suggesting that the right hemisphere (RH) is specialized for processing global, and the left hemisphere (LH)for processing local, perceptual structure (e.g., Fink, Halligan, Marshall, Frith, Frackowiak, & Dolan, 1996; Van Kleeck, 1989; Volberg & Hübner, 2004). Among the most compelling evidence for this hemispheric asymmetry comes from the results of neuropsychological studies of individuals who have suffered from unilateral brain injuries. For instance, Lamb, Robertson, and Knight (1989) presented LH injured, RH injured, and neurologically intact participants with composite letters and asked them to identify either the large letter or the small letter as quickly as possible. Results showed that relative to those in the control group, LH injured participants were faster and RH injured participants slower to respond to global than local targets. In line with these findings, visual hemifield studies using neurologically intact participants have typically revealed that global letters are identified more quickly when projected to the left visual field (LVF)/RH and local letters identified more quickly when projected to the right visual field (RVF)/LH (see Hellige, 2001, for a review).

Tucker and his colleagues' hypotheses also appear consistent with findings revealing hemispheric asymmetries in conceptual attentional processing. Specifically, a number of studies have found that access to remotely associated mental representations is enhanced by right, and potentially impeded by left, hemispheric processing. For instance, in a study by Bowden and Beeman (1998), participants were first asked to solve a series of RAT insight problems (see above) and after a brief period of time (typically not sufficient to solve a given problem), they were administered a speeded pronunciation time task in which either solution words or unrelated words were projected to either the LVF/RH or RVF/LH. For unsolved problems, naming latencies were selectively decreased when solution words were presented to the LVF, suggesting that the remotely associated cognitive material required for solution was rendered more accessible within the RH. These behavioral findings have been conceptually replicated and/or extended in several studies (e.g., Beeman & Bowden, 2000; Bowden & Jung-Beeman, 2003; Fiore & Schooler, 1998; Seger, Desmond, Glover, & Gabrieli, 2000). Moreover, the role of RH processing in attentional expansion and RAT problem solving has been confirmed by recent fMRI findings revealing increased activity in the right anterior superior temporal gyrus during problems on which the correct answer was suddenly realized following an impasse (Jung-Beeman et al., 2004; see also, Kounios et al., 2008). Presumably, these solutions appear suddenly, engendering so-called *Aha!* experiences, because they are preceded by unconscious prior activation of solution-related mental representations in the RH (Bowden, Jung-Beeman, Fleck, & Kounios, 2005).

Inspired by Tucker's neuropsychological theory as well as theory-consistent evidence regarding hemispheric asymmetries in attentional processing, Friedman and Förster (2005) recently tested whether implicit safety, relative to danger, cues suffice to shift the balance of hemispheric activation in the manner posited to accompany states of arousing positive, relative to negative, emotion. To this end, they had participants complete either approach or avoidance maze tasks, followed by a variant of the Milner line bisection task (Milner, Brechmann, & Pagliarini, 1992), a behavioral measure of relative hemispheric activation. Specifically, participants were presented with a set of horizontal lines and instructed to mark the center of each line. Typically, there is a tendency to commit leftward bisection errors on this task. According to Milner et al. (1992), this may be interpreted as reflecting an attentional bias toward the LVF (i.e., attentional neglect of the rightward extension of the line) and as signifying greater relative RH activation (see also, Bowers & Heilman, 1980; Bisiach, Geminiani, Berti, & Rusconi, 1990; Morton, 2003; Shrira & Martin, 2005). However, accounting for this main effect, which is presumably due to the perceptual demands of the task, there remains variance in the extent as well as the direction of bisection errors. This permits an assessment of differences in relative hemispheric activation, although it does not allow determination of whether any differences obtained were due to increased activation of one hemisphere, diminished activation of the other, or both.

In line with predictions, using this and other variants of the line bisection task, Friedman and Förster (2005) found that approach, in comparison to avoidance, maze completion engendered greater relative right (i.e., lesser relative left) hemispheric activation. Moreover, in one experiment, they found that relative hemispheric activation partially mediated the attention-expanding effects of approach maze completion, operationalized as enhanced creative generation. They also partially mediated the attention-constricting effects of avoidance maze completion, operationalized as enhanced analytical problem solving.

Recently, Förster and Friedman (2008) conceptually replicated these findings using enactment of approach and avoidance motor actions, as opposed to maze completion, as a manipulation of implicit affective cues. They also replicated them using a variant of the chimeric faces task (Levy, Heller, Banich, & Burton, 1983a, 1983b), another behavioral measure of relative hemispheric activation. Specifically, participants were presented with pictures of faces, some of which displayed either a smile or a frown, and others that were "chimeric", displaying a smile on one side and a frown on the other. Each face appeared on a computer screen for 200 ms and participants were asked to make speeded judgments as to whether each was happy or sad. Judgment of a chimeric face as displaying the emotional expression depicted on one side of the face was posited to indicate an attentional bias to that side, reflecting relative activation of the contralateral hemisphere. Participants exposed to "benign situation", relative to "threatening situation", cues made more leftward selections, irrespective of expression content (i.e., happy vs. sad), suggesting that the cues had elicited greater relative right hemispheric activation.

In light of the foregoing discussion, it would seem reasonable to assume that implicit affective cues influence hemispheric activation in the same manner as do conscious states of heightened emotional arousal. However, to date, the only study that has directly tested this assumption yielded inconsistent findings. Here, Friedman and Förster (2005, Experiment 3) assigned one group of participants to complete a standard version of their "cheese" and "owl" maze tasks, while others were asked to complete variants of the tasks designed to elicit high-arousal positive or negative emotional states (i.e., happiness or anxiety). Specifically, participants in the positive arousal group were asked to view the maze and vividly imagine the mouse gradually approaching and eating the cheese, whereas those in the negative arousal group were asked to imagine the mouse attempting to escape the owl, but eventually being caught and devoured. Results replicated other findings that approach, relative to avoidance, maze completion led to

greater relative right (diminished relative left) hemispheric activation; yet, they also revealed that positive, relative to negative, arousal regarding the same stimuli (i.e., imagining a mouse approaching cheese vs. avoiding an owl) promoted *diminished* relative right (enhanced relative left) hemispheric activation.

To account for this inconsistency, Friedman and Förster (2005) drew on the theorizing of Heller (e.g., Heller, Koven, & Miller, 2003; Heller & Nitschke, 1998), who has suggested that anxiety responses are comprised of a somatic component, reflecting the physiological arousal they entail, as well as a cognitive component, reflecting the apprehension of threats (i.e., worry; see also, Barlow, 1991). Heller and her colleagues have also posited that the cognitive component of anxiety is associated with activation of left frontal brain regions (as these areas support verbal rumination as well as attempts to anticipate and plan responses to prospective threats), whereas the somatic component is associated with activation of right posterior regions. In support of these hypotheses, Heller, Nitschke, Etienne, and Miller (1997) reported an EEG study showing that trait anxious participants exhibited increased relative left frontal activity at rest, presumably reflecting their chronic tendency to worry, whereas they exhibited increased right parietal activity when listening to narratives that produced feelings of strong negative emotional arousal. In a conceptual replication, Nitschke, Heller, Palmieri, & Miller (1999) used survey measures in tandem with measures of resting EEG activity to show that individuals uniquely high in anxious arousal exhibited greater right hemispheric activation than those uniquely high in anxious apprehension.

Inspired by these ideas, Friedman and Förster (2005) speculated that implicit affective cues, which are presumed to function independent of emotional arousal, may capture the anticipatory component of emotional experience, eliciting a cognitive (or regulatory; cf. Higgins, 2000) focus on the prospect of benign versus threatening outcomes. As such, they speculated that implicit safety and danger cues may differentially engage the left-lateralized worry centers highlighted by Heller. If so, this would help explain why implicit “threatening situation” cues, such as arm extension and avoidance maze completion, appear to engender greater relative LH (lesser relative RH) activation than do implicit “benign situation” cues such as arm flexion and approach maze completion. It would also help account for why implicit affective safety and danger cues seem to be associated with a different pattern of hemispheric asymmetry than conscious emotions (i.e., high-arousal positive and negative states) that explicitly convey the same message (cf. Derryberry & Reed, 1998).

However, this account leaves a quandary in its wake: If implicit and explicit safety and danger signals indeed produce divergent patterns of lateralized activity, why do they continue to show convergent effects on attentional tuning? Restated, how is it that functionally analogous emotional states (e.g., happiness) and affective cues (e.g., arm flexion) moderate the scope of attention in a similar fashion despite shifting the balance of hemispheric activation in different directions? One admittedly conjectural possibility may be derived from the classic work of Hellige and his colleagues (e.g., Hellige & Wong, 1983; Hellige & Cox, 1976). Essentially, Hellige suggests that when one brain hemisphere is moderately activated, specialized functions within that hemisphere are enhanced (a case of *hemisphere-specific priming*). However, when activation of a given hemisphere is particularly intense, specialized functions that are not integrally tied to that activation become impaired (*hemisphere-specific interference*). Hellige and Cox (1976) originally tested this idea by examining how concurrently holding smaller or larger sets of nouns in working memory would influence recognition of complex polygons that were briefly projected to either the LVF/RH or RVF/LH. As expected, there were no effects of load on LVF/RH trials as rehearsal of nouns largely relies on left hemispheric processing (Hellige, 2001). However, on the critical RVF/LH trials, smaller loads (2 or 4 nouns) facilitated recognition accuracy, whereas a large load (6 nouns) impaired recognition accuracy. Hellige (2001) has referred to this as a hemisphere-specific Yerkes-Dodson effect.

Extrapolating from these findings, it is possible that implicit safety and danger cues moderately activate the right and left hemispheres, respectively. This would enhance the extent of right versus left hemispheric attentional processing, leading to the observed broadening versus narrowing of attentional focus (a case of hemisphere-specific priming). However, conscious states of positive versus negative emotional arousal may strongly activate the left versus right hemispheres, taxing the intrahemispheric resources required to implement emotional responses such as attentional tuning. This hemisphere-specific interference would presumably result in greater relative engagement of *right* lateralized attentional systems in states of high-arousal positive emotion and greater relative engagement of *left* lateralized systems in states of high-arousal negative emotion. Consequently, "genotypically" distinct patterns of hemispheric activation would ultimately influence attention in the same manner.

Another potential explanation for Friedman and Förster's (2005) finding of a discrepancy between the patterns of hemispheric activation elicited by implicit affective cues and conscious emotional states may be drawn from psychophysiological studies of cortical asymmetry. Here, a considerable body of research has documented lawful shifts in the balance of interhemispheric activity in response to transient changes in emotional state (see Coan & Allen, 2003, Pizzigali, Shackman, & Davidson, 2003; for reviews). For instance, Davidson and Fox (1982) found that 10-month-old infants exhibited increased left frontal activation following exposure to happy versus sad facial expressions. Relatedly, in a study of responses to emotionally evocative films, Davidson, Ekman, et al. (1990) demonstrated that facial expressions of happiness were associated with greater left anterior temporal activation and expressions of disgust with greater right anterior temporal activation; see also, Canli et al., 1998; Coan, Allen, & Harmon-Jones, 2001; Sutton et al., 1997).

Although these and kindred findings have often been interpreted as suggesting that left hemispheric activation is associated with positive, and right hemispheric activation with negative emotional arousal (Davidson, 1995, 2004; Davidson & Tomarken, 1989), the available evidence is more consistent with the notion that the left versus right hemispheres differentially support approach versus avoidance motivation (Coan & Allen, 2003). Perhaps the most compelling evidence for this proposition has come from research on anger. Unlike other hedonically unpleasant emotions such as anxiety or disgust, anger is associated with approach rather than avoidance motivation, exemplified by the urge to confront rather withdraw from an aggressor (Harmon-Jones, 2004). Interestingly, in several studies, Harmon-Jones and his colleagues (see Harmon-Jones, Peterson, Gable, & Harmon-Jones, 2008, for a review), have found that anger is associated with greater left as opposed to right frontal activity. This suggests that lateralized cortical activity may be more indicative of motivational direction (approach versus avoidance) than emotional valence (positive versus negative). This proposition gains credence from recent data suggesting that appetitive positive emotions (i.e., desire; see previous subsection) are also associated with increased left frontal activity (Harmon-Jones & Gable, 2009).

Assuming that emotions high in approach motivational intensity are associated with left hemispheric activity, and those high in avoidance intensity with right hemispheric activity, it is possible that Friedman and Förster (2005) obtained different patterns of relative hemispheric activation among those who completed consciously arousing and standard versions of their maze task because maze version was confounded with motivational state. Specifically, whereas completion of the original "cheese" and "owl" mazes may have primed mental representations of *goal attainment* (see above), completion of the emotionally arousing mazes, in which participants were asked to vividly imagine the mouse gradually approaching the cheese or trying to escape the owl, may have primed motivational systems associated with *goal pursuit*. As alluded to above, appetitive and consumptive emotional states may be marked by opposing patterns of hemispheric asymmetry (Harmon-Jones & Gable, 2009; Gable &

Harmon-Jones, 2008). Therefore, if Friedman and Förster (2005) indeed unintentionally confounded signal type (explicit versus implicit) and motivational state (appetitive versus consummatory), this may account for the disordinal pattern of relative activation they obtained.

In sum, there is evidence that implicit affective cues elicit distinct patterns of lateralized activity that contribute to attentional tuning in a manner consistent with the theorizing of Tucker and his colleagues (e.g., Derryberry & Tucker, 1994). However, these findings must be seen as preliminary at best for at least two reasons: First, it remains entirely unclear as to why the activation patterns obtained for implicit safety and danger signals did not parallel those obtained with explicit signals (i.e., subjective feelings of elation or tension). Second, at least one recent experiment did not conceptually replicate Friedman and Förster's (2005 Friedman and Förster's (2008) initial findings. Here, Elliot et al. (2007) found that exposure to the color red, in contrast to arm extension or avoidance maze completion, was associated with increased relative right, rather than left, hemispheric activation (i.e., the same pattern typically associated with negative emotional arousal). Moreover, these findings were made using direct EEG recordings. Therefore, considerable uncertainty remains as to the effects of implicit safety and danger cues on relative hemispheric activation, highlighting the acute demand for additional research regarding the issue. Barring resolution of empirical discrepancies, one or more of the foregoing propositions regarding the connection between "benign" and "threatening" situation cues, lateralized activity, and attentional tuning will have to fall by the wayside.

Additional Directions for Future Research

Extension to other physical and social cues

As recently discussed by Schwarz and Clore (2007), individuals are able to use a virtually unbounded array of cues as information regarding whether the current situation is benign or threatening. Accordingly, researchers are beginning to uncover a range of other, often surprising, ways in which implicit safety and/or danger cues may moderate the scope of attentional selection. For instance, Friedman (2007) recently examined the attentional tuning effects of listening to descending versus ascending sequences of musical tones. According to Friedman (2007), due to the Doppler effect, the sounds of objects that recede in space appear to fall in pitch, whereas those that advance in space appear to rise in pitch. Therefore, descending tones may be associated with the threat of abandonment, "the experience of being left behind…" (p. 12), whereas ascending tones may, if anything, be associated with approaching incentives. Although not discussed by Friedman (2007), it has also been found that descending musical scales sound sadder and more pessimistic than ascending scales (e.g., Collier & Hubbard, 2001). Moreover, falling pitch can signal hostility or suspicion in a verbal utterance, whereas rising pitch can signal friendliness (Argyle, 1975). For all of these reasons, descending, relative to ascending, musical sequences may implicitly signal that the current situation is threatening versus benign and thereby engender a constriction of attentional scope. In support of this notion, Friedman (2007) discovered that listening to descending, relative to ascending, musical scales impaired performance on tasks posited to benefit from attentional broadening (Gestalt Completion Test and single-solution anagrams), yet bolstered performance on a task posited to benefit from attentional narrowing (proofreading). These effects were independent of conscious emotional experience, suggesting that the tone sequences indeed functioned as implicit affective cues.

Recent evidence suggests that much like rudimentary physical cues (e.g., colors, sounds), social relational cues may also prompt attentional tuning. For instance, in an elegant series of studies, Smith and Trope (2006), investigated the effects of power on perceptual and conceptual attention. According to Smith and Trope, powerful individuals control the superordinate goals that their groups pursue, whereas it is the role of their subordinates to flesh out the means required to accomplish these goals. Based on this assumption regarding the distinct purviews

of high versus low power individuals, it was predicted that activating mental representations of power would prompt individuals to focus on the "big picture", perceiving or categorizing stimuli more broadly, whereas activating representations of powerlessness would prompt more detail-oriented processing. As noted by Smith and Trope (2006), powerful people also view their environments as relatively benign, whereas the powerless view theirs as more threatening (Keltner, Gruenfeld, & Anderson, 2003). This implies that power/powerlessness cues may also moderate the scope of attention by serving as rudimentary safety/danger signals.

In line with these propositions, Smith and Trope (2006) found that exposure to power primes (e.g., words such as "authority" or "captain"), relative to powerlessness primes (e.g., words such as "obey" or "servant"), engendered a broader scope of attention, controlling for conscious affective arousal. This expanded attentional scope was demonstrated on both the perceptual level, for instance, via improved ability to identify fragmented images in a variant of the Gestalt Completion Test (cf. Friedman & Förster, 2000, 2001), as well on the conceptual level, for instance, via a tendency to rate weak exemplars as better fit to their overarching categories (cf. Friedman & Förster, 2000). Moreover, Smith and Trope (2006) also found that high versus low power priming led to greater relative right hemispheric activation, as measured with a variant of the Milner line bisection task. This suggests that power priming, like arm flexion and approach maze completion, engages the right lateralized systems involved in expanding the scope of attentional selection (Friedman & Förster, 2005; Förster & Friedman, 2008).

In sum, Smith and Trope's (2006) findings are consistent with the idea that power cues serve as implicit safety signals and powerlessness cues as implicit danger signals, thereby tuning attention much as do more rudimentary implicit affective cues. Their work is poised to inspire renewed investigation of the attentional tuning effects of other social relational stimuli that may carry value as implicit signals regarding the nature of the current environment. Such stimuli may include cues that activate mental representations of significant others who tend to show relatively unconditional acceptance, as opposed to conditional acceptance or outright rejection. As shown by Baldwin and his colleagues, remarkably subtle social cues associated with approval versus disapproval can significantly impact self-evaluation (see Baldwin & Baccus, 2002, for a review). For instance, Baldwin, Carrell, and Lopez (1990) found that graduate students subliminally exposed to the scowling face of their department chair subsequently evaluated their own research ideas more critically than those exposed to pictures of an approving face. However, just as such cues influence the content of cognition, they may influence its structure as well: Inasmuch as social acceptance cues signal a benign situation, they should broaden the scope of attention, whereas rejection cues, which signal threat, should correspondingly narrow attentional scope. Relatedly, it is possible that cues associated with positive and negative social stereotypes (e.g., photos of group members, symbols of group membership) may have analogous effects, with stimuli that prime mental representations of benign groups promoting a broader scope of attention than stimuli that prime representations of threatening groups (cf. Seibt & Förster, 2004).

Extension to social information processing

Just as the attentional tuning effects of a variety of such social cues remain to be explored, so do the effects of these and other implicit affective signals on social information processing. To illustrate, it is quite possible that implicit safety and threat cues may moderate the ability to decode and interpret verbal and non-verbal communications during social interaction. Regarding verbal decoding, it is common knowledge that the meaning of a given message (e.g., a vocal utterance) can not be reliably interpreted from its literal content (Krauss & Fussell, 1996). For instance, when a restaurant patron who ravenously devours her meal comments to the approaching waiter, "I didn't like it!", she may be employing sarcasm to convey a meaning quite contrary to the literal interpretation of her utterance, perhaps to make light of having

overeaten. As such, understanding verbal communications invariably requires taking contextual cues (e.g., the patron's empty pasta bowl) into account.

Therefore, it may be deduced that factors that broaden the focus of attention so as to permit processing of contextual cues may facilitate accurate decoding of the meaning of verbal communications, whereas factors that constrain attentional focus, "choking off" access to such information, may undermine verbal decoding. As such, implicit "benign situation", relative to "threatening situation" cues may be predicted to enhance comprehension of verbal messages, particularly under conditions demanding processing of relatively peripheral or "remote" perceptual or conceptual information. Such conditions are often put in place by communications entailing the use of humor or figurative language (e.g., Glucksberg, 2001). Correspondingly, under conditions that put a premium on quickly apprehending and responding to the literal meaning of an utterance (e.g., military combat), danger, relative to safety, cues may engender more efficient verbal decoding by "shutting out" access to irrelevant contextual information. In line with these speculations, Kuschel, Förster, and Denzler (2010) have recently found preliminary evidence that completion of cheese relative to control or owl maze tasks speeds comprehension of novel metaphors.

The attentional effects of implicit cues may also influence decoding of nonverbal communications. It is a truism that the most telling information we learn about others is often gleaned not from the content of what they say, but from their "body language", including their emotional expressions and vocal tone (see e.g., DePaulo, 1992). The difficulty of nonverbal decoding is routinely exacerbated by the necessity of simultaneously attending to the verbal channel of communication (i.e., speech content). As such, in conversational contexts, a broader scope of attention should facilitate access to and decoding of nonverbal cues, whereas a narrower scope of attention, typically involving a focus of attentional resources upon the verbal channel, should restrict access to nonverbal cues and thereby undermine their interpretation. It follows that attention-broadening safety cues, relative to attention-constricting danger cues should enhance the capacity to accurately decode the meaning of other peoples' nonverbal behavior during the course of conversation.

Although there is no direct evidence for this hypothesis, the results of an intriguing study by Lieberman and Rosenthal (2001) may be consistent with its underlying logic. Here, it was found that extraverts were superior to introverts in accurately construing the meaning of a partner's nonverbal cues when they had to simultaneously maintain a conversation with the partner, whereas no such difference emerged when such conversation maintenance was not required. Lieberman and Rosenthal (2001) concluded from these findings that extraverts' advantage in social interactions may be due to an enhanced ability to simultaneously process multiple sources of communicative input (i.e., verbal and nonverbal signals). From our perspective, such multitasking may entail an expanded scope of attention, a proclivity to focus the spotlight of attention broadly enough to capture information from peripheral as well as central cues.

According to Eysenck (1967; 1990), extraversion is associated with the tendency to experience positive emotional arousal (cf. Carver, Sutton, & Scheier, 2000). Therefore, given our construal of multitasking in terms of attentional scope, Lieberman and Rosenthal's (2001) findings may be interpreted as suggesting that emotional experiences signaling a benign, as opposed to threatening, situation broaden the scope of attention, enabling more effective processing of nonverbal cues during social interaction. Extrapolating from this line of reasoning, it is possible that implicit safety and danger cues (e.g., arm flexion and extension) analogously influence nonverbal decoding. If so, it would suggest that such cues may exert a fairly pervasive influence on the course of communication and social perception, an influence that remains almost entirely unexplored.

Beyond affective cues: Direct priming of attentional scope

Although we have focused on the attentional tuning effects of safety and danger cues, such cues are not the only stimuli that moderate the scope of attentional selection. For instance, we have recently begun to investigate how mere implementation of a broad versus narrow scope of attention on the perceptual level may "carry over" to influence the scope of attention on the conceptual or representational level. The notion that perceptual scope should affect conceptual scope in this manner follows from cognitive theorizing suggesting that the underlying mechanisms of perceptual and conceptual selection are either identical or highly correlated (e.g., Anderson & Spellman, 1995; Neill & Westberry, 1987; Posner, 1987; for a review, see Förster & Dannenberg, in press). This view accords well with the array of evidence, reviewed above, that "benign situation" and "threatening situation" cues yield analogous effects on both perceptual as well as conceptual attention. Most pertinently, in light of this proposition, it is possible that an initial broadening or narrowing of the scope of perceptual selection may prime the tendency to expand or constrict the scope of conceptual selection. Restated, focusing attention broadly versus narrowly on some initial perceptual stimulus may subsequently facilitate versus impede the ability to cognitively activate relatively inaccessible conceptual representations in LTM.

In an initial test of this hypothesis, Friedman, Fishbach, Förster, and Werth (2003), manipulated the tendency to focus perceptual attention broadly versus narrowly by presenting participants with a series of visual displays, each containing nine digits. In half of the displays, the digit "3" appeared, whereas the other half did not contain 3s. Each display appeared for 1 sec. Afterward, participants were to indicate as quickly as possible whether a 3 was present or not. In the broad attention condition, digits comprising the search set were randomly situated around the periphery of the display, necessitating that participants attend to a relatively expansive area of visual space in order to perform the task. In contrast, in the narrow attention conditions, digits were randomly situated within a small radius of the center of the display, necessitating attention to a relatively constrained area of visual space. Following the visual search task, participants were asked to complete two creative generation tasks, one in which they were to generate creative uses for a brick (Friedman & Förster, 2001, 2002) and another in which they were generate a creative title for a photograph. As discussed earlier, such tasks are posited to benefit from a broader scope of conceptual attention inasmuch as this would facilitate access to the remote associates (e.g., brick features irrelevant to building) required to produce innovative solutions. Consistent with predictions, participants who were led to focus perceptual attention broadly produced more original responses on these tasks than did those who focused attention narrowly. Moreover, these results were conceptually replicated in a follow-up study in which broad, relative to narrow, perceptual attention was also found to enable generation of more unusual exemplars of a series of semantic categories (e.g., "furniture", "vehicles"; cf. Isen et al., 1985).

Although the aforementioned studies focused on creative generation, a number of scholars have described the creative process as not only involving a generation phase in which original alternatives are produced, but also a subsequent evaluation phase in which these alternatives are assessed to establish which ones are meaningful or useful (Bink & Marsh, 2000; Finke Ward, & Smith, 1992). Unlike the generation phase, which benefits from conceptual breadth, the evaluation phase may instead profit from a narrow scope of conceptual attention, enabling individuals to hone in on, assess, and the compare the merits of the alternatives they have produced. As such, whereas broadened perceptual focus elicits an expansion of conceptual selection and thereby facilitates creative generation, narrowed perceptual focus may constrict the scope of conceptual selection and thereby facilitate evaluation of generated responses.

To test this hypothesis, Förster and Friedman (2009) showed participants a series of composite letters (large letters comprised of smaller letters; see above) and asked them to identify either

the large letter or the small letter, thereby eliciting either a tendency to focus on global perceptual structure or on local perceptual details (see also, Macrae & Lewis, 2002). Moreover, this "attentional priming" manipulation was administered either prior to generating creative uses for a brick or during a subsequent phase in which participants were asked to rank the solutions they had just generated according to their quality. Results replicated prior findings by Friedman et al. (2003) suggesting that global, relative to local, perceptual attention led participants to generate more original responses, controlling for the sheer quantity of responses tendered. However, when attentional priming preceded the evaluation phase, participants in whom global attention was primed were slower than those primed to attend to local features (see also, Förster, 2009). Notably, this effect remained reliable statistically controlling for the sheer number of solutions generated, suggesting that narrowed perceptual scope constricts the focus of conceptual attention, enabling individuals to more efficiently process the information given. Additional research will be needed to determine the robustness and external validity of this interactive effect of attentional priming on distinct phases of creativity. In line with the main theme of this review, it will also be interesting to examine whether implicit safety and threat cues correspondingly facilitate generation and evaluation of creative alternatives, respectively.

Conclusion

In sum, a considerable amount of evidence may be interpreted as suggesting that implicit "benign situation" cues broaden, and "threatening situation" cues narrow, the scope of attention on both the perceptual and conceptual levels. These findings accord well with views of the interplay between emotion and attention advanced by several prominent theorists (e.g., Derryberry & Tucker, 1994; Fredrickson, 1998; Schwarz, 1990). Moreover, they complement these earlier approaches by suggesting how implicit affective cues may instigate psychological responses analogous to those traditionally associated with conscious emotional arousal (cf. Schwarz & Clore, 2007). As discussed, a number of important questions remain unanswered, particularly those regarding the moderating role of motivational state (i.e., appetitive versus consummatory) as well as the physiological underpinnings of the effects. Additional research is also needed to explore the attentional effects of a more extensive range of implicit affective cues (e.g., benign versus threatening social stereotypes) as well to investigate new domains of social cognitive processing (e.g., nonverbal decoding) that may be subtly influenced by such cues as well as by procedural primes (e.g., global/local perceptual sets) that analogously moderate the scope of attentional selection. We hope that this review, which conceptually integrates both cutting-edge as well as foundational discoveries regarding the attentional effects of implicit affective cues, will stimulate the additional research needed to address unresolved questions, thereby helping advance knowledge of how subtle contextual cues shape the structure, as well as the content, of thought.

Acknowledgments

Preparation of this article was supported by National Institute on Alcohol Abuse and Alcoholism Grant R03AA017969 to Ronald S. Friedman.

We thank Tram Neill for his thoughtful advice and Laura Dannenberg for her invaluable assistance in preparing the manuscript.

References

Amabile, TM. Creativity in context. Boulder, CO: Westview; 1996.

Anderson MC, Bjork RA, Bjork EL. Remembering can cause forgetting: Retrieval dynamics in long-term memory. Journal of Experimental Psychology: Learning, Memory, and Cognition 1994;20:1063–1087.10.1037/0278-7393.20.5.1063

Anderson, MC.; Neely, JH. Interference and inhibition in memory retrieval. In: Bjork, EL.; Bjork, RA., editors. Memory. New York: Academic Press; 1996. p. 237-313.

Anderson MC, Spellman BA. On the status of inhibitory mechanisms in cognition: Memory retrieval as a model case. Psychological Review 1995;102:68–100.10.1037/0033-295X.102.1.68 [PubMed: 7878163]

Argyle, M. Bodily communication. New York: International Universities Press; 1975.

Ashby FG, Isen AM, Turken AU. A neuropsychological theory of positive affect and its influence on cognition. Psychological Review 1999;106(3):529–550.10.1037/0033-295X.106.3.529 [PubMed: 10467897]

Baas M, De Dreu CKW, Nijstad BA. A meta-analysis of 25 years of mood-creativity research: Hedonic tone, activation, or regulatory focus? Psychological Bulletin 2008;134:779–806.10.1017/S0033291700018523 [PubMed: 18954157]

Baldwin, MW.; Baccus, JR. An expectancy-value approach to self-esteem. In: Spencer, SJ.; Fein, S.; Zanna, MP.; Olson, JM., editors. Motivated social perception: The Ontario symposium. Vol. 9. Mahwah: NJ: Erlbaum; 2002. p. 171-194.

Baldwin MJ, Carrell SE, Lopez DF. Priming relationship schemas: My advisor and the Pope are watching me from the back of my mind. Journal of Experimental Social Psychology 1990;26:435–454.10.1016/0022-1031(90)90068-W

Barlow DH. Disorders of emotion. Psychological Inquiry 1991;2:58–71.10.1207/s15327965pli0201_15

Basso MR, Schefft BK, Ris MD, Dember WN. Mood and global-local visual processing. Journal of the International Neuropsychological Society 1996;2:249–255.10.1207/s15327965pli0201_15 [PubMed: 9375191]

Beeman, M. Coarse semantic coding and discourse comprehension. In: Beeman, M.; Chiarello, C., editors. Right hemisphere language comprehension: Perspectives from cognitive neuroscience. Mahwah: NJ: Erlbaum; 1998. p. 255-284.

Beeman MJ, Bowden E. The right hemisphere maintains solution-related activation for yet-to-be solved insight problems. Memory & Cognition 2000;28:1231–1241.

Bink ML, Marsh RL. Cognitive regularities in creative activity. Review of General Psychology 2000;4:59–78.10.1037/1089-2680.4.1.59

Bisiach E, Geminiani G, Berti A, Rusconi ML. Perceptual and premotor factors of unilateral neglect. Neurology 1990;40:1278–1281. [PubMed: 2381538]

Blascovich, J.; Tomaka, J. The biopsychosocial model of arousal regulation. In: Zanna, MP., editor. Advances in experimental social psychology. Vol. 28. New York: Academic Press; 1996. p. 1-51.

Bless H, Clore GL, Schwarz N, Golisano V, Rabe C, Wölk M. Mood and the use of scripts: Does being in a happy mood really lead to mindlessness? Journal of Personality and Social Psychology 1996;71:665–679.10.1037/0022-3514.71.4.665 [PubMed: 8888596]

Bowden EM, Beeman MJ. Getting the right idea: Semantic activation in the right hemisphere may help solve insight problems. Psychological Science 1998;6:435–440.10.1111/1467-9280.00082

Bowden EM, Jung-Beeman M. Aha! Insight experience correlates with solution activation in the right hemisphere. Psychonomic Bulletin & Review 2003;10:730–737. [PubMed: 14620371]

Bowden EM, Jung-Beeman M, Fleck J, Kounios J. New approaches to demystifying insight. Trends in Cognitive Sciences 2005;9:322–328.10.1016/j.tics.2005.05.012 [PubMed: 15953756]

Bruner, J. Going beyond the information given. New York: Norton; 1973.

Brymer E, Oades L. Extreme sports: A positive transformation in courage and humility. Journal of Humanistic Psychology 2009;49(1):114–126.10.1177/0022167808326199

Burke A, Heuer F, Reisberg D. Remembering emotional events. Memory & Cognition 1992;20:277–290.

Cacioppo, JT.; Berntson, GG.; Crites, SL, Jr. Social neuroscience: Principles of psychophysiological arousal and response. In: Higgins, ET.; Kruglanski, AW., editors. Social psychology: Handbook of basic principles. New York: Guilford; 1996. p. 72-101.

Cacioppo JT, Priester JR, Berntson GG. Rudimentary determinants of attitudes II: Arm flexion and extension have differential effects on attitudes. Journal of Personality and Social Psychology 1993;65:5–17.10.1037/0022-3514.65.1.5 [PubMed: 8355142]

Callaway E, Dembo D. Narrowed attention: A psychological phenomenon that accompanies a certain physiological change. Archives of Neurology and Psychiatry 1958;79:74–90. [PubMed: 13486983]

Canli T, Desmond JE, Zhao Z, Glover G, Gabrieli JDE. Hemispheric asymmetry for emotional stimuli detected with fMRI. Neuroreport 1998;9:3233–3239.10.1097/00001756-199810050-00019 [PubMed: 9831457]

Carson SH, Peterson JB, Higgins DM. Decreased latent inhibition is associated with increased creative achievement in high-functioning individuals. Journal of Personality and Social Psychology 2003;85:499–506.10.1037/0022-3514.85.3.499 [PubMed: 14498785]

Carver CS. Pleasure as a sign you can attend to something else: Placing positive feelings within a general model of affect. Cognition & Emotion 2003;17:241–261.10.1080/02699930302294

Carver CS, Sutton SK, Scheier MF. Action, emotion, and personality: Emerging conceptual integration. Personality and Social Psychology Bulletin 2000;26:741–751.10.1177/0146167200268008

Centerbar D, Clore GL. Do approach-avoidance actions create attitudes? Psychological Science 2006;17:22–29.10.1111/j.1467-9280.2005.01660.x [PubMed: 16371140]

Chen M, Bargh JA. Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. Personality and Social Psychology Bulletin 1999;25:215–224.10.1177/0146167299025002007

Clore, GL.; Colcombe, S. The parallel worlds of affective concepts and feelings. In: Musch, J.; Klauer, KC., editors. The psychology of evaluation: Affective processes in cognition and emotion. Mahwah, NJ: Erlbaum; 2003. p. 335-369.

Clore, GL.; Ortony, A. Cognition in emotion: Always, sometimes, or never?. In: Nadel, L.; Lane, R.; Ahern, GL., editors. The cognitive neuroscience of emotion. New York: Oxford University Press; 2000.

Coan, JA.; Allen, JJB. The state and trait nature of frontal EEG asymmetry in emotion. In: Hugdahl, K.; Davidson, RJ., editors. The asymmetrical brain. Cambridge, MA: MIT Press; 2003. p. 565-615.

Coan JA, Allen JJB, Harmon-Jones E. Voluntary facial expression and hemispheric asymmetry over the frontal cortex. Psychophysiology 2001;38:912–925.10.1111/1469-8986.3860912 [PubMed: 12240668]

Collier WG, Hubbard TL. Musical scales and evaluations of happiness and awkwardness: Effects of pitch, direction, and scale mode. American Journal of Psychology 2001;114:355–75.10.2307/1423686 [PubMed: 11641885]

Davidson RJ. Well-being and affective style: neural substrates and biobehavioural correlates. Philosophical Transactions of the Royal Society (London) 2004;359:1395–411.10.1098/rstb.2004.1510

Davidson, RJ. Cerebral asymmetry, emotion, and affective style. In: Davidson, RJ.; Hugdahl, K., editors. Brain asymmetry. Cambridge, MA: MIT Press; 1995. p. 361-387.

Davidson RJ, Ekman P, Saron C, Senulis J, Friesen WV. Emotional expression and brain physiology I: Approach/withdrawal and cerebral asymmetry. Journal of Personality and Social Psychology 1990;58:330–341.10.1037/0022-3514.58.2.330 [PubMed: 2319445]

Davidson RJ, Fox NA. Asymmetrical brain activity discriminates between positive and negative affective stimuli in human infants. Science 1982;218:1235–1237.10.1126/science.7146906 [PubMed: 7146906]

Davidson, RJ.; Tomarken, AJ. Laterality and emotion: An electrophysiological approach. In: Boller, F.; Grafman, J., editors. Handbook of neuropsychology. Amsterdam: Elsevier; 1989. p. 419-441.

DePaulo BM. Nonverbal behavior and self-presentation. Psychological Bulletin 1992;111:203–243.10.1037/0033-2909.111.2.203 [PubMed: 1557474]

Derryberry D, Reed MA. Anxiety and attentional focusing: Trait, state and hemispheric influences. Personality and Individual Differences 1998;25:745–761.10.1016/S0191-8869(98)00117-2

Derryberry, D.; Tucker, DM. Motivating the focus of attention. In: Niedenthal, PM.; Kitayama, S., editors. Heart's eye: Emotional influences in perception and attention. New York: Academic Press; 1994. p. 167-196.

Dreisbach G. How positive affect modulates cognitive control: The costs and benefits of reduced maintenance capability. Brain and Cognition 2006;60(1):11–19.10.1016/j.bandc.2005.08.003 [PubMed: 16216400]

Dreisbach G, Goschke T. How positive modulates cognitive control: Reduced perseveration at the cost of increased distractability. Journal of Experimental Psychology: Learning, Memory, and Cognition 2004;30(2):343–353.10.1037/0278-7393.30.2.343

Easterbrook JA. The effect of emotion on cue utilization and the organization of behavior. Psychological Review 1959;66:183–201.10.1037/h0047707 [PubMed: 13658305]

Ekstrom, RB.; French, JW.; Harman, HH.; Dermen, D. Manual for kit of factor-referenced cognitive tests. Princeton, NJ: Educational Testing Service; 1976.

Elliot AJ, Maier MA. Color and psychological functioning. Current Directions in Psychological Science 2007;16(5):250–254.10.1111/j.1467-8721.2007.00514.x

Elliot AJ, Maier MA, Binser MJ, Friedman R, Pekrun R. The Effect of red on avoidance behavior in achievement contexts. Personality and Social Psychology Bulletin 2009;35:365–375.10.1177/0146167208328330 [PubMed: 19223458]

Elliot AJ, Maier MA, Moller AC, Friedman R, Meinhardt J. Color and psychological functioning: The effect of red on performance in achievement contexts. Journal of Experimental Psychology: General 2007;136:154–168.10.1037/0096-3445.136.1.154 [PubMed: 17324089]

Elliot A, Niesta D. Romantic red: Red enhances men's attraction to women. Journal of Personality and Social Psychology 2008;95(5):1150–1164.10.1037/0022-3514.95.5.1150 [PubMed: 18954199]

Ellsworth PC. William James and emotion: Is a century of fame worth a century of misunderstanding? Psychological Review 1994;101:222–229.10.1037/0033-295X.101.2.222 [PubMed: 8022957]

Eysenck, HJ. The biological basis of personality. Springfield, IL: Charles C. Thomas; 1967.

Eysenck, HJ. Biological dimensions of personality. In: Pervin, LA., editor. Handbook of personality: Theory and research. New York: Guilford; 1990. p. 244-276.

Fenske MJ, Eastwood JD. Modulation of focused attention by faces expressing emotion: evidence from flanker tasks. Emotion 2003;3:327–343.10.1037/1528-3542.3.4.327 [PubMed: 14674827]

Fink GR, Halligan PW, Marshall JC, Frith CD, Frackowiak RSJ, Dolan RJ. Where in the brain does visual attention select the forest and the trees? Nature 1996;382:626–628.10.1038/382626a0 [PubMed: 8757132]

Finke, R.; Ward, T.; Smith, S. Creative cognition: Theory, research and applications. Cambridge: MIT Press; 1992.

Fiore, SM.; Schooler, JW. Right hemisphere contributions to creative problem solving: Converging evidence for divergent thinking. In: Beeman, M.; Chiarello, C., editors. Right hemisphere language comprehension: Perspectives from cognitive neuroscience. Mahwah, NJ: Erlbaum; 1998. p. 349-371.

Förster J. The influence of approach and avoidance motor actions on food intake. European Journal of Social Psychology 2003;33:339–350.10.1002/ejsp.150

Förster J. How body feedback influences consumer's evaluation of products. Journal of Consumer Psychology 2004;14:415–425.

Förster J. Relations between perceptual and conceptual scope: How global versus local processing fits a focus on similarity versus dissimilarity. Journal of Experimental Psychology: General 2009;138:88–111.10.1037/a0014484 [PubMed: 19203171]

Förster J, Dannenberg L. GLOMO sys: A Systems Account of Global versus Local Processing. Psychological Inquiry, target article. in press.

Förster, J.; Friedman, RS. Expression entails anticipation: Towards a self- regulatory model of bodily feedback effects. In: Semin, GR.; Smith, ER., editors. Embodied grounding: Social, cognitive, affective, and neuroscientific approaches. New York: Cambridge; 2008. p. 289-308.

Förster, J.; Friedman, RS. The influence of subtle approach versus avoidance cues on creative versus analytic performance. University of Amsterdam; 2009. Unpublished manuscript

Förster J, Friedman RS, Özelsel A, Denzler M. The influence of approach and avoidance cues on the scope of perceptual and conceptual attention. Journal of Experimental Social Psychology 2006;42:133–146.10.1016/j.jesp.2005.02.004

Förster J, Higgins ET. How global versus local perception fits regulatory focus. Psychological Science 2005;16:631–636.10.1111/j.1467-9280.2005.01586.x [PubMed: 16102066]

Fredrickson BL. What good are positive emotions. Review of General Psychology 1998;2:300–319.10.1037/1089-2680.2.3.300

Fredrickson BL. The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. American Psychologist 2001;3:218–226.10.1037/0003-066X.56.3.218 [PubMed: 11315248]

Fredrickson BL, Branigan C. Positive emotions broaden the scope of attention and thought-action repertoires. Cognition & Emotion 2005;19(3):313–332.10.1080/02699930441000238

Friedman, R. The sound of motivation: Utilizing the doppler effect to activate avoidance motivation. University of Rochester; Rochester, NY: 2007. Unpublished doctoral dissertation

Friedman RS, Förster J. The effects of approach and avoidance motor actions on the elements of creative insight. Journal of Personality and Social Psychology 2000;79:477–492.10.1037/0022-3514.79.4.477 [PubMed: 11045734]

Friedman RS, Förster J. The effects of promotion and prevention cues on creativity. Journal of Personality and Social Psychology 2001;81:1001–1013.10.1037/0022-3514.81.6.1001 [PubMed: 11761303]

Friedman RS, Förster J. The influence of approach and avoidance motor actions on creative cognition. Journal of Experimental Social Psychology 2002;38:41–55.10.1006/jesp.2001.1488

Friedman RS, Förster J. Effects of motivational cues on perceptual asymmetry: Implications for creativity and analytical problem solving. Journal of Personality and Social Psychology 2005;88:263–275.10.1037/0022-3514.88.2.263 [PubMed: 15841858]

Gable PA, Harmon-Jones E. Approach-motivated positive affect reduces breadth of attention. Psychological Science 2008;19:476–482.10.1111/j.1467-9280.2008.02112.x [PubMed: 18466409]

Gasper K. Do you see what I see? Affect and visual information processing. Cognition and Emotion 2004;18:405–421.10.1080/02699930341000068

Gasper K, Clore G. Attending to the big picture: Mood and global versus local processing of visual information. Psychological Science 2002;13:34–40.10.1111/1467-9280.00406 [PubMed: 11892776]

Gentner D. Structure-mapping: A theoretical framework for analogy. Cognitive Science 1983;7:155–170.10.1207/s15516709cog0702_3

Glucksberg, S. Understanding figurative language: From metaphors to idioms. London: Oxford University Press; 2001.

Green, S.; Brownstein, SC.; Wolf, IK.; Weiner Green, S. Barron's how to prepare for the GRE. Hauppage, NY: Barron's; 2000.

Harmon-Jones E. Insights on asymmetrical frontal brain activity gleaned from research on anger and cognitive dissonance. Biological Psychology 2004;67:51–76.10.1016/j.biopsycho.2004.03.003 [PubMed: 15130525]

Harmon-Jones E, Gable PA. Neural activity underlying the effect of approach-motivated positive affect on narrowed attention. Psychological Science 2009;20:406–409.10.1111/j.1467-9280.2009.02302.x [PubMed: 19298263]

Heller, W.; Koven, NS.; Miller, GA. Regional brain activity in anxiety and depression, cognition/emotion interaction, and emotion regulation. In: Hugdahl, K.; Davidson, RJ., editors. The asymmetrical brain. Cambridge, MA: MIT Press; 2003. p. 533-564.

Heller W, Nitschke JB. The puzzle of regional brain activity in depression and anxiety: The importance of subtypes and comorbidity. Cognition and Emotion 1998;12:421–447.10.1080/026999398379664

Heller W, Nitschke JB, Etienne MA, Miller GA. Patterns of regional brain activity differentiate types of anxiety. Journal of Abnormal Psychology 1997;106:376–385.10.1037/0021-843X.106.3.376 [PubMed: 9241939]

Hellige, JB. Hemispheric asymmetry: What's right and what's left. Cambridge: Harvard University Press; 2001.

Hellige JB, Cox PJ. Effects of concurrent verbal memory on recognition of stimuli from the left and right visual fields. Journal of Experimental Psychology: Human Perception and Performance 1976;2(2):210–221.10.1037/0096-1523.2.2.210 [PubMed: 1271028]

Hellige JB, Wong TM. Hemisphere-specific interference in dichotic listening: task variables and individual differences. Journal of Experimental Psychology: General 1983;112(2):218–39.10.1037/0096-3445.112.2.218 [PubMed: 6223972]

Higgins, ET. Beyond pleasure and pain. In: Higgins, ET.; Kruglanski, AW., editors. Motivational science: Social and personality perspectives. Philadelphia, PA: Taylor & Francis; 2000. p. 231-255.

Isen, AM. Positive affect and decision making. In: Lewis, M.; Haviland-Jones, J., editors. Handbook of emotions. 2. New York: Guilford; 2000. p. 417-435.

Isen AM, Daubman KA. The influence of affect on categorization. Journal of Personality and Social Psychology 1984;47:1206–1217.10.1037/0022-3514.47.6.1206

Isen AM, Daubman KA, Nowicki GP. Positive affect facilitates creative problem solving. Journal of Personality and Social Psychology 1987;52:1122–1131.10.1037/0022-3514.52.6.1122 [PubMed: 3598858]

Isen AM, Johnson MMS, Mertz E, Robinson GF. The influence of positive affect on the unusualness of word associations. Journal of Personality and Social Psychology 1985;48:1413–1426.10.1037/0022-3514.48.6.1413 [PubMed: 4020605]

Jung-Beeman M, Bowden EM, Haberman J, Frymiare JL, Arambel-Liu S, Greenblatt R, Reber PJ, Kounios J. Neural activity observed in people solving verbal problems with insight. Public Library of Science -Biology April;2004 2(4):e97.10.1371/journal.pbio.0020097

Keltner D, Gruenfeld DH, Anderson C. Power, approach, and inhibition. Psychological Review 2003;110:265–284.10.1037/0033-295X.110.2.265 [PubMed: 12747524]

Kimchi R, Palmer SE. form and texture in hierarchically constructed patterns. Journal of Experimental Psychology: Human Perception and Performance 1982;8:521–535.10.1037/0096-1523.8.4.521 [PubMed: 6214605]

Korossy, K. Solvability and uniqueness of linear-recursive number sequence tasks. Methods of Psychological Research. 1998. {www.mpr-online.de}

Kounios J, Fleck J, Green DL, Payne L, Stevenson JL, Bowden EM, Jung-Beeman M. The origins of insight in resting-state brain activity. Neuropsychologia 2008;46:281–291.10.1016/j.neuropsychologia.2007.07.013 [PubMed: 17765273]

Kuschel S, Förster J, Denzler M. Going beyond information given: How approach versus avoidance cues influence access to higher order information. Social Psychological and Personality Science e 2010;1:4–10.10.1177/1948550609345023

Krauss, RM.; Fussell, SR. Social psychological models of interpersonal communication. In: Higgins, ET.; Kruglanski, AW., editors. Social psychology: Handbook of basic principles. New York: Guilford; 1996. p. 655-701.

Lamb MR, Robertson LC, Knight RT. Attention and interference in the processing of hierarchical patterns: Inferences from patients with right and left temporal-parietal lesions. Neuropsychologia 1989;27:471–483.10.1016/0028-3932(89)90052-3 [PubMed: 2733820]

LeDoux JE. Emotion, memory, and the brain. Scientific American 1994;270:32–39.10.1038/scientificamerican0694-50

LeDoux, JE. The emotional brain. New York: Simon & Schuster; 1996.

LeDoux, JE. Cognitive-emotional interactions: Listen to the brain. In: Lane, R.; Nadel, L., editors. Cognitive neuroscience of emotion. New York: Oxford University Press; 2000. p. 129-155.

Levy J, Heller W, Banich MT, Burton LA. Are variations among right-handed individuals in perceptual asymmetries caused by characteristic arousal differences between hemispheres? Journal of Experimental Psychology: Human Perception and Performance 1983a;9:329–359.10.1037/0096-1523.9.3.329 [PubMed: 6223975]

Levy J, Heller W, Banich MT, Burton LA. Asymmetry of perception in free viewing of chimeric faces. Brain & Cognition 1983b;2:404–419.10.1016/0278-2626(83)90021-0 [PubMed: 6546034]

Lieberman M, Rosenthal R. Why introverts can't always tell who likes them: Multitasking and nonverbal decoding. Journal of Personality & Social Psychology 2001;80:294–310.10.1037/0022-3514.80.2.294 [PubMed: 11220447]

Macrae CN, Lewis HL. Do I know you?: Processing orientation and face recognition'. Psychological Science 2002;13:194–196.10.1111/1467-9280.00436 [PubMed: 11934008]

Maier MA, Elliot AJ, Lichtenfeld S. Mediation of the negative effect of red on intellectual performance. Personality and Social Psychology Bulletin 2008;34(11):1530–1540.10.1177/0146167208323104 [PubMed: 18768745]

Markman AB, Brendl CM. Constraining theories of embodied cognition. Psychological Science 2005;16:6–10.10.1111/j.0956-7976.2005.00772.x [PubMed: 15660844]

Martindale, C. Creativity and connectionism. In: Smith, SM.; Ward, TB.; Finke, RA., editors. The creative cognition approach. Cambridge, MA: Bradford; 1995. p. 249-268.

Metcalfe J, Wiebe D. Intuition in insight and non-insight problem solving. Memory and Cognition 1987;15:238–246.

Mednick SA. The associative basis of the creative process. Psychological Review 1962;69:220–232.10.1037/h0048850 [PubMed: 14472013]

Mehta R, Zhu R. Blue or red? Exploring the effect of color on cognitive task performances. Science 2009;323(5918):1226–1229.10.1126/science.1169144 [PubMed: 19197022]

Miyake A, Witzki AH, Emerson MJ. Field dependence–independence from a working memory perspective: A dual-task investigation of the Hidden Figures Test. Memory 2001;9:445–457.10.1080/09658210143000029

Mikulincer M, Kedem P, Paz D. Anxiety and categorization – 1. The structure and boundaries of mental categories. Personality and Individual Differences 1990a;11:805–814.10.1016/0191-8869(90)90189-X

Mikulincer M, Paz D, Kedem P. Anxiety and categorization – 2. Hierarchical levels of mental categories. Personality and Individual Differences 1990b;11:815–821.10.1016/0191-8869(90)90190-3

Milner AD, Brechmann M, Pagliarini L. To halve and to halve not: An analysis of line bisection in normal subjects. Neuropsychologia 1992;30:515–526.10.1016/0028-3932(92)90055-Q [PubMed: 1641116]

Morton BE. Two-hand line-bisection task outcomes correlate with several measures of hemisphericity. Brain and Cognition 2003;51:305–316.10.1016/S0278-2626(03)00017-4 [PubMed: 12727185]

Navon D. Forest before trees: The precedence of global features in visual perception. Cognitive Psychology 1977;9:353–383.10.1016/0010-0285(77)90012-3

Neill WT, Westberry RL. Selective attention and the suppression of cognitive noise. Journal of Experimental Psychology: Learning, Memory, and Cognition 1987;13:327–334.10.1037/0278-7393.13.2.327

Neumann R, Strack F. Approach and avoidance: The influence of proprioceptive and exteroceptive cues on encoding of affective information. Journal of Personality & Social Psychology 2000;79:39–48.10.1037/0022-3514.79.1.39 [PubMed: 10909876]

Nickerson RS. Retrieval inhibition from part-set cuing: A persisting enigma in memory research. Memory and Cognition 1984;12:531–552.

Nitschke JB, Heller W, Palmieri PA, Miller GA. Contrasting patterns of brain activity in anxious apprehension and anxious arousal. Psychophysiology 1999;36:628–637.10.1017/S0048577299972013 [PubMed: 10442031]

Öhman, A.; Flykt, A.; Lundqvist, D. Unconscious emotion: Evolutionary perspectives, psychophysiological data and neuropsychological mechanisms. In: Lane, R.; Nadel, L., editors. Cognitive neuroscience of emotion. New York: Oxford University Press; 2000. p. 296-327.

Öhman A, Soares JJF. On the automaticity of phobic fear: Conditioned skin conductance responses to masked phobic stimuli. Journal of Abnormal Psychology 1993;102:121–132.10.1037/0021-843X.102.1.121 [PubMed: 8436688]

Olson, JM.; Hafer, CL. Self-inference processes: Looking back and ahead. In: Olson, JM.; Zanna, MP., editors. Self-inference processes: The Ontario symposium. Vol. 6. Hillsdale, NJ: Erlbaum; 1990. p. 293-320.

Ortony, A.; Clore, GL.; Collins, A. The cognitive structure of emotions. New York: Cambridge University Press; 1988.

Pizzagalli, D.; Shackman, AJ.; Davidson, RJ. The functional neuroimaging of human emotion: Asymmetric contributions of cortical and subcortical circuitry. In: Hughdal, K.; Davidson, RJ., editors. The asymmetrical brain. Cambridge: MIT Press; 2003. p. 511-532.

Pomerantz JR. Global and local precedence: Selective attention in form and motion perception. Journal of Experimental Psychology: General 1983;112:516–540.10.1037/0096-3445.112.4.516 [PubMed: 6229597]

Posner MI. Selective attention and cognitive control. Trends in Neuroscience 1987;10:13–17.10.1016/0166-2236(87)90116-0

Priester JR, Cacioppo JT, Petty RE. The influence of motor processes on attitudes toward novel versus familiar semantic stimuli. Personality and Social Psychology Bulletin 1996;22:442–447.10.1177/0146167296225002

Reeves FB, Bergum BO. Perceptual narrowing as a function of peripheral cue relevance. Perceptual and Motor Skills 1972;35:719–724. [PubMed: 4643960]

Reyna VF, Farley F. Risk and rationality in adolescent decision making: Implications for theory, practice, and public policy. Psychological Science in the Public Interest 2006;7:1–44.10.1111/j.1529-1006.2006.00026.x

Riis J, Schwarz N. Approaching and avoiding Linda: Motor signals influence the conjunction effect. Social Cognition 2003;21:247–262.10.1521/soco.21.4.247.27004

Roediger HL, Neely JH. Retrieval blocks in episodic and semantic memory. Canadian Journal of Psychology 1982;36:213–242.10.1037/h0080640

Rotteveel M, Phaf RH. Automatic affective evaluation does not automatically predispose for arm flexion and extension. Emotion 2004;4(2):156–172.10.1037/1528-3542.4.2.156 [PubMed: 15222853]

Rowe G, Hirsh JB, Anderson AK. Positive affect increases the breadth of attentional selection. Proceedings of the National Academy of Sciences 2007;104:383–388.10.1073/pnas.0605198104

Rundus D. Negative effects of using list items as retrieval cues. Journal of Verbal Learning and Verbal Behavior 1973;12:43–50.10.1016/S0022-5371(73)80059-3

Schmitz TW, DeRosa E, Anderson AK. Opposing influences of affective state valence on visual cortical encoding. Journal of Neuroscience 2009;29(22):7199–7207.10.1523/JNEUROSCI.5387-08.2009 [PubMed: 19494142]

Schooler, JW.; Melcher, J. The ineffability of insight. In: Smith, SM.; Ward, TB.; Finke, RA., editors. The creative cognition approach. Cambridge, MA: MIT Press; 1995. p. 97-134.

Schooler JW, Ohlsson S, Brooks K. Thoughts beyond words: When language overshadows insight. Journal of Experimental Psychology: General 1993;122:166–183.10.1037/0096-3445.122.2.166

Schwarz, N. Feelings as information: Informational and motivational functions of affective states. In: Higgins, ET.; Sorrentino, RM., editors. Handbook of motivation and cognition: Foundations of social behavior. Vol. 2. New York: Guilford; 1990. p. 527-561.

Schwarz N. Judgment in a social context: Biases, shortcomings, and the logic of conversation. Advances in Experimental Social Psychology 1994;26:123–162.10.1016/S0065-2601(08)60153-7

Schwarz, N.; Clore, GL. Feelings and phenomenal experiences. In: Kruglanski, A.; Higgins, ET., editors. Social psychology: Handbook of basic principles. 2. New York: Guilford; 2007. p. 385-407.

Seibt B, Förster J. Stereotype threat and performance: How self-stereotypes influence processing by inducing regulatory foci. Journal of Personality and Social Psychology 2004;87:38–56.10.1037/0022-3514.87.1.38 [PubMed: 15250791]

Seger CA, Desmond JE, Glover GH, Gabrieli JDE. Functional magnetic resonance imaging evidence for right-hemisphere involvement in processing unusual semantic relationships. Neuropsychology 2000;14:361–369.10.1037/0894-4105.14.3.361 [PubMed: 10928739]

Shrira I, Martin LL. Stereotyping, self-affirmation, and the cerebral hemispheres. Personality & Social Psychology Bulletin 2005;31:846–856.10.1177/0146167204272232 [PubMed: 15833910]

Smith PK, Trope Y. You focus on the forest when you're in charge of the trees: Power priming and abstract information processing. Journal of Personality and Social Psychology 2006;90:578–596.10.1037/0022-3514.90.4.578 [PubMed: 16649856]

Solarz AK. Latency of instrumental responses as a function of compatibility with the meaning of eliciting verbal signs. Journal of Experimental Psychology 1960;59:239–245.10.1037/h0047274 [PubMed: 13832584]

Spence KW. A theory of emotionally based drive (D) and its relation to performance in simple learning situations. American Psychologist 1958;13:131–141.10.1037/h0045054

Stroop JR. Studies of interference in serial verbal reactions. Journal of Experimental Psychology 1935;18:643–662.10.1037/0096-3445.121.1.15

Sutton SK, Ward RT, Larson CL, Holden JE, Perlman SB, Davidson RJ. Asymmetry in prefrontal glucose metabolism during appetitive and aversive emotional states: an FDG-PET study. Psychophysiology 1997;34:S89.10.1111/j.1469-8986.1997.tb02381.x

Tucker DM, Williamson PA. Asymmetric neural control systems in human self-regulation. Psychological Review 1984;91:185–215.10.1037/0033-295X.91.2.185 [PubMed: 6152836]

Tyler SK, Tucker DM. Anxiety and perceptual structure: Individual differences in neuropsychological function. Journal of Abnormal Psychology 1982;91:210–220.10.1037/0021-843X.91.3.210 [PubMed: 7096791]

Van Kleeck MH. Hemispheric differences in global versus local processing of hierarchical visual stimuli by normal subjects: New data and a meta-analysis of previous studies. Neuropsychologia 1989;27:1165–1178.10.1016/0028-3932(89)90099-7 [PubMed: 2812299]

Volberg G, Hübner R. On the role of response conflicts and stimulus position for hemispheric differences in global/local processing: An ERP study. Neuropsychologia 2004;42:1805–1813.10.1016/j.neuropsychologia.2004.04.017 [PubMed: 15351629]

Watkins MJ. Inhibition in recall with extralist “cues”. Journal of Verbal Learning and Verbal Behavior 1975;14:294–303.10.1016/S0022-5371(75)80073-9

Weltman G, Smith JE, Edstrom GH. Perceptual narrowing during pressure-chamber exposure. Human Factors 1971;13:99–107. [PubMed: 5550590]

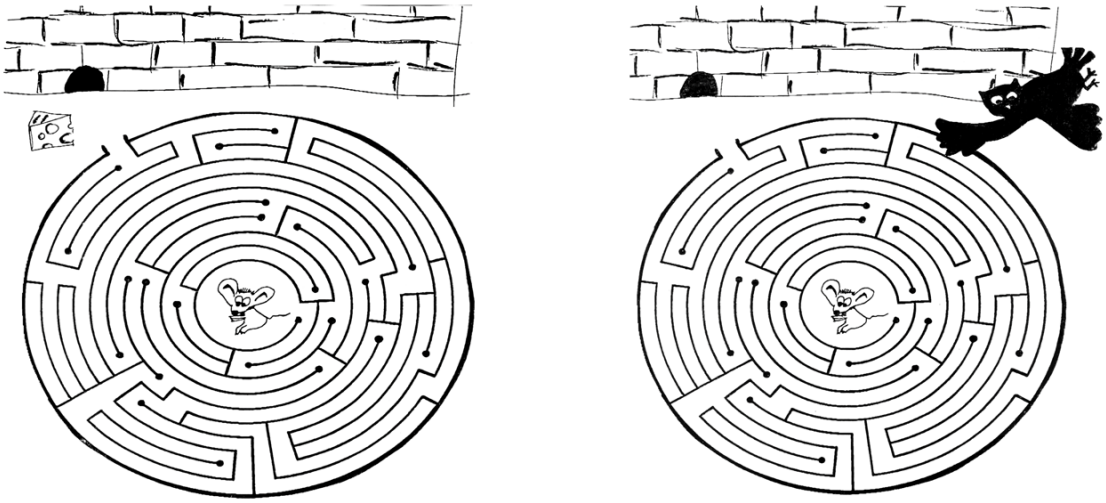

Figure 1.
Example of one of the “virtual” approach and avoidance maze manipulations used in prior research.

Table 1

Summary of Experimental Procedures Reviewed Indexed by Implicit Affective Cue Manipulation, Level of Attention Assessed, and Measures Administered

Cue manipulation	Level of Attention Assessed	Measures Administered
Approach and avoidance motor actions (arm flexion/extension)	Perceptual	Snowy Pictures Test Gestalt Completion Test
	Conceptual	Part-list cuing inhibition Insight problem solving Alternative Uses Test GRE Analytical Test
Virtual enactment of approach and avoidance behaviors (maze task)	Perceptual	Global/Local RT Snowy Pictures Test
	Conceptual	Retrieval blocking Stroop task Alternative Uses Test GRE Analytical Test
Colors (red vs. blue)	Perceptual	Global/Local preference
	Conceptual	Single-solution anagrams Verbal analogy problems Number sequence task Alternative Uses Test Creative generation Remote Associates Test