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# Anger as Seeing Red: Perceptual Sources of Evidence

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Abstract

A class of metaphors links the experience of anger to perceptions of redness. Whether such metaphors have significant implications for understanding perception is not known. In Experiment 1, anger (versus sadness) concepts were primed and it was found that priming anger concepts led individuals to be more likely to perceive the color red. In Experiment 2, anger states were directly manipulated, and it was found that evoking anger led individuals to be more likely to perceive red. Both experiments showed that the observed effects were independent of the actual color presented. These findings extend the New Look, perceptual, metaphoric, and social cognitive literatures. Most importantly, the results suggest that emotion representation processes of a metaphoric type can be extended to the perceptual realm.


KEYWORDS: emotion, priming, metaphor, perception, color

# Anger as Seeing Red: Perceptual Sources of Evidence

The 1950s "New Look" movement in psychology was based on the general premise that organismic states related to motivation and emotion influence perceptual processes in a top-down manner, independent of the actual stimulus to-be-perceived (Bruner, 1951). This framework was loose, demonstration-oriented, and often reliant on questionable psychoanalytic assumptions, such as the idea that individuals might perceive and then defend against unwanted content of a sexual or aggressive nature (Allport, 1955; Fuhrer & Eriksen, 1960). Subsequently, the cognitive revolution took hold and defined perception in low-level terms, certainly with little consideration of top-down influences related to motivation and emotion (Minsky, 1988).

Increasingly so in recent years, exclusively bottom-up views of perception have been challenged by the embodied cognition perspective (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). A particularly provocative theory of this type was proposed by Lakoff and Johnson (1999), a linguist and a philosopher respectively. These theorists posit that common linguistic metaphors (e.g., "love is a journey", "an uplifting message") do not merely reflect poetic thinking or serve a primarily communication-related linguistic purpose. Rather, they argue, the ubiquity of metaphor (Gibbs, 1994) follows from a more basic tendency to use perceptual experiences (e.g., of motion, spatial orientation, or color) to understand private thoughts and feelings. If so, people may often conceptualize their affect and emotion in metaphoric terms (Lakoff, 1986).

The metaphor representation perspective (Lakoff & Johnson, 1999) has proven generative in initial experimental investigations. Meier and Robinson (2004) found that positive

(negative) words were evaluated more quickly when presented higher (lower) in physical space, consistent with a broad class of metaphors linking positive states to presumed higher levels of physical elevation (Kövecses, 1991). Related findings concerning the up-down dimension have been reported in relation to divinity (Meier, Hauser, Robinson, Friesen, & Schjedahl, 2007), depression (Meier & Robinson, 2006), and dominance (Robinson, Zabelina, Ode, & Moeller, 2008) concepts. No investigation, however, has asked individuals to report on their perceptions. This is an important omission theoretically (Lakoff & Johnson, 1999) and in relation to cognitive theories of perception (Coltheart, 2010).

*Overview of Investigation*

An emerging line of research indicates that the color red is not just an aesthetic stimulus, but that it also carries meaning (Elliot & Maier, 2007). Specifically, red has been shown to carry the meaning of failure, evoking avoidance motivation and behavior in achievement situations (Elliot, Maier, Moller, Friedman, & Meinhardt, 2007; Moller, Elliot, & Maier, 2009). In social situations, on the other hand, the color red has been shown to signal sexual receptivity and high status, evoking approach motivation and behavior in such contexts (Elliot & Niesta, 2008; Elliot et al., in press). Such work, however, has been exclusively focused on the *influence* of perceiving red on subsequent outcomes. In the present research, we focus on the reverse question of whether a psychological experience can lead individuals to *perceive* the color red. Specifically, guided by the prominent metaphor likening anger to "seeing red" (Lakoff & Johnson, 1999), we tested whether manipulating anger concepts or anger itself would result in a greater proportion of red perceptions, perhaps independent of the actual color presented. Findings of this type would be informative to the emotion representation literature and yet no such findings have been reported.

We also examined two additional questions. The first question was whether both anger concepts (Experiment 1) and anger experiences (Experiment 2) would be equally effective in priming red perceptions. According to the common currency view of Lakoff (1986), this should be the case. The second question was whether such manipulations would lead individuals to perceive red independent of the color presented or, rather, would facilitate recognition of the color red when actually presented. We sought to disentangle such potential influences in a factorial manner. As we view metaphoric phenomena in terms of top-down influences (Meier & Robinson, 2005), consistent with the earlier New Look literature (Bruner, 1951), it was hypothesized that anger primes would lead individuals to perceive red generally speaking, independent of the actual color presented.

Experiment 1

Metaphoric processes were examined in relation to a strong set of constraints: No linguistic phrases were presented, no interactive communications were required, and the dependent task was fully perceptual in nature. Anger versus sadness emotion concepts were primed, the latter condition to ensure that priming effects were anger-specific rather than due to the activation of negative emotion concepts more generally. Anger primes were hypothesized to lead individuals to perceive ambiguously colored stimuli as red.

Method

*Pilot Test*

The stimuli for the perception task were objectively red or blue, but ambiguous enough to be misperceived. To accomplish this aim, we used Adobe Photoshop to select prototypic red (CIE angle 0) and blue (CIE angle 240) hues, equal in brightness values. Such hues were then superimposed on a pure white background to produce ambiguity. A panel of six judges were

presented stimuli of this type and simply asked to indicate whether they were red or blue. On the basis of their responses, saturation levels for red and blue were selected such that they resulted in 75% accuracy rates for both colored stimuli, accuracy rates deemed ideal for examining priming-related influences on perception.

*Participants*

The Experiment 1 sample consisted of 79 (32 female; $M = 20.35$ years of age) undergraduates from North Dakota State University seeking course credit. The ethnic make-up of the sample was 66.25% White, 3.75% Black, 21.25% Asian/Pacific Islander, and 8.75% other/not specified.

*Procedure*

The experiment was run on a personal computer. Participants were informed that the experiment focused on their ability to alternate between two different tasks, one involving categorizing words and the other involving perceiving degraded colors. This general instruction provided a rationale for alternating tasks across trials (Pashler, 1998). Moreover, it has been shown that such procedures are ideal for guarding against expectancy effects that can occur when primes are ostensibly to-be-ignored (McRae & Boisvert, 1998; Robinson, Moeller, & Goetz, 2009). There were 120 paired trials of this concept-color perception type.

On odd-numbered trials, participants categorized words as anger- or sadness-related. There were six stimuli for each emotion category (anger: anger, furious, irate, outrage, scornful, violent; sadness: depressed, gloomy, lonely, miserable, sad, sorrowful), drawn from lexical studies of emotion (Storm & Storm, 1987) and associated with high categorization accuracy rates in previous investigations (e.g. Wilkowski, Meier, Robinson, Carter, & Feltman, 2009). The stimuli were categorized by saying either "anger" or "sadness" into a voicekey microphone. The

verbal categorization of such primes mitigates response-compatibility contributions to performance, as a manual response was required for target trials (Kornblum, Hasbroucq, & Osman, 1990). A brief 120 ms blank delay then ensued.

On even-numbered trials, participants indicated whether the ambiguous color stimulus was red or blue, using the 1 and 5 keys of a response box, with the mappings counterbalanced across participants. A 500 ms blank delay occurred after each such response. Stimuli for both tasks were randomly selected by a computer program and, therefore, no concept-color covariation was actually present. Nevertheless, it was hypothesized that a higher percentage of ambiguous stimuli would appear red following the activation of anger-related thoughts.

## Results

The effects of the priming and color manipulations could be parsimoniously examined in a 2 (Actual Color) x 2 (Prime Type) repeated-measures ANOVA, with the proportion of red perceptual responses as the dependent measure. The ANOVA revealed a main effect for Actual Color, $F(1, 78) = 71.88$, $p < .01$, partial eta squared = .48 (a large effect size), such that there was a greater tendency to categorize color stimuli as red when they were actually red (40.15%) rather than blue (30.02%). More importantly, there was a main effect of Prime Type, $F(1, 78) = 14.49$, $p < .01$, partial eta squared = .16 (also a large effect size). Participants were more likely to perceive a color stimulus as red following anger primes (41.03%) relative to sadness primes (29.15%). There was no Actual Color x Prime Type interaction, $F(1, 78) = 2.66$, $p > .10$. Thus, the effect of the anger priming manipulation was independent of actual color. Prime Type interactions with participant sex were not significant, $p$s > .05.

## Discussion

Experiment 1 found that the activation of anger concepts resulted in perceptions that were consistent with the metaphor of anger as "seeing red". Such an influence could occur in a bottom-up sensory manner or could guide perceptions in a top-down (emotional or semantic) manner. The experimental design was uniquely capable of disentangling such influences. Activating anger concepts did not facilitate sensory processing of the color red, which would have resulted in an actual color by prime type interaction. Rather, activating anger concepts led individuals to perceive red regardless of the color actually presented. Such results are consistent with the metaphor-representation perspective, according to which metaphoric thinking leads individuals to co-opt the perceptual realm in understanding their experiences, but does not influence the sensation-related achievements of the brain (Lakoff & Johnson, 1999).

Anger and sadness primes were contrasted in Experiment 1. This was deemed useful to ensure that the priming effects of anger demonstrated specificity with respect to another common negative emotional concept. However, sadness primes may have led individuals to perceive blue, as "blue" is a synonym for sadness. We consider this unlikely on the basis of the reaction time data reported by Fetterman, Robinson, and Meier (2010). In one study of that paper, anger categorizations were faster when stimuli were colored red than blue, but sadness categorizations were not faster when stimuli were colored blue than red. In any case, the present Experiment 2 removes this ambiguity by using an emotion-neutral control condition.

Experiment 2

Emotion-cognition scholars disagree, to some extent, as to whether emotional experiences or emotion concepts are more likely to result in emotion-consistent cognitions (Martin & Clore, 2001). On the other hand, the metaphor-representation perspective contends that there is a common currency to emotional concepts and emotional experiences (Meier &

Robinson, 2005). If so, manipulating states of anger rather than anger concepts should result in a pattern of findings identical to Experiment 1. Of further importance, Experiment 2 contrasted a manipulation of anger with a non-emotional control condition. To the extent that the results of Experiment 2 replicate those of Experiment 1, then, the perceptual priming effects of anger, specifically so, would be highlighted.

<div align="center">Method</div>

*Pilot Test*

The aggression literature has used white noise blasts to provoke individuals for many years now (Bushman & Anderson, 1998). On the other hand, it was deemed important to confirm that the specific anger-provocation procedures of Experiment 2 would indeed result in higher anger levels. Following 20 noise blasts (4000 ms at 80 dB) and 20 silent intervals (4000 ms at 0 dB), a sample of 85 pilot individuals then reported on the extent to which they were currently angry (1 = not at all; 5 = extremely). A repeated-measures ANOVA established that anger levels were quite a bit higher following noise blasts ($M = 3.13$) than not ($M = 1.32$), $F(1, 84) = 192.73$, $p < .01$. Accordingly, this manipulation was used in Experiment 2.

*Participants*

Experiment 2 consisted of a sample of 98 (29 female, 7 unidentified; $M = 19.4$ years of age) undergraduates from North Dakota State University seeking course credit. The ethnic make-up of the participants was 87.50% White, 2.5% Black, 5.0% Asian/Pacific Islander, 1.25% Hispanic, and 3.75% other/not specified.

*Procedure*

The experiment was run on a personal computer. Participants were informed that the experiment focused on their ability to alternate between two different perceptual tasks. They

were told that odd-numbered trials would involve listening to sounds or non-sounds over headphones, whereas even-numbered trials would involve a very different color perception task. The colored stimuli used in Experiment 2 were identical to those presented in Experiment 1 and there were 120 paired trials.

There was no response required for prime trials (noise versus no noise). Following each 4000 ms interval, a 300 ms blank delay occurred, after which a color screen was presented. Participants were to categorize the degraded color as red or blue using the 1 and 5 keys of a button box, with mappings counterbalanced across participants. There was a 500 ms blank delay following each color categorization, after which the next paired trial began. The hypothesis was that participants would report seeing red to a greater extent following noise (i.e., anger) primes.

## Results

Bottom-up and top-down influences on color perception could be parsimoniously examined in a 2 (Actual Color) x 2 (Noise Condition) repeated-measures ANOVA, with the percentage of red responses as the dependent measure. As in Experiment 1, there was a main effect for Actual Color, $F(1, 97) = 103.95$, $p < .01$, partial eta squared $= .52$ (a large effect size), with a greater proportion of red responses for actually red (47.02%) relative to blue (14.57%) stimuli. More importantly, there was a main effect for Noise Condition, $F(1, 97) = 9.43$, $p < .01$, partial eta squared $= .09$ (a medium-to-large effect size). Participants were more likely to perceive a colored stimulus as red following noise (33.64%) relative to non-noise (27.96%) primes. On the other hand, there was no Actual Color x Noise Condition interaction ($F < 1$). Thus, the anger induction led individuals to see red independent of the actual color of target stimuli. Noise Condition interactions with participant sex were not significant, $p$s $> .50$.

## Discussion

The metaphor-representation perspective proposes a common currency to emotion concepts and emotional experiences (Lakoff & Johnson, 1999). In both cases, individuals are thought to draw upon perceptual metaphors to understand affect and emotion (Meier & Robinson, 2005). Experiment 2 manipulated experiences of anger in the absence of directly activating emotion concepts. Because the results of Experiment 2 were exactly parallel to those of Experiment 1, unique support for the common-currency view of metaphor (Lakoff, 1986) was obtained. In addition, such results involved a neutral control condition, thereby better supporting the perceptual priming effects of anger, distinctly so.

## General Discussion

Traditional thinking on metaphor is that it constitutes poetic language that is used to impress an audience (Davidson, 1979). Lakoff's (1987) more recent contention is that metaphor is about *thought* rather than language. That is, even in the absence of a communication context, people understand their experiences by likening them to physical referents. The present experiments sought to substantiate this idea in multiple ways. Moreover, they sought to do so in the realm of color perception, a hitherto unexamined area of conceptual metaphor's potential scope.

In neither experiment were participants led to believe that metaphoric associations were of interest. Further, in neither of the experiments were phrases of speech presented. Finally, the dependent task involved color perception, not linguistic processing. Experiment 1 found that priming individuals with anger (versus sadness) concepts led them to "see red" more often in relation to ambiguous subsequent colored stimuli. This finding is consistent with Lakoff's (1987) assertion that people think in metaphors; that is, to conceptualize anger is to implicitly invoke its metaphoric referents.

Given the linguistic nature of the primes in Experiment 1, the observed effect may have been semantic in some broad sense. This is not a problem for the conceptual nature of metaphor, but it does raise the question of whether emotional experience itself, in the absence of a primed concept, could have a similar influence on perception. Experiment 2 addressed this question directly, and demonstrated that individuals in an angry state are literally more likely to "see red".

*Antecedents, Specificity, Implications, and Future Directions*

Developmental research shows that the comprehension and acquisition of abstract concepts follows an earlier sensorimotor stage of functioning in which thinking is much more concrete and perceptual in nature (Thelen, 2008). Given the ubiquity of metaphor in speech and writing (Gibbs, 1994), a strong case can be made for the continued use of this sensorimotor scaffolding among human adults as well. At least this is the central idea of one important and generative theory of metaphor, which contends that people draw upon metaphors, implicitly so, in understanding what their internal thoughts and feelings "are like" (Lakoff & Johnson, 1999). Our results are important in this connection because they are consistent with the idea that to understand anger, people appear to implicitly recruit metaphors related to perceptual redness.

Lakoff and Johnson (1999) further propose that most common metaphors are likely to be universal rather than culture-specific. This appears to be the case for emotional associations to the color red (Soriano & Valenzuela, 2009). As to why this is true, anger produces a testosterone-based increase in blood flow that is most visible in the neck and face region (Changizi, Zhang, & Shimojo, 2006; Drummond, 1997). Accordingly, repeated observation of angry others displaying flushed facial skin are probably responsible, at least in part, for the anger-perceptual redness link. Given that the physiological processes involved in anger displays

are the same across cultures (and, indeed, across species: Changizi, 2009; Darwin, 1899), the likelihood that our findings would generalize across cultures is high.

Are the present results unique to anger representations? The answer to this question is likely nuanced in multiple manners worth discussing. The results of Experiment 1 rule out the idea that the priming effects of anger are due to the activation of negative emotional concepts per se as the activation of sadness concepts did not activate perceptual redness. Further, in a reaction time paradigm, Fetterman et al. (2010) found that the categorization of fear-related words was not facilitated by a red font color, whereas this was the case for the categorization of anger-related words. As fear and anger are equally high-arousal emotional states and concepts (Russell & Barrett, 1999), such data would seem to provide further evidence for the emotion specificity of a link between anger and perceptual redness.

On the other hand, the facial flushing that we have proposed guides metaphoric links between anger and perceptual redness may be found in at least one other state. Specifically, the state of sexual passion or lust is also associated with increased blood flow and visible reddening on the face, neck, and chest (Katchadourian, 1987) and the color red has been shown to increase sexual attraction in a series of recent studies (see Elliot & Neista, 2008, for a review). It would therefore be useful to examine whether emotion concepts or feelings related to sexual attraction also prime perceptions of redness in relation to ambiguous colored stimuli. This might be the case and, if so, provide further support for the physiological-perceptual processes that we have suggested likely underlie anger-redness metaphors.

It is further noteworthy that anger and sexual attraction have additional elements in common. Both are approach-motivated states (Carver & Harmon-Jones, 2009), both are associated with a potential feeling of loss of self-control (Baumeister, Heatherton, & Tice, 1994),

and both are associated with the anticipation of possible body-to-body contact (Mazur, 2005). If so, it could be suggested that a common core to perceptual redness metaphors is likely captured by the primitive bodily instincts – toward sex and aggression – highlighted by Freud (1926). Regardless, it is worth reiterating that perceptual redness likely has a different signal value in achievement contexts (Elliot et al., 2007; Moller et al., 2009). That red may mean different things in different contexts fits with the wider idea that the same perceptual referents are often co-opted for multiple purposes (Lakoff, 1987; Meier et al., 2007).

*Final Considerations*

Findings from both of the present experiments converge on the locus of the anger-red effect as a top-down one, in that anger primes did not facilitate the recognition of stimuli that were actually red, but rather led them to see redness regardless of the actual color present. We therefore suggest that that both the New Look (Bruner, 1951) and modular perspectives (Goldstein, 1999) of perception have merit, but with respect to different processes. It is unlikely that affective metaphor influences retinal processing or other lower-order areas of the visual processing system. Rather, the influences of affective metaphor are later, when sensations must be interpreted or converted for purposes of deciding what one has seen.

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