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EMOTION AFFECTS SIMILARITY VIA SOCIAL PROJECTION

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Given the ubiquity of emotional experiences and the importance of similarity for understanding cognition and behavior, we examined how emotional valence affects perceived similarity. We hypothesized an affective projection process, whereby the emotion evoked by a prime is projected onto and influences judgments of unrelated targets. Experiment 1 revealed that positive events were judged more likely after a positive prime ("respected") than after a negative prime ("rejected"), thus demonstrating affective projection, whereas negative events were judged equally likely regardless of prime valence. Across five further experiments, positive primes increased similarity ratings of unrelated social categories (musicians & dentists), animals (penguins & horses), and animal-like novel figures (greebles). In contrast, because emotions cannot be projected onto inanimate objects, judgments of artifacts (saws & spoons) and artifact-like figures (yadgits) were unaffected. The influence of prime valence on target judgment was asymmetric, with positive primes affecting similarity but negative primes having no effect.

Similarity influences virtually every aspect of cognition and behavior, from attention and perception (Duncan & Humphreys, 1989) to reasoning (Sloutsky & Fisher, 2004; Smith, Shafir, & Osherson, 1993) and problem solving (Novick, 1988). Similarity is also evoked to explain many aspects of social perception and behavior, from social comparison (Mussweiler, 2003) and group membership (Campbell, 1958; Zarate & Sanders, 1999) to attraction (Byrne, 1971) and interpersonal interac-

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tion (Tajfel, 1982). Clearly then, understanding cognition and predicting behavior require a sound understanding of similarity. The present study investigates how emotional valence influences perceived similarity.

Emotion is known to influence many perceptions and judgments. As described by the affect infusion model (AIM), "affectively loaded information exerts an influence on and becomes incorporated into the judgmental process, entering into the judge's deliberations and eventually coloring the judgmental outcome" (Forgas, 1995, p. 39). Likewise, the emotions as social information model (EASI; van Kleef, 2009) posits that emotions induce inferential processes to understand or explain those affective states, and those inferential processes may in turn influence judgments and behaviors. Regarding similarity, the emotional valence of social interactions or interpersonal relations has long been associated with perceived similarity. Similar individuals tend to have positive interactions, whereas dissimilar individuals tend to have negative interactions (McPherson, Smith-Lovin, & Cook, 2001; Tajfel, 1982). Thus it is well established that interpersonal similarity influences whether a social interaction is likely to be negative or positive. In contrast, the present study investigates the converse relationship, and at a more general level: How does emotional valence influence perceived similarity?

Effects of mood on cognition are relatively well understood. Much recent evidence reveals that positive mood broadens selective attention and semantic activation (Rowe, Hirsh, & Anderson, 2007), thus increasing disruption by irrelevant stimuli (Dreisbach & Goschke, 2004), memory for those irrelevant stimuli (Bauml & Kuhbandner, 2009), and likelihood of employing those irrelevant stimuli in subsequent tasks (Biss, Hasher, & Thomas, 2010). For instance, Biss and colleagues had participants judge a series of pictures, some of which were superimposed with distracting words that participants were instructed to ignore. Participants later completed a word fragment completion task, where some of the fragments could be completed with previously distracting words. Participants were likely to use the previous distracters as completions when possible, but critically, this was significantly more likely among participants in positive mood. Positive mood also facilitates the perception of both commonalities and differences (Murray, Sujan, Hirt, & Sujan, 1990). Contrarily, negative mood tends not to affect these cognitive processes (for review see Clore & Huntsinger, 2007). Thus, positive mood affects a broad array of cognitive processes, whereas negative mood exerts little effect.

Although such mood effects are well documented, little is known of how very short-term affective experiences influence subsequent cognitions such as likelihood judgments and similarity perceptions. Dunn, Huntsinger, Lun, and Sinclair (2008) found that the desirability of a given gift affects the recipient's perception of similarity to the gift giver. Thus, positive and negative gifts affect perceived similarity, but it is uncertain whether this effect would generalize to other primes (beyond gift giving) and to other targets (beyond the self). In a study of particular relevance, Estes and Alix-Gaudreau (2003) investigated the influence of positive and negative social interactions on perceived similarity. In a first experiment, participants read sentences conveying a positive or a negative social interaction between members of two different social categories, and then they judged the similarity of those social categories. For instance, after reading "The scientist [encouraged/threatened] the prison guard," participants judged the similarity of scientists and prison guards. Consistent with prior research (McPherson et al., 2001; Tajfel, 1982), the categories were indeed judged more similar following positive than negative social interactions, thus revealing that the relationship between similarity and affect is bidirectional. More interestingly, a second experiment tested whether this influence of positive and negative social interactions also affects the perceived similarity of otherwise unrelated social categories. After reading a sentence conveying a positive or a negative relation between two individuals (e.g., "The scientist [encouraged/threatened] the prison guard"), participants judged the similarity of two other social categories (e.g., bus drivers & lawyers). Similarity ratings were again significantly higher following positive relations than negative relations. Thus, preliminary evidence indicates that emotional valence does influence perceived similarity. Here we propose and test a novel explanation of this effect.

AFFECTIVE PROJECTION

Both intuitively and theoretically, it is rather surprising that a positive social interaction between two individuals (e.g., a scientist and a prison guard) would increase the judged similarity of two other social categories that are uninvolved in the interaction and unrelated to those interacting individuals (e.g., bus drivers & lawyers). What might underlie this effect? We propose an *affective projection* process, whereby the affect evoked by a prime is projected onto a target, and that projected affect then influences judgment of the target. For example, the positive affect elicited by "The scientist encouraged the prison guard" is projected onto bus drivers and lawyers, and as Estes and Alix-Gaudreau (2003) showed in their first experiment, such positive affect increases perceived similarity. This hypothesized affective projection is akin to the more general phenomenon of social projection, which is well documented in social judgment (Ames, 2004; Robbins & Krueger, 2005). For example, students who cheat on an exam tend to overestimate the percentage of other students who have cheated (Katz & Allport, 1931). Moreover, merely imagining a social interaction with a member of a different social group can affect the projection of one's own traits to members of that group (Crisp & Turner, 2009). Note however that these prior demonstrations of social projection have entailed the projection of the participant's own characteristics onto some other individual or group, in a self-to-other direction. The affective projection hypothesized here instead entails the projection of affect from some prime to other targets, in an other-to-other way. Thus, our affective projection hypothesis gains some indirect support from the robustness of social projection effects, but such affective projection would differ importantly from prior demonstrations of social projection.

We tested the affective projection hypothesis in several ways. First we tested directly whether affective projection does indeed occur. After evoking a given emotion, is that same emotion more likely to be projected onto another, unrelated target? As in Estes and Alix-Gaudreau (2003), we used positive and negative social interactions as primes, and participants judged the likelihood that two other individuals would interact in a positive or negative way. Affective projection would be observed as higher likelihood judgments of the same valence than of the opposite valence between other, unrelated targets. For example, the likelihood that a bus driver would smile at a lawyer should be judged higher after reading "The scientist encouraged the prison guard" than after reading "The scientist threatened the prison guard."

Critically though, affective projection should occur *selectively* among some targets but not others. In particular, prime valence should be projected to targets that can plausibly experience the primed emotional affect, but should not be projected to targets that cannot experience the given affect. Because some targets have affective experiences (e.g., humans) whereas other targets do not (e.g., tools), valence can plausibly be projected onto the former but not the latter. Thus, depending on whether the prime valence can be projected onto the target stimuli or not, affective projection should occur or not. Notice that this prediction contrasts from a simple priming explanation, whereby positive primes and negative primes would respectively increase and decrease judgments in a more general manner. By such a priming account, positive and negative social interactions—or indeed any positive or negative prime stimulus—might influence judgments of any target stimuli. Thus, exploring the generality of this hypothesized phenomenon will discriminate the affective projection account from a simpler priming account.

Exploring the symmetry of the hypothesized phenomenon will also critically test the affective projection account. Are positive affect and negative affect both projected onto unrelated targets, and in approximately equal measure? Or is one valence more likely to be projected than the other, in an asymmetric manner? Prior research suggests that affective projection should be *asymmetric*. As described earlier, positive mood exerts a broad range of effects on cognition, whereas negative mood exerts little effect (Clore & Huntsinger, 2007). So if positive and negative primes are analogous to positive and negative moods, then positive emotions should be projected but negative emotions should have little effect.

Another way to test the affective projection hypothesis is to examine its effect on similarity. To reiterate, Estes and Alix-Gaudreau (2003) found that two targets (e.g., bus driver & lawyer) are judged more similar following a positive social interaction than following a negative social interaction between two other individuals (e.g., scientist & prison guard). If that effect is indeed due to affective projection, as we have hypothesized, then it should exhibit the same properties as affective projection more generally. That is, affective primes should influence the perceived similarity of affective targets such as humans but not of targets that are incapable of experiencing emotions, such as tools (i.e., *selectivity*). Furthermore, positive primes should increase perceived similarity whereas negative primes should not (i.e., *asymmetry*).

OVERVIEW OF EXPERIMENTS

In sum, preliminary evidence indicates that emotion influences similarity (Estes & Alix-Gaudreau, 2003), but the reliability, basic properties, and theoretical explanation of this effect are presently unknown. Before examining this effect of emotion on similarity, Experiment 1 first tested the viability of the affective projection account. We presented positive and negative prime scenarios (e.g., "The scientist [encouraged/threatened] the prison guard"), and then we asked participants to judge how likely another given scenario was to occur between two other, unrelated people (e.g., "How likely is it that a poet [encourages/threatens] a florist?"). Based on prior research (see Clore & Huntsinger, 2007), we predicted that positive primes would increase the perceived likelihood of another positive interaction, but negative primes would not affect the perceived likelihood of other negative interactions. This prediction was supported.

Having thus established the occurrence of affective projection, five further experiments tested its influence on perceived similarity. We varied whether the primes consisted of sentences with transitive verbs (e.g., "The poet smiled at the florist"), sentences with intransitive verbs (e.g., "The poet laughed"), or intransitive verbs alone (e.g., "laughed"). If the effect of the emotional prime on similarity is relational in nature (e.g., X smiled at Y), then it should occur with relational (transitive) sentences but not with solo (intransitive) sentences or verbs. Alternatively, if it were due to emotional valence (i.e., positive), then the same effect should occur regardless of whether the prime is relational (i.e., transitive and intransitive primes).

We also varied whether the target stimuli were social categories (e.g., priest & stunt man), artifacts (e.g., axe & fork), animals (e.g., penguin & horse), artifact-like novel figures, or animal-like novel figures. The purpose of manipulating the nature of the target stimuli was to test the generality of affective projection. Would the valence effect observed among human targets (Estes & Alix-Gaudreau, 2003) also be observed among artifacts, animals, and even novel perceptual figures? The affective projection account predicts that prime valence will selectively influence the similarity of targets that can plausibly experience that affect (i.e., humans and possibly animals), but not of targets that cannot experience the affect (i.e., tools). Thus, the present experiments examined the generality and symmetry of affective projection and its influence on perceived similarity.

EXPERIMENT 1

According to our affective projection hypothesis, the affect evoked by a prime stimulus is projected onto subsequent target stimuli. This hypothesis is consistent with prior findings of social projection (cf. Ames, 2004; Robbins & Krueger, 2005), but differs in two important respects. First, whereas prior studies have examined the projection of beliefs and behaviors (e.g., the likelihood of cheating), the present study examines the projection of affective states (e.g., positive emotion). Second, whereas prior studies have entailed the projection of one's own beliefs or behaviors onto another, the present study entailed the projection of an externally observed affective state onto yet another external stimulus. Thus, evidence of such affective projection would generalize models of social projection to include emotional states that are observed in others rather than experienced by the self.

Experiment 1 tested whether such affective projection occurs. Across a series of trials, participants were first asked to imagine a given positive or negative interaction between two individuals (e.g., "The librarian [thanked/tricked] the astronaut"), and then they were asked to rate how likely another given interaction was to occur between two other individuals (e.g., "How likely is it that a soldier [thanks/trusts/tricks] a chef?"). Will a positive prime (e.g., "The librarian thanked the astronaut") increase likelihood judgments of the given prime interaction only (e.g., "A soldier thanks a chef"), or will that affective projection generalize to other positive interactions (e.g., "A soldier trusts a chef"), relative to a negative interaction (e.g., "A soldier tricks a chef")? Such a result would indicate that the emotional valence is projected, rather than just the given prime scenario per se.

Additionally, the target categories were either humans (e.g., soldier & chef) or artifacts (e.g., saw & spoon). This manipulation of target domain tested whether the hypothesized effect was attributable to affective projection, or to simple priming. If positive primes simply increase likelihood judgments in general, then the same effect should occur among human and artifact targets. Alternatively, if the effect were due to affective projection, then it should occur among human targets but not among artifact targets, because humans can plausibly experience the projected emotion but artifacts cannot.

METHOD

Participants. Fifty-five undergraduates at the University of Warwick (Coventry, England) participated in the experiment for partial course credit, and 25 undergraduates at Wayne State University (Detroit, Michigan, U.S.) participated in a valence norming pretest.

Valence Norming Pretest. Prime stimuli were sampled from Estes and Alix-Gaudreau (2003). To validate the valence manipulation of those stimuli, while also pretesting alternative stimuli for the subsequent experiments, we generated a list of 141 verbs that were intended to vary in valence, including the 20 positive verbs and 20 negative verbs from Estes and Alix-Gaudreau (2003). The list included both transitive verbs that typically entail human agents and patients (e.g., "kiss") as well as intransitive verbs that could be performed by a single individual (e.g., "cry"). The latter were included for use in subsequent experiments. Twenty-five participants rated the valence of all 141 verbs on a scale from 1 ("very negative") to 7 ("very positive"). The 20 negative verbs (M = 2.24, SE = .11) and 20 positive verbs (M = 5.80, SE = .09) that were used in Experiment 1 differed significantly in valence, $t(38) = 24.81$, $p < .001$, but not in extremity (i.e., distance from the midpoint of the scale; $p = .78$). That is, the positive stimuli were just as positive as the negative stimuli were negative.

Materials. Prime sentences were constructed from 20 common person categories, 10 positive verbs and 10 negative verbs. Categories were randomly paired, with the constraint that no pair consisted of two categories that canonically interact (e.g., doctors and nurses), and one positive and one negative verb were randomly assigned to each category pair. Prime sentences were created by asserting either the positive or the negative verb between each category pair in subject-verb-object definite past tense form (e.g., "The librarian thanked the astronaut"). Target sentences were constructed from 20 different pairs of human social categories, 20 pairs of artifacts, 10 additional negative verbs and 10 additional positive verbs. Human targets were again constrained so that no pair consisted of two categories that canonically interact. Similarly, to minimize pre-existing relations, each pair of artifacts consisted of one kitchen utensil or appliance and one gardening or carpentry tool (e.g., saw & spoon). One positive and one negative verb were randomly assigned to each category pair, and target sentences were created by asserting either the positive or the negative verb between each category pair in subject-verb-object indefinite present tense form (e.g., "A soldier trusts a chef"). Target categories were randomly paired with prime sentences, with the constraint that prime and target categories do not interact canonically, and these random pairings were held constant across participants. Because the same category pairs appeared in all experimental conditions, any effect on likelihood judgments would only be attributable to the valence of the primes and target verbs.

Target sentences related to prime sentences in one of three ways. Prime and target sentences always used different categories, but the verbs were either identical (Identical condition), different but of the same valence (Same Valence condition), or different and of the opposite valence (Different Valence condition). For instance, after the positive prime "The librarian thanked the astronaut," an *identical* target was "A soldier thanks a chef," a *same valence* target was "A soldier trusts a chef," and a *different valence* target was "A soldier trips a chef." But after the negative prime "The librarian tricked the astronaut," an *identical* target was "A soldier tricks a chef," a *same valence* target was "A soldier trips a chef," and a *different valence* target was "A soldier trusts a chef." Thus, each participant judged the same targets twice, once after a same-valence prime and once after a different-valence prime. A complete list of stimuli, for all experiments reported herein, is available from the authors upon request.

Target valence (negative, positive), target domain (humans, artifacts), and prime-target relation (identical, same valence, different valence) were all manipulated within-participants. Thus, 20 prime sentences (10 negative, 10 positive) appeared six times each, followed by one target sentence from each of the six target conditions (i.e., 2 target domains × 3 relations).

Procedure. The experiment was administered via computer. Participants initiated each trial by pressing the space bar, which triggered a prompt to "Imagine the following scenario." This prompt appeared centered at the top of the screen, with the prime sentence centered directly below, so that prompt and prime both appeared in the top half of the display. After 2 seconds, participants were asked "How likely is the following scenario?" with the target sentence directly below, and a 7-point response scale (1 = "extremely unlikely," 7 = "extremely likely") directly below that. The target prompt, scenario, and scale all appeared in the lower half of the display. The prime scenario remained onscreen during target presentation, which was terminated by pressing a number response, which in turn triggered a 500 ms inter-trial interval. Each participant completed 120 trials, 10 in each cell of the 2 (Target Valence) × 2 (Target Domain) × 3 (Prime-Target Relation) design. Trial order was randomized separately for each participant.

RESULTS AND DISCUSSION

Full results are reported in Table 1. An initial 2 (Domain: humans, artifacts) × 2 (Target Valence: negative, positive) × 3 (Relation: identical, same valence, different valence) repeated measures ANOVA yielded a highly significant main effect of Domain, $F(1, 54) = 588.40$, $p < .001$. As expected, affective interactions were judged far more likely to occur between human targets ($M = 4.74$, $SE = .09$) than between artifact targets ($M = 1.68$, $SE = .12$). This result confirms that affective states (e.g., X smiled at Y, X frowned at Y) are projected to humans (e.g., a poet and a florist) but not to artifacts (e.g., an axe and a fork). Although it is intuitive, this result provides an important constraint insofar as it demonstrates that the effect is not due to merely priming the target judgment indiscriminately. Domain interacted significantly with Target Valence, $F(1, 54) = 216.21$, $p < .001$, and the three-way

TABLE 1. Likelihood ratings as a function of Domain, Target Valence, and Relation in Experiment 1. Prime and target interactions were either identical (Identical), different but of the same valence (Same Valence), or different and of the opposite valence (Different Valence).

		Relation					
	Target	Identical		Same Valence		Different Valence	
Domain	Valence	*M*	*SE*	*M*	*SE*	*M*	*SE*
Humans	Negative	4.28	0.13	4.32	0.11	4.17	0.11
	Positive*	5.37	0.11	5.24	0.09	5.03	0.11
Artifacts	Negative†	1.85	0.16	1.81	0.15	1.64	0.11
	Positive	1.62	0.14	1.64	0.11	1.52	0.09

Note. *All pairwise comparisons in this row were significant ($p < .05$). †Different Valence differed marginally from Identical and Same Valence ($p < .06$).

interaction was also significant, $F(2, 108) = 3.93$, $p < .05$. We therefore conducted further analyses of artifact and human targets separately.

Artifact targets exhibited only a significant main effect of Target Valence, $F(1, 54) = 11.44$, $p < .001$, such that negative interactions were judged more likely ($M = 1.77$, $SE = .13$) than positive interactions ($M = 1.59$, $SE = .10$). Thus, artifact targets were judged highly unlikely to interact in an emotional way, but negative interactions were slightly more likely than positive interactions between those artifacts.

A 2 (Target Valence: negative, positive) × 3 (Relation: identical, same valence, different valence) ANOVA with human targets yielded a different and more marked pattern of results. Evident in Table 1 is a main effect of Target Valence, $F(1, 54) = 244.65$, $p < .001$, with positive interactions ($M = 5.21$, $SE = .09$) rated significantly more likely than negative interactions ($M = 4.26$, $SE = .10$). That is, participants judged positive interactions such as a poet smiling at a florist to be more likely than negative interactions such as a poet frowning at a florist. However, Target Valence also interacted significantly with Relation, $F(2, 108) = 3.55$, $p < .05$. To examine this interaction in more detail, we subsequently conducted one-way ANOVAs across the negative and the positive targets separately. There was no effect of Relation on negative targets ($p = .36$). For instance, a poet frowning at a florist was judged equally unlikely after imagining a scientist frowning at, insulting, or smiling at a prison guard. Among positive targets, though, the effect of Relation was significant, $F(2, 108) = 5.65$, $p < .01$. Positive target interactions were judged more likely after imagining that same positive interaction between two other individuals (identical) than after imagining another positive interaction (same valence), $t(54) = 2.00$, $p = .05$, which in turn was more likely than after imagining a negative interaction (different valence), $t(54) = 2.16$, $p < .05$. In other words, the perceived likelihood of a positive interaction between two individuals varied according to its similarity to the preceding interaction. Identical interactions were more likely than same-valence interactions, which were more likely still than different-valence interactions.[1] So for instance, a poet smiling at a florist was judged most likely after a scientist smiled at a prison guard, relatively less likely after a scientist thanked a prison guard, and was judged least likely after a scientist frowned at a prison guard.

1. The corresponding comparison of same-valence and different-valence conditions was not significant with negative targets, $p = .17$.

Thus, three main results were observed. First, the main effect of target domain indicates that affective states were attributed to human targets but not to artifact targets. This finding in itself does not necessarily imply that affective projection occurred. However, the selectivity of this effect was predicted by the affective projection account: Because artifacts cannot plausibly experience emotion, the primed affective state cannot be projected onto them. This selectivity also excludes a simple priming explanation; positive primes did not simply increase subsequent judgments indiscriminately, as a priming account would predict. Second, the main effect of target valence indicates that positive interactions were more likely than negative interactions to be attributed to human targets. Finally and most importantly, the interaction of target valence and prime-target relation indicates affective projection of positive but not of negative emotions. More specifically, the difference between identical and different-valence targets indicates affective projection akin to the social projection of other experiences and traits (Ames, 2004; Robbins & Krueger, 2005). This affective projection occurred with positive targets but not with negative targets. Furthermore, the difference between same-valence and different-valence targets also indicates that this affective projection generalizes to other instances of the same valence. That is, positive affect was projected, not just the specific interaction described in the prime scenario. So in sum, Experiment 1 provided the first demonstration that affective states are projected from primes to unrelated targets, in a selective and asymmetric manner. The subsequent experiments examined the influence of this affective projection on similarity.

EXPERIMENT 2

In Experiment 2, participants first read sentences describing either a positive or a negative social interaction, and then they judged the similarity of either unrelated social categories (as in Estes & Alix-Gaudreau, 2003) or unrelated artifact categories. For instance, after reading "The scientist encouraged the prison guard," participants judged the similarity either of priests and stunt men or of axes and forks. The projection hypothesis assumes a sort of social projection (cf. Ames, 2004; Robbins & Krueger, 2005), whereby the affect evoked by a prime is projected onto the subsequent target stimuli (see Experiment 1), which are then influenced by that projected affect. So for instance, after reading that a scientist encouraged a prison guard, that positive affect is projected onto priests and stunt men, hence increasing their perceived similarity. Critically though, Experiment 1 demonstrated that valence should only influence target stimuli to which the given affect can be projected; it should not influence target stimuli that do not experience such affect. That is, a social relation between scientists and prison guards can influence the similarity of priests and stunt men because these targets could also experience emotional affect. In contrast, that same social interaction should not influence the similarity of axes and forks because these targets could not experience that affect. Thus, the affective projection account predicts that prime valence should selectively influence judgment of human targets but not of artifact targets.

METHOD

Participants. Participants in all subsequent experiments reported herein were undergraduates at Wayne State University, and all received partial course credit for participation. One hundred nine undergraduates participated in Experiment 2.[2]

Materials and Design. Prime valence (negative, positive) and target domain (humans, artifacts) were both manipulated within-participants. Prime sentences were the same as those used by Estes and Alix-Gaudreau (2003) and shown in Experiment 1 to differ significantly in valence but not in extremity (see *Valence Norming Pretest*). They were constructed from 40 common person categories (e.g., scientists & prison guards), 20 positive verbs and 20 negative verbs (e.g., encouraged, discouraged). As in Experiment 1, categories were randomly paired, one positive and one negative verb were randomly assigned to each category pair, and prime sentences were created by asserting either the positive or the negative verb between each category pair in subject-verb-object definite past tense form (e.g., "The scientist encouraged the prison guard"). Targets consisted of 20 different pairs of human social categories (e.g., priest & stunt man) and 20 pairs of artifacts (e.g., axe & fork). Human targets were again constrained so that no pair consisted of two categories that canonically interact, and each pair of artifacts again consisted of one kitchen utensil or appliance and one gardening or carpentry tool. Target categories were randomly paired with prime sentences.

Procedure. The experiment was administered via computer and was introduced to participants as a study of task-switching, in which their ability to change repeatedly between two unrelated tasks was under investigation. Each trial began with presentation of a prime sentence (e.g., "The scientist encouraged the prison guard"), which participants rated for valence on a scale from 1 ("extremely negative") to 7 ("extremely positive") by pressing the corresponding number on the keyboard. A target question then appeared (e.g., "How similar is an axe to a fork?"), and finally participants rated the similarity of the given targets from 1 ("not at all similar") to 7 ("extremely similar") by pressing the corresponding number. Each participant completed 40 trials, 10 in each cell of the 2 (Prime Valence) × 2 (Target Domain) design. The order of presentation of the targets (e.g., "How similar is [an axe to a fork/a fork to an axe]?") was counterbalanced across experimental lists, with participants randomly assigned to lists. Trial order was randomized separately for each participant.

RESULTS AND DISCUSSION

As expected, the positive primes ($M = 5.27$, $SE = .09$) elicited higher valence ratings than the negative primes ($M = 2.53$, $SE = .09$), $t(108) = 20.43$, $p < .001$. The manipu-

2. A few participants provided little or no variance in their similarity ratings across trials. For instance, some participants provided the exact same rating on every trial of the experiment. On the basis that these invariant participants were presumably not engaged in the task, we excluded any participant whose ratings had a standard deviation less than 0.5. Across all experiments this led to the exclusion of 3% of participants.

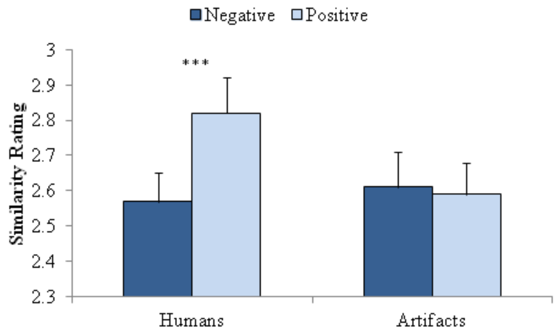

FIGURE 1. Similarity ratings (M + SE) of humans and artifacts following a negative or a positive prime in Experiment 2. ***$p < .001$.

lation of prime valence was thus validated, and participants' attention to the task was confirmed. Mean similarity ratings, which are illustrated in Figure 1, were analyzed via 2 (Prime Valence: negative, positive) × 2 (Target Domain: humans, artifacts) repeated measures ANOVA. Similarity ratings were significantly higher following a positive than a negative prime, $F(1, 108) = 8.40$, $p < .01$, and were marginally higher among human than among artifact targets, $F(1, 108) = 3.14$, $p = .08$. The critical Valence × Domain interaction was significant, $F(1, 108) = 4.75$, $p < .05$. As illustrated in Figure 1, the valence of the prime sentence significantly affected the similarity of otherwise unrelated humans, $t(108) = 4.15$, $p < .001$, but not artifacts, $t(108) = .25$, $p = .81$. As shown in Table 2, the effect of prime valence on the perceived similarity of human targets was of medium size ($d = .41$).[3] To examine the reliability of the null effect on artifact targets, we conducted post hoc power analyses (see Faul, Erdfelder, Lang, & Buchner, 2007). Assuming the same effect size of .41 and the standard alpha of .05, the achieved power in the artifact condition was 1.00. Thus, despite full statistical power, prime valence exerted no effect on similarity ratings of artifacts.

Two aspects of these data are notable. First, the target categories (e.g., priests & stunt men) were unrelated to the prime sentence (e.g., "The scientist encouraged the prison guard"), yet participants' similarity ratings were reliably affected by that preceding sentence. This finding confirms that the effect of emotional valence on target similarity is quite general, extending beyond the categories involved in the prime to other unrelated human targets (Estes & Alix-Gaudreau, 2003). Second, because this effect was not observed with artifact targets, the present study also demonstrates that this effect is selective. This selectivity was predicted by the affective projection account, and it corroborates the finding in Experiment 1 that affect is projected to humans but not to artifacts. Affective primes only influence the perceived similarity of target stimuli to which the given affect could plausibly be projected. For instance, a prime such as "The scientist encouraged the prison guard" did not influence the similarity of artifact targets such as axes and forks,

3. All effect sizes reported herein were calculated as Cohen's *d* with Morris and DeShon's (2002, equation 8) adjustment for repeated measures.

TABLE 2. Similarity Ratings as a Function Prime Stimuli, Prime Valence, and Target Stimuli

				Prime Valence						
		Prime	Target	Negative		Neutral		Positive		
Exp't	***N***	**Stimuli**	**Stimuli**	***M***	***SE***	***M***	***SE***	***M***	***SE***	***d***
2	109	Trans. Sent.	Humans	2.57	0.08	—	—	2.82	0.10	0.41***
			Artifacts	2.61	0.10	—	—	2.59	0.09	0.02
3	80	Trans. Sent.	Humans	2.77	0.10	—	—	2.92	0.11	0.26*
			Animals	2.16	0.11	—	—	2.36	0.11	0.36**
4	72	Trans. Sent.	Yadgits	2.59	0.11	—	—	2.63	0.11	0.08
			Greebles	2.95	0.12	—	—	3.18	0.12	0.39**
5	75	Trans. Sent.	Greebles	2.22	0.12	2.18	0.09	3.08	0.12	1.05***
		Intrans. Sent.		2.54	0.12	2.56	0.12	3.26	0.12	1.04***
6	36	Intrans. Sent.	Greebles	1.89	0.12	1.94	0.12	2.80	0.14	1.31***
		Intrans. Verb		1.82	0.12	2.03	0.12	2.76	0.15	1.39***

Note. Prime stimuli were sentences containing a transitive verb ("Trans. Sent."; e.g., "The professor thanked the bartender"), sentences containing an intransitive verb ("Intrans. Sent."; e.g., "The professor smiled"), or just intransitive verbs alone ("Intrans. Verb"; e.g., "smiled"). Target stimuli were human categories ("Humans"; e.g., bus driver & lawyer), artifacts ("Artifacts"; e.g., axe & fork), animals ("Animals"; e.g., horse & penguin), artifact-like novel figures ("Yadgits"), or animal-like novel figures ("Greebles"). Higher ratings indicate greater similarity or difference (scale: 1 to 7). d = Cohen's *d*, comparing negative and positive conditions. $*p < .05$, $**p < .01$, $***\ p < .001$, all two-tailed.

presumably because artifacts cannot experience the emotional affect elicited by the prime. These results thus support the affective projection hypothesis.

EXPERIMENT 3

Experiment 2 revealed that the valence of a social relation affects the similarity of human targets but not artifact targets. Experiment 3 investigated further the boundary conditions of this effect. There is reason to believe that emotion may affect the similarity of other nonhuman targets, namely, animals. Most cultures exhibit a common hierarchy of animacy, with decreasing levels of animacy from humans to animals to artifacts (e.g., Whaley, 1997). Experiment 2 tested the extreme ends of this animacy hierarchy, showing that the valence effect does have limitations. However, that experiment did not reveal whether the valence effect is limited to human targets. Experiment 3 therefore tested whether the valence effect occurs among nonhuman animals such as penguins and horses. Indeed, much evidence indicates that people judge artifacts and animals differently (Estes, 2003c, 2004; Hampton, 1998; Hampton, Estes, & Simmons, 2007; Hampton, Storms, Simmons, & Heussen, 2009; Rhodes & Gelman, 2009). Thus, we predicted that the valence of a social relation between two humans might affect the perceived similarity of two animal targets.

METHOD

Eighty undergraduates participated. The materials and procedures were the same as Experiment 2, with the sole exception that the artifact pairs of Experiment 2 were replaced with animal pairs here in Experiment 3. Each pair of animals consisted of one mammal and one bird that were not likely to occur within the same context (e.g., penguin & horse).

RESULTS AND DISCUSSION

As expected, valence ratings were significantly higher for the positive primes (M = 5.17, SE = .11) than the negative primes (M = 2.58, SE = .10), $t(79) = 16.33$, $p < .001$. Thus, the manipulation of prime valence was validated, and participants' engagement in the prime task was confirmed. Participants' similarity ratings of the target stimuli are illustrated in Figure 2 and were analyzed via 2 (Prime Valence: negative, positive) × 2 (Target Domain: humans, animals) repeated measures ANOVA. The human targets (i.e., different occupations) were rated more similar than the animal targets (i.e., mammals and birds), $F(1, 79) = 44.01$, $p < .001$. More importantly, the targets were rated more similar following a positive prime than following a negative prime, $F(1, 79) = 15.77$, $p < .001$. This valence effect on similarity ratings occurred regardless of whether the target stimuli were humans or animals, as the interaction failed to approach significance, $F(1, 79) = .34$, $p = .56$. Paired comparisons confirmed this valence effect among both humans, $t(79) = 2.31$, $p < .05$, and animals, $t(79) = 3.13$, $p < .01$. For instance, a social interaction between a librarian and an astronaut affected the similarity not only of ranchers and therapists, but

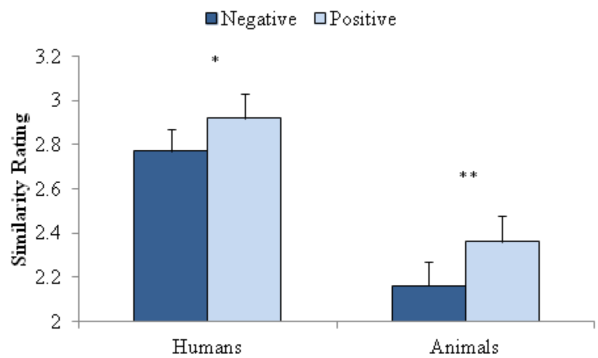

FIGURE 2. Similarity ratings (M + SE) of humans and animals following a negative or a positive prime in Experiment 3. **p* < .05, ***p* < .01.

also of penguins and horses. Thus, the effect of prime valence on perceived similarity is not limited to human targets, but also generalizes to other animals.

EXPERIMENT 4

Experiments 2 and 3 together indicate that animacy, rather than humanity, is the critical predictor of whether the valence of a social interaction affects the similarity of the subsequent targets. One purpose of Experiment 4 was to compare animate and inanimate nonhuman targets within the same experiment. Another purpose was to provide an even stronger test of the generality of the valence effect. Specifically, for maximal generality, we sought to demonstrate the effect with novel perceptual stimuli. In Experiment 4 we therefore contrasted "greebles" and "yadgits," which are novel figures that were designed to appear respectively animal-like and artifact-like (Gauthier & Tarr, 1997; Gauthier, Tarr, Anderson, Skudlarski, & Gore, 1999). Examples are provided in Figure 3. The use of greebles and yadgits as target stimuli is advantageous in two respects. First, because similarity judgments of verbal and pictorial stimuli sometimes differ (Gati & Tversky, 1984; Ritov, Gati, & Tversky 1990), replication of the valence effect with pictorial stimuli would provide a strong generalization. Second, because they are novel, greebles and yadgits provide a test of the valence effect with target stimuli for which there could not be any extant relations or prior knowledge of any sort. They are effectively a blank slate for the potential projection of prime valence. If valence can be projected to animate targets but not to inanimate targets, as indicated by Experiments 2 and 3, then we should observe the valence effect with greebles but not yadgits here in Experiment 4. Such a result would corroborate our prior support of the affective projection account.

METHOD

Seventy-two undergraduates participated. The materials and procedures were the same as Experiments 2 and 3, except that targets were pairs of greebles and

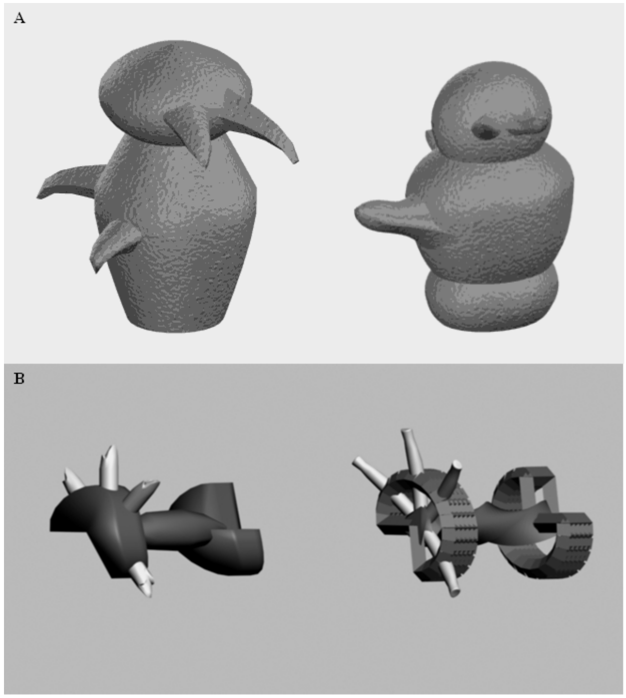

FIGURE 3. Examples of greeble (Panel A) and yadgit (Panel B) target stimuli, Experiment 4. Stimulus images courtesy of Michael J. Tarr, Center for the Neural Basis of Cognition, Carnegie Mellon University, http://www.tarrlab.org/.

yadgits (see Figure 3). Each target stimulus was approximately 3 inches wide by 3 inches high, and they were presented simultaneously in left and right locations (respectively 25% and 75% across the horizontal plane of the display) 3 inches apart. Below the targets were the prompt "How similar are these figures?" and a response scale ranging from 1 ("not at all similar") to 7 ("extremely similar"). As in Experiments 2 and 3, participants rated the valence of the prime sentences and the similarity of the targets by pressing the appropriate number key.

RESULTS AND DISCUSSION

As expected, valence ratings were significantly higher for the positive primes (M = 5.52, SE = .10) than the negative primes (M = 2.32, SE = .07), $t(71) = 22.45$, $p < .001$, thereby validating the manipulation of prime valence. A 2 (Prime Valence: negative, positive) × 2 (Target Domain: greebles, yadgits) repeated measures ANOVA on participants' similarity ratings indicated that the targets overall were rated more similar after a positive prime than after a negative prime, $F(1, 71) = 6.82$, $p = .01$, and the greebles were rated more similar than the yadgits, $F(1, 71) = 22.60$, $p < .001$. These main effects, however, were qualified by a significant interaction, $F(1, 71) = 4.56$, $p < .05$. Specifically, as illustrated in Figure 4, prime valence significantly affected similarity judgments of greebles, $t(71) = 3.27$, $p < .01$, but not yadgits, $t(71) = .70$, $p = .49$. Assuming an effect size of .39 (as observed in the greeble condition; see Table 2) and the standard alpha of .05, the achieved power in the yadgit condition

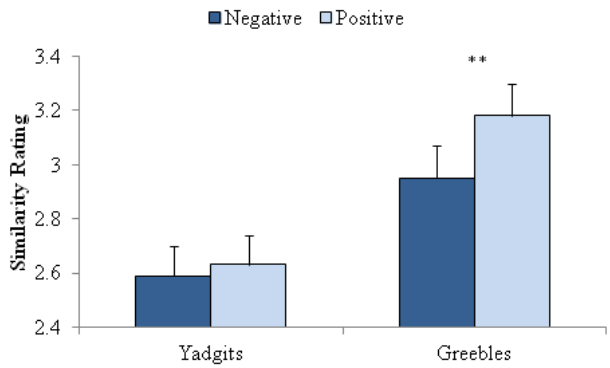

FIGURE 4. Similarity ratings (M + SE) of yadgits and greebles following a negative or a positive prime in Experiment 4. $^{**}p < .01$.

was .95, where power of .80 or higher is typically considered good. Thus, despite good statistical power, no effect of prime valence was observed on similarity ratings of yadgits.

These results further generalize the valence effect to novel perceptual figures, and they also corroborate our prior conclusions. The lack of affect with yadgit targets corroborates the observation in Experiment 2 that prime valence does not influence the similarity of artifact or artifact-like targets. Prime valence evidently influences the perceived similarity of just about any two subsequent stimuli, from familiar human categories to novel perceptual figures, so long as those targets are or appear to be animate. These results thus provide additional support for the projection hypothesis, in that prime valence selectively influences the judgment of targets that could plausibly experience the projected affect. According to this hypothesis, because the greebles in Figure 3 look like animals, and because animals can plausibly experience emotional affect, the affect evoked by a prime is projected onto and influences the perceived similarity of those greebles. In contrast, because the yadgits in Figure 3 appear to be inanimate, they cannot experience emotional affect and hence the prime valence does not influence their similarity.

EXPERIMENT 5

Experiment 4 demonstrated an effect of prime valence on the rated similarity of animal-like figures. This effect is striking and novel—it is not at all obvious that a social interaction between two individuals, such as a plumber and a housewife, should affect the perceived similarity of two perceptual figures. We have argued that this effect arises from a projection of valence onto the target stimuli (cf. Ames, 2004; Robbins & Krueger, 2005), and hence affective valence influences the similarity of stimuli that could plausibly experience that affect (e.g., humans, animals, and animal-like greebles), but does not influence the similarity of stimuli that could not instantiate that affect (e.g., artifacts and artifact-like yadgits). Alternatively, however, the effect could be explained by relation priming. Because Experiments 1–4 all used relational primes (e.g., "The singer thanked the engineer"), it could be the prime relation (e.g., "X thanked Y") rather than the prime valence (e.g., positive) that is projected onto the target stimuli. Indeed, much research has shown that a relation between two concepts can prime that same relation in two unrelated target concepts (Estes, 2003b; Estes & Jones, 2006; Raffray, Pickering, & Branigan, 2007; Spellman, Holyoak, & Morrison, 2001; Wisniewski & Love, 1998), and relations between concepts influence their perceived similarity (Bassok & Medin, 1997; Estes, 2003a; Golonka & Estes, 2009; Simmons & Estes, 2008; Wisniewski & Bassok, 1999; for review see Estes, Golonka, & Jones, 2011). Thus, it is unclear from the preceding experiments whether the prime relation or its valence influenced similarity, because relations and valence were perfectly confounded in those experiments.

Experiment 5 unconfounded these two factors by manipulating orthogonally the valence and the relationality of the prime sentences. To manipulate relationality, we presented some prime sentences with transitive verbs describing a relation between two individuals (e.g., "The violinist thanked the engineer") and others with intransitive verbs describing an act by a single individual (e.g., "The tailor cried"). Participants then judged the similarity of greebles, as in Experiment 4. If the previously observed effects were due to the relation, then they should occur here with transitive primes but not with intransitive primes. Alternatively, if the effects were due to valence, then they should occur with both transitive and intransitive sentences.

Finally, Experiment 5 also tested the symmetry of this effect. In addition to positive and negative primes, this experiment included neutral primes (e.g., "The baker glanced at the athlete"). Recall from the introduction that positive mood influences a broad range of judgments and behaviors, whereas negative mood has little or no effect on those same judgments and behaviors (Clore & Huntsinger, 2007). Thus, assuming that the influence of valence on similarity is analogous to the influence of mood on other cognitions, positive primes should increase similarity relative to neutral primes, whereas negative primes should not influence similarity. Moreover, in Experiment 1 we found social projection of positive emotion but not of negative emotion. We thus predicted an asymmetric influence of prime valence on target similarity.

METHOD

Seventy-five undergraduates participated. A new set of stimuli were sampled from the *Valence Norming Pretest* described in Experiment 1. In addition to transitive verbs that require both an agent and a patient (e.g., "thanked," "insulted"), Experiment 5 also used intransitive verbs that can occur without a patient (e.g., "laughed," "cried"). We selected ten verbs in each cell of the 2 (Prime Form: transitive, intransitive) × 3 (Prime Valence: negative, neutral, positive) design, with the goal of equating the form conditions on valence while maximizing the differences between valence conditions. A 2 (Form) × 3 (Valence) ANOVA on the verbs' valence ratings yielded neither a main effect of Form nor an interaction with Valence (both $p > .99$), thereby confirming that the transitive and the intransitive verbs were closely matched across the negative, neutral, and positive conditions. In contrast, the main effect of Valence was significant, $F(2, 54) = 727.64$, $p < .001$, thus validating the manipulation of valence. The neutral verbs ($M = 4.14$, $SE = .05$) differed significantly in valence from both the negative verbs ($M = 2.08$, $SE = .05$), $t(38) = 29.74$, $p < .001$, and the positive verbs ($M = 5.78$, $SE = .09$), $t(38) = 15.51$, $p < .001$. The negative and positive verbs were equally extreme, that is, equally distant from the midpoint of the valence scale ($p = .17$). Transitive primes were constructed as in the preceding experiments (e.g., "The poet danced with the historian"). Intransitive primes consisted of the form "The [human category] [verb]," where the verb appeared in past tense (e.g., "The musician smiled"). Participants judged the valence of each prime by pressing the 1 (negative), 2 (neutral), or 3 (positive) key. Target stimuli were the same greebles used in the preceding experiment (yadgits were not used in this experiment), and the procedure was otherwise identical to that of the preceding experiment.

RESULTS AND DISCUSSION

We first analyzed participants' mean valence ratings of the primes via 2 (Prime Form) × 3 (Prime Valence) ANOVA. As expected, the main effect of Prime Valence was significant, $F(2, 148) = 199.51$, $p < .001$. The negative primes ($M = 1.39$, $SE = .05$) were judged less positive than the neutral primes ($M = 2.10$, $SE = .02$), which in turn were judged less positive than the positive primes ($M = 2.55$, $SE = .04$). Thus, the manipulation of prime valence was validated.[4]

A 2 (Prime Form) × 3 (Prime Valence) ANOVA on participants' similarity ratings also revealed a significant main effect of Valence, $F(2, 148) = 84.67$, $p < .001$. This valence effect indicates that, as in the preceding experiments, novel animal-like figures were rated more similar following a positive prime than following a negative prime (see Figure 5). Strikingly, however, negative primes and neutral primes elicited virtually identical similarity ratings, $t(74) = .18$, $p = .86$. This result indicates asymmetry: Positive primes increased perceived similarity, whereas negative primes had no effect (relative to neutral primes). This finding is consistent with much prior research demonstrating that positive mood, but not negative mood, exerts broad effects on cognition and behavior (Clore & Huntsinger, 2007). It also corroborates the finding in Experiment 1 that positive affect is projected to unrelated targets but negative affect is not.

Target similarity ratings also exhibited unexpected effects. The main effect of Prime Form was significant, $F(1, 74) = 62.98$, $p < .001$, with higher similarity ratings after intransitive primes ($M = 2.79$, $SE = .11$) than after transitive primes ($M = 2.50$, $SE = .10$). The interaction of Prime Form and Valence was also significant, $F(2, 148) = 3.39$, $p < .05$. Valence exerted a significantly larger effect on perceived similarity following transitive primes ($M_{pos} - M_{neg} = .86$) than following intransitive primes ($M_{pos} - M_{neg} = .71$). Despite this significant difference in the absolute magnitude of

4. Unexpectedly, the main effect of Prime Form was also significant, $F(1, 74) = 4.86$, $p < .05$: The intransitive sentences ($M = 2.05$, $SE = .02$) were judged more positive than the transitive sentences ($M = 1.99$, $SE = .03$). Also in contrast to the *Valence Norming Pretest*, the interaction of Prime Form and Prime Valence was significant, $F(2, 148) = 6.24$, $p < .01$. Specifically, whereas the transitive and intransitive sentences did not differ in mean valence of negative primes ($p = .49$) or neutral primes ($p = .64$), the positive intransitive primes were rated more positive than the positive transitive primes, $t(74) = 4.19$, $p < .001$. Given that neither the main effect of Prime Form nor its interaction with Prime Valence approached significance in the stimulus pretest, we are unaware of why these effects occurred here. Most importantly, however, the negative, neutral, and positive primes clearly differed in valence within both the transitive and the intransitive conditions. Thus, the manipulation of prime valence was validated, albeit to different extents in the transitive and intransitive conditions. The unexpected main effect of Prime Form and its interaction with Valence may be related to the same unexpected effects in the valence ratings (see below).

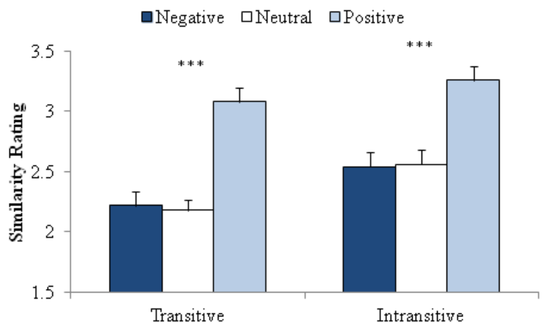

FIGURE 5. Similarity ratings (M + SE) of greebles following a negative, neutral, or positive prime in Experiment 5. Prime sentences were either transitive (e.g., "The violinist thanked the engineer") or intransitive (e.g., "The tailor cried"). $***p < .001$.

the effect, the standardized effect size was reliable (*p*s < .001), robust, and nearly identical in the transitive ($d = 1.05$) and intransitive ($d = 1.04$) conditions. Note also that the effect size increased dramatically relative to the preceding experiments (see Table 2). It is unclear whether this increased effect size was attributable to the inclusion of intransitive verbs or of neutral verbs in the present experiment. Most importantly, though, transitive and intransitive primes both affected the perceived similarity of a subsequent pair of greebles, and this effect was due to greater similarity following a positive sentence than following either a negative or a neutral sentence. Thus, the effect was asymmetric, and it was attributable to the valence of the prime (i.e., positive) rather than the relation per se (e.g., "kissed").

EXPERIMENT 6

In Experiment 5, positive primes increased the similarity of greeble targets, regardless of whether the prime sentences were transitive or intransitive. That finding was theoretically informative because it suggested that the influence of the prime sentence on target similarity was attributable to affective projection rather than relation priming. Experiment 6 aimed to replicate this effect among intransitive sentences (e.g., "The librarian won") and to extend this effect to intransitive verbs alone (e.g., "won"). If the effect is attributable to prime valence, as we have argued, then it should occur with both sentence and verb primes. Experiment 6 also sought to replicate the asymmetry of this effect, with positive primes increasing similarity ratings (relative to neutral primes) but negative primes having little or no effect on similarity ratings.

METHOD

Thirty-six undergraduates participated. Sentence primes were those used in the intransitive condition of Experiment 5 (e.g., "The reporter sat"), and verb primes were just the verbs from those sentences (e.g., "sat"). The design was thus a 2 (Form: sentence, verb) × 3 (Valence: negative, neutral, positive) within-participant

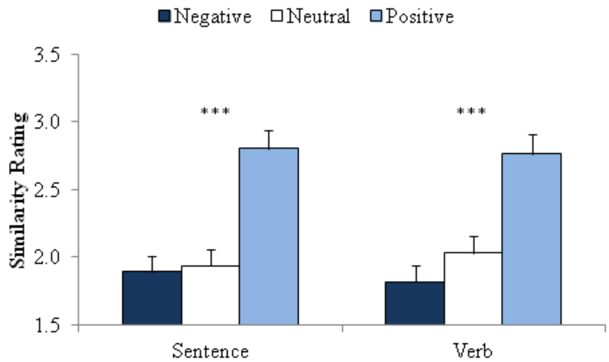

FIGURE 6. Similarity ratings (M + SE) of greebles following a negative, neutral, or positive prime in Experiment 6. Primes were either intransitive sentences (e.g., "The tailor cried") or just their intransitive verbs (e.g., "cried"). ***$p < .001$.

experiment, with greebles as target stimuli. The procedure was identical to that of the preceding experiment.

RESULTS AND DISCUSSION

Participants' mean valence judgments of the primes were analyzed via 2 (Prime Form) × 3 (Prime Valence) ANOVA. Only the main effect of Valence was significant, $F(2, 70) = 284.21$, $p < .001$. As expected, the negative ($M = 1.31$, $SE = .06$), neutral ($M = 2.13$, $SE = .03$), and positive primes ($M = 2.76$, $SE = .03$) elicited increasingly higher valence ratings. Neither the main effect of Form ($p = .86$) nor its interaction with Valence ($p = .25$) was significant. Thus, the manipulation of Prime Valence was validated.

A 2 (Prime Form) × 3 (Prime Valence) ANOVA on participants' similarity ratings revealed a significant main effect of Valence, $F(2, 70) = 58.30$, $p < .001$. This valence effect indicates that, as in the preceding experiments, novel animal-like figures were rated more similar following a positive prime than following a negative prime (see Figure 6). Neither the main effect of Form ($p = .87$) nor its interaction with Valence ($p = .16$) was significant. As in the preceding experiment, similarity ratings were significantly higher following positive primes than following neutral primes, $t(35) = 9.63$, $p < .001$, but similarity ratings did not differ following neutral primes and negative primes ($p = .15$).[5] The difference in similarity ratings of greebles following positive and negative primes was again very large for both sentence primes ($d = 1.31$) and verb primes ($d = 1.39$). Experiment 6 thus replicated the asymmetric influence of emotion on judgment, and extended this effect to nonsocial primes (e.g., "relaxed").

5. Although the Form × Valence interaction was nonsignificant ($p = .16$) and the overall comparison of negative and neutral primes was also nonsignificant ($p = .15$), visual inspection of Figure 6 suggests that negative verbs might have elicited lower similarity ratings than neutral verbs. This comparison indeed was significant, $t(35) = 2.09$, $p < .05$, thus suggesting that under some conditions negative primes can influence target judgments. Notably, however, this effect was substantially smaller than the effect of positive primes, and it was also substantially less reliable: Whereas positive primes influenced judgments in all five tests reported here (i.e., Experiment 1, Experiment 5 transitive condition, Experiment 5 intransitive condition, Experiment 6 sentence condition, and Experiment 6 verb condition), negative primes influenced judgments in only one of those five tests.

GENERAL DISCUSSION

Across six experiments, emotion selectively and asymmetrically affected judgment. Animate stimuli including humans (e.g., priests & stunt men), animals (e.g., horses & penguins), and animal-like figures (i.e., greebles) were judged more similar following a positive prime (e.g., "The scientist encouraged the prison guard") than following a negative prime (e.g., "The scientist threatened the prison guard"). In contrast, similarity ratings of inanimate stimuli including artifacts (e.g., axes & forks) and artifact-like figures (i.e., yadgits) were unaffected by the preceding primes. This valence effect was asymmetric in that, relative to neutral primes, positive primes increased target similarity but negative primes had no effect on similarity. Finally, the valence effect was elicited by both transitive (relational) and intransitive (non-relational) primes. We have argued that these effects are explained by a process of affective projection, whereby the emotion evoked by a prime is projected onto and influences judgments of unrelated targets.

AFFECTIVE PROJECTION

Three aspects of these results implicate an affective projection process. First, Experiment 1 directly demonstrated that affective projection occurs. Prior research on social projection has shown that traits and experiences are projected from the self to others (Ames, 2004; Katz & Allport, 1931; Robbins & Krueger, 2005). For example, liberals overestimate the percentage of a given population who are liberal, and students who cheat similarly overestimate the likelihood of other students cheating. In our first experiment, we found that imagining a scenario such as "The librarian thanked the astronaut" led a similar scenario such as "A soldier thanks a chef" to be judged highly likely. Moreover, a positive scenario such as "A soldier trusts a chef" was judged significantly more likely to occur following another positive scenario such as "The librarian thanked the astronaut" than following a negative scenario such as "The librarian tricked the astronaut." Thus, the prime scenario increased the perceived likelihood of a target scenario of the same affective valence. Evidently, the emotion evoked by the first scenario is projected onto the subsequent targets, thereby increasing the likelihood of a similarly positive experience.

Second, the affective projection account correctly predicted that the effect of prime valence on target judgments is selective. Affective projection should be observed in targets that could instantiate the given affect, but not in targets that cannot instantiate that affect. Experiments 1–4 supported this prediction by demonstrating valence effects with human, animal, and animal-like targets but not with artifact or artifact-like targets. In those experiments, prime valence affected judgments of humans, animals, and animal-like figures because those targets could conceivably experience the emotional affect described in the primes. But prime valence did not affect the judgment of artifacts or artifact-like figures because they cannot plausibly experience emotional affect. Because spoons cannot experience positivity, the affective projection fails and hence their judgment is unaffected.

Third, the affective projection account also correctly predicted that the valence effect is asymmetric. Much prior research has demonstrated that positive affect tends to influence various judgments, whereas negative affect tends to have little influence (Clore & Huntsinger, 2007). If the present results are due to affective projection, then, positive primes should influence judgment more than negative primes. Experiment 1 supported this prediction by showing that affective projection occurs with positive primes but not with negative primes. Experiments 5 and 6 further supported this prediction by showing that, relative to neutral primes, positive primes increased similarity but negative primes did not influence similarity. Thus, the selectivity and asymmetry of the valence effect both support the affective projection account.

POSSIBLE MECHANISMS

The present experiments demonstrate that positive emotions, evoked by a prime, influence judgments of unrelated targets, and the results strongly implicate an affective projection process. However, these experiments do not reveal what lower-level mechanisms may underlie this effect. Why do positive emotions influence judgments more than negative emotions, and how exactly do they do so? As for why, the likely explanation is that positive and negative emotions differentially affect processing style. Specifically, positive affect elicits *heuristic processing*, which is more reliant on prior knowledge and contextual cues, whereas negative affect elicits *systematic processing*, which is more reliant on immediate details of the target stimuli (Chartrand, van Baaren, & Bargh, 2006; Forgas, 1995; Schwarz, 2001). Regarding the present research, affective projection may be viewed as a type of heuristic processing (Davis, Hoch, & Ragsdale, 1986; Schul & Vinokur, 2000). Rather than evaluating the target stimuli on the basis of their features alone, affective projection is a sort of contextual cue that affects judgment. Thus our positive primes might have induced heuristic processes such as affective projection, whereas our negative primes would instead induce greater attention to the features of the target stimuli, which is presumably how the target stimuli are typically judged in a neutral context. This differential processing would therefore result in increased similarity from positive primes but no effect of negative primes, relative to neutral primes.

As for how exactly positive primes influence judgment, one possibility is that positive affect may influence the selection or weighting of evidence on which judgments are based. In the present experiments, for instance, positive affect may influence which features are important for the similarity judgment. The similarity of any two objects is a weighted function of their common and distinctive features (Markman & Gentner, 2000; Tversky, 1977). To illustrate, roses and violets have many common features (e.g., shape, size) and many distinctive features (e.g., color, scent), and their perceived similarity depends on the salience of those common features relative to the distinctive features. Murray and colleagues (1990) showed that positive mood increases the perception of both commonalities and differences. To illustrate, when comparing a poet and a florist, positive affect might emphasize commonalities such as their artistry *and* differences such as their products (i.e., poems and flowers). Critically though, perceived similarity depends more strongly on commonalities than on differences (Markman & Gentner, 1993; Tversky, 1977). Consequently, the net effect of this increased perception of both commonalities and differences would be an increase in perceived similarity. In contrast, because negative emotion emphasizes neither commonalities nor differences (cf. Murray et al., 1990), similarity is largely unaffected.

Combining these possibilities provides a relatively detailed explanation of the observed effects. Positive primes elicit heuristic processing, including the projection of the prime's positive affect onto the target stimuli. That positive affect then increases the perception of commonalities and differences, but because similarity relies more on commonalities than on differences, similarity is increased. In contrast, negative primes elicit systematic processing of the targets' commonalities and differences. Because similarity judgments are ordinarily based on such a systematic comparison of commonalities and differences, the negative primes have little effect on judgment. Whether these speculations are borne out, and whether this hypothesized mechanism affects other judgments as well, is an important topic for further research.

CONCLUSION

In sum, we have shown that emotional valence exerts far-reaching effects on the judgment of other, entirely unrelated social targets, including humans, animals, and animal-like figures. We proposed and supported a general theoretical explanation whereby activated emotions are projected onto and influence the judgment of unrelated targets. In the introduction we noted that similarity is invoked to explain virtually every aspect of cognition and behavior, from visual attention (Duncan & Humphreys, 1989) to physical attraction (Byrne, 1971). To the extent that psychological models endow similarity with such explanatory power, the present results may have broad implications for cognition and behavior. As just one example, the tendency to cooperate or compete is related to both social projection (Toma, Yzerbyt, & Corneille, 2010) and perceived similarity (Fischer, 2009). Could the mere observation of a positive social interaction influence the likelihood of interpersonal cooperation? An important and exciting challenge for future research is to determine whether emotion exerts cascading effects on other similarity-based thoughts and behaviors.

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