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Individual Differences in Learning the Affective Value of Others Under Minimal Conditions

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This paper provides the first demonstration that people can learn about the positive and negative value of other people (e.g., neutral faces) under minimal learning conditions, with stable individual differences in this learning. In four studies, participants viewed neutral faces paired with sentences describing positive, negative or neutral behaviors on either two (Study 1) or four (Studies 2, 3, and 4) occasions. Participants were later asked to judge the valence of the faces alone. Studies 1 and 2 demonstrated that learning does occur under minimal conditions. Study 3 and 4 further demonstrated that the degree of learning was moderated by Extraversion. Finally, Study 4 demonstrated that initial learning persisted over a period of 2 days. Implications for affective processing and person perception are discussed.

Keywords: affect, learning, extraversion

People live in a world that is saturated with affective value. We see sunsets as beautiful and cockroaches as ugly. Chocolate tastes good to some, and brussel sprouts bad to others. Humans are born with the ability to have pleasant and unpleasant reactions to certain "prepared stimuli" (stimuli that evoke a response in the absence of previous experience with or exposure to them; Seligman, 1970, 1971; for a discussion see Öhman & Mineka, 2001) but for the most part, we must learn whether objects in the world are helpful or harmful, rewarding or threatening, worthy of acceptance or rejection. The study of such learning, called affective learning, has a long history in psychological science (for a review see Wasserman & Miller, 1997). This report is concerned with how people learn about others with only minimal exposure to mildly affective behavioral cues. We call this learning "minimal affective learning." Furthermore, we explore individual differences in minimal affective learning.

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Affective Learning

Affective learning is the process by which a neutral object in the environment acquires value or valenced meaning via its ability to predict a rewarding or threatening outcome. When a neutral object is paired with stimulus that incites an affective response (i.e., cause changes in an individual's baseline affective state) a sufficient number of times, the neutral object comes to elicit an affective response on future occasions, and in this way can be said to acquire affective value.

One of the most robust ways that people learn about the affective value of objects is through associative learning mechanisms such as classical conditioning (*CC*; e.g., Pavlov, 1927, for a review see Pearce & Bouton, 2001 or Dickinson & Mackintosh, 1978) and evaluative conditioning (*EC*; e.g., Levey & Martin, 1975; for a review see De Houwer, Thomas, & Baeyens, 2001).[1] In a typical associative learning paradigm, a neutral stimulus, such as a neutral picture or a colored geometric shape (called the conditioned stimulus, or *CS*) is paired with stimulus of known affective value (the unconditioned stimulus, or *US*).[2] Over successive trials, the CS

[1] See Baeyens & De Houwer (1995) for a discussion of how EC may be distinct from CC.

[2] Examples of aversive primary reinforcers include electric shocks (e.g., Grillon, 2002; LaBar, Gatenby, Gore, LeDoux, & Phelps, 1998), high pitched and loud noises (e.g., Büchel, Dolan, Armony, & Friston, 1999; LaBar & Phelps, 2005), and aversive smells (e.g., Hermann, Ziegler, Birbaumer, & Flor, 2002). Examples of rewarding stimuli include food (e.g., Brunstrom, Higgs, & Mitchell, 2005), nicotine (e.g., Dols, Willems, van den Hout, & Bittoun, 2000), and sex (e.g., Hoffmann, Janssen & Turner, 2004; for a review see Domjan, Cusato, & Krause, 2004). Secondary reinforcers have themselves acquired value through prior learning. Examples of secondary reinforcers include words (e.g., De Houwer, Baeyens, & Eelen, 1994), pictures (e.g., De Houwer, Baeyens, Vansteenwegen, & Eelen, 2000; Levey & Martin, 1975), odors (e.g., Todrank, Byrnes, Wrzesniewski, & Rozin, 1995; van Reekum, van den Berg, & Frijda, 1999) and sounds (e.g., van Reekum, van den Berg, & Frijda, 1999).

comes to predict the presence of the US and in so doing itself acquires affective value.[3] Associative learning very likely occurs in an associative processing mode (Sloman, 1996; Smith & DeCoster, 2000; for a similar distinction between associative and rule-based processes see Gawronski & Bodenhaus, 2006) where new knowledge about the world is inductively acquired over a large number of experiences, such that learning proceeds very slowly. Typical associative learning protocols maximize learning by varying three parameters that reflect the properties of this slow learning system: Only *a small number of stimuli* are presented with a *robust threat or reward* over *many trials*. In this way, the organism can focus on one (or very few stimuli) across many trials (allowing the learner a good deal of experience with it). An intense threat or reward (a stimulus that incites robust physiological responding is judged to be extremely unpleasant or pleasant, or vivid and detailed symbolic representations of positive or negative information) provides a robust context for affective learning.

Mammals can learn quickly and efficiently about the affective value of many different objects that vary in potency and relevance, however. Nonhuman animals learn about the value of conspecifics rapidly. For example, studies by Johnston and colleagues (Bath & Johnston, 2007; Lai & Johnston, 2002; Petrulis, Weidner, & Johnston, 2004; Lai, Ramiro, Yu, & Johnston, 2005) demonstrate that male hamsters require only a few exposures to an aggressive conspecific to learn that the other creature has the potential to again cause them harm.[4] Importantly, subordinate animals' threat responses to dominant animals persist over time (e.g., 4 days, Bath & Johnston, 2007; 7 days, Lai & Johnston, 2002).

For optimal adaptation, humans must learn about the affective value of other people quickly, perhaps after only a few encounters. In daily life, people come to like or dislike *many* different things and people after very limited experience with them. A person may change the radio station after hearing only a few bars of a new song because it sounds unpleasant. A person's heart may race with pleasure upon seeing a new acquaintance about whom he or she knows very little. In other words, affective learning should proceed even under "minimal" learning conditions. To achieve speed and efficiency in learning, humans are endowed with a fast-learning, rule-based processing system that uses symbolic representations (e.g., verbal instruction) to impart new knowledge (Gawronski & Bodenhaus, 2006; Sloman, 1996; Smith & DeCoster, 2000). There is some evidence that people can learn about affective value via rule-based processes.

Although rule-based learning requires fewer trials than does associative learning, the two types of protocols share two features: a small number of neutral stimuli (e.g., one to four) are paired with robust affect-inducing stimuli (e.g., the threat of shock or detailed descriptions of intense affective stimuli).

In what has been called "instructed fear," people responded to a previously neutral stimulus with increases in sympathetic nervous system (SNS) activity when merely told the stimulus (a picture of a face) would be paired with an electric shock (Olsson & Phelps, 2004). Similarly, decreases in SNS reactivity occurred when an individual was told that the originally neutral stimulus was no longer threatening (e.g., Lipp & Edwards, 2002). At the beginning of another study, participants were told that two letter strings (i.e., nonsense words) would always proceed positive pictures (e.g., flowers) and two different letter strings would always proceed negative pictures (e.g., mutilated bodies) (De Houwer, 2006, p. 181). Participants then showed an implicit preference for the two letter strings that were supposed to be paired with the positive pictures as compared to the two letter strings that were supposed to be paired with the negative pictures, even though the letter strings and pictures were never actually paired (De Houwer, 2006).

There is limited evidence that people can learn the affective value of a small number of individuals from vivid, detailed behavioral descriptions of those targets. For example, when participants were told vivid stories about the behaviors of two characters (one "good guy" who engaged in good/nice behaviors and one "bad guy" who engaged in bad/mean behaviors; each story repeated twice), participants later indicated that they liked the "good guy" more than the "bad guy" and these preferences persisted over time (Johnson, Kim, & Risse, 1985). Even an amnesic patient subgroup who could not recall any of the biographical information demonstrated initial preferences for the "good guy" and maintained those preferences over time (Johnson, Kim, & Risse, 1985). When patients with Alzheimer's disease and mixed dementia were shown pictures of four faces and read fictional biographies about four individuals (that were either very pleasant or very unpleasant, as well as long and detailed), their preference for the faces after a three hour period correlated positively with the valence of the biographies (Blessing et al., 2006). This was the case even though participants were not better than chance at indicating whether or not they had seen the face before (Blessing et al., 2006). Similarly, participants who were presented with a graphic and detailed account of behavior of two social groups later demonstrated implicit preference for the group that was characterized as being "civilized, accommodating and constructive" as compared with the group that was characterized as being "savage, ruthless and brutal" (Gregg, Seibt, & Banaji, 2006, p. 5).

[3] Affective learning via associative means can has also been shown to occur in a single trial when the US stimuli are very potent and have a robust influence on the individual (e.g., are related to preexisting phobias, Öhman, Eriksson, & Olofsson, 1975). This phenomenon is referred to as single trial learning. Importantly, documentation of this effect in humans is rare. Furthermore, this type of learning differs from the learning under investigation in this report because the US stimuli in single trial learning must be extremely robust and the individual must have a preexisting bias against (or for) them (e.g., a phobia).

[4] In the typical paradigm, two male hamsters are placed together in the same cage. They are allowed to interact until one animal either escapes (by jumping over the side of the cage) or lies in a submissive position (in cases where the animal tries and fails to jump over the side of the cage). Animals that escape or act submissively are considered the subordinate animals, and their partners are considered dominant. This pairing is repeated two or three additional times. On subsequent exposures to the dominant animal, subordinate animals respond to the dominant animal as a threat. The subordinate's threat response is evident by its reduced time exploring the dominant animal's enclosure, reduced scent marking in the dominant animal's home cage and an increased number of threat related behaviors in the presence of the dominant animal (i.e., "stretch-attend posture"; Petrulis, Weidner, & Johnston, 2004, p. 632). Subordinate animals also actively avoid the presence and odor of the dominant animal, but not the presence or odor of unfamiliar animals, when confined to a Y shaped enclosure (where the dominant/unfamiliar animal is in one branch of the Y and the subordinate animal is in another branch) (Lai & Johnston, 2002; Lai et al., 2004).

We believe that studies of person perception—particularly those involving spontaneous trait inferences— give indirect evidence that people can learn information variety of other people quickly with only few pairings. During the first phase of the spontaneous trait inference (STI) paradigm (e.g., Todorov, Gobbini, Evans, & Haxby, 2007; Todorov & Uleman, 2002, 2003), participants are presented with pictures of faces (targets) and sentences describing behaviors, and are told that they would later complete a memory task (although the nature of the task was not specified). Each sentence was consistent with a specific trait word, and in some cases, trait words were presented in the sentences. For instance, a picture of "Andrew" could be presented with one of the following two sentences that are both consistent with the trait "aggressive." Example 1: "Andrew threatened to hit her unless she took back what she said;" example 2: "Andrew was so aggressive that he threatened to hit her unless she took back what she said" (Todorov & Uleman, 2002, p. 1053). During a subsequent second phase, participants were presented with the faces from the first phase and trait words. Participants were asked to indicate whether or not the trait word had been presented in the description of the target's behavior. In cases where faces were paired with sentences that did not explicitly contain trait words (such as the first example sentence above), participants were more likely than chance to indicate that a trait word had been presented with a face if the trait word was implied by the sentence with which the target was originally paired (e.g., participants indicate that the word "aggressive" was in the sentence that was presented with the picture of Andrew even though sentence from the first example was presented with the face) (Todorov & Uleman, 2002). Such false recognition effects (as they are called) suggest that at the time of encoding, participants infer that a trait caused the targets' behaviors. These findings suggest that people are able to learn about many other people rapidly and when presented about with only a limited amount of information about the other people's behavior. Furthermore, false recognition effects manifested when participants were under cognitive load and when the cognitive processing was shallow in nature (Todorov & Uleman, 2003), suggesting that attributions about the cause of targets' behaviors were made spontaneously, at the time when sentence was paired with faces. These findings suggest that the false recognition effects arise as a result of processing that occurs at the time of learning, and not as a result of deliberate, effortful processing when participants make judgments during the second test phase of the experiment. While the role of affective learning is not specifically addressed in STI studies, Todorov and Uleman (2002) discussed affective processing as a substrate of spontaneous trait inferences under certain conditions (when participants falsely identify a trait word as belonging to a face when that word matches the valence of the actual word presented; p. 1062).

In the present study, we modified the STI paradigm to examine whether people can learn the affective value of many other people quickly and efficiently via rule-based mechanisms when the USs in question were mildly affective in nature. Specifically, we assessed whether people learned the affective value of 60 neutral faces by pairing each face with mild positive or negative stimulus for a limited number of presentations (i.e., two or four presentations per pair). This tapped rule-based learning because participants were *instructed to imagine* the CS (the neutral face of a person) *causing* the US (a positive or negative act). By instructing participants about the cause of an act, we expected that participants would learn more efficiently. Furthermore, our instructions mirror the kind of person-related learning that occurs in everyday life. As people watch others perform positive or negative behaviors, they make causal inferences about those behaviors, which in turn lead them to view the actors in positive or negative terms (for a review see Gilbert, 1998).

Individual Differences in Affective Learning

Not only might affective learning proceed under minimal learning conditions, but there may also be significant variation in the extent to which individuals can learn about the affective value of stimuli under such conditions. Individuals who are more sensitive to the affect-inducing properties of their surroundings may be more reactive to USs, thereby providing the basis for individual differences in the magnitude of affective learning. In particular, individuals who are more sensitive to information that will induce a pleasant affective state may more readily acquire new positive associations, while individuals who are more sensitive to information that will induce an unpleasant affective state may more readily acquire new negative associations.

Extraversion and neuroticism are two personality traits that have been consistently linked to reward and threat sensitivity, respectively. Extraversion is defined as a sensitivity to positive or pleasure cues, and neuroticism is defined as a pervasive sensitivity to negative or punishment cues (e.g., Costa & McCrae, 1992; Izard, Libero, Putnam, & Hayes, 1993; Larsen & Ketelaar, 1991; Watson & Clark, 1992). Individuals who describe themselves as high in extraversion are differentially sensitive to reward cues (Pickering & Gray, 1999) and positive stimuli in general (Derryberry & Reed, 1994), whereas individuals high in neuroticism automatically orient to novel situational cues (for reviews see Wallace & Newman, 1997, 1998; Wallace, Newman, & Bachorowski, 1991) and more easily assess situations as threatening than those who are low in neuroticism (Schneider, 2004). Extraverts are also differentially sensitive to social information (Ashton, Lee, & Paunomem, 2002), particularly when that information is positive in valence (Lucas & Diener, 2001). The link between extraversion and positive affect, and neuroticism and negative affect, has been widely documented. Compared to those people who describe themselves as low in extraversion, those higher in extraversion report more positive affect (e.g., Costa & McCrae, 1992; Watson & Clark, 1992; Lucas & Fujita, 2000) and are more susceptible to positive mood induction procedures (e.g., Lucas & Baird, 2004; Larsen & Ketelaar, 1991). Compared to individuals who describe themselves as low in neuroticism, those high in neuroticism exhibit greater negative affect (e.g., Costa & McCrae, 1992) and are more reactive to negative mood induction procedures (e.g., Larsen & Ketelaar, 1991). In the present studies, we examined the magnitude of affective learning as it varied with Extraversion and Neuroticism.

Overview of the Present Studies

In the present studies, we first developed a minimal affective learning paradigm (Studies 1 and 2) in which participants were asked to learn the affective value of a large number of people (60). Then, using that minimal learning paradigm we demonstrate that there are stable individual differences in minimal affective learning (Studies 3 and 4) and that affective learning is retained over time (Study 4).

Study 1

Method

Participants

Participants were 40 Boston College students (19 women and 21 men; M_{age} = 19.46, SD_{age} = 1.10). Participants were paid $10 or received one departmental research credit as remuneration. Data from one male participant were not included because of technical problems.

Materials and Procedure

After providing informed consent and completing a paper and pencil battery of self-report measures (not relevant to this report), participants completed the minimal learning task based on the paradigm used by Todorov and colleagues (Todorov, Gobbini, Evans, & Haxby, 2007; Todorov & Uleman, 2002). The minimal affective learning task was implemented in E-Prime Version 1 and run on a Dell Pentium VI PC using a 17" CRT monitor. During a *pretest* phase, participants viewed a series of 60 Caucasian (target) faces each of which portrayed a neutral affective state (Minear, & Park, 2004). When each face was presented focally on the screen, participants were instructed to make "snap" judgments about the face as positive, negative, or neutral. Each stimulus was displayed until the participant keyed his or her response (using labeled keys on a standard keyboard) or for a maximum of 3 seconds. After a 1-s intertrial interval, the screen advanced to the next face stimulus.

During a *learning* phase, participants viewed face-sentence pairs and were told to remember the pairings by imagining each person performing the behavior described in by the corresponding sentence. The 60 target faces were each paired with a unique descriptive sentence that was positive, negative or neutral in affective tone. Half of the sentences were *social* in nature (i.e., explicitly or implicitly referenced another person) and half were *nonsocial* (i.e., did not make reference to another person). See Appendix A for a complete list of the sentences. The face-sentence pairs were each displayed on the computer screen for 5 seconds with a 1-s intertrial interval. Each face-sentence pair was presented twice in random order.

During a *postlearning judgment* phase, participants again categorized the 60 target faces, plus 20 novel faces from the same face set, as being positive, negative, or neutral. Using the same test parameters as the pretest phase, participants were instructed to make quick, "snap" judgments about the faces in the pictures.

Results

At pretest, participants were significantly more likely than chance to categorize all faces as neutral (means, standard errors, and statistical tests of prelearning judgment data presented in Figure 1), but after only two pairings with a valenced sentence, neutral faces acquired positive or negative meaning (means, standard errors, and statistical tests of postlearning judgment data presented in Figure 2). Faces paired with positive sentences were significantly more likely than chance to be categorized as positive, significantly less likely to be categorized as negative, and were categorized as neutral at chance levels. Similarly, faces paired with negative sentences were significantly more likely than chance to be categorized as negative, significantly less likely to be categorized as positive, and were categorized as neutral at chance levels. Faces paired with neutral sentences, as well as the novel faces, were more likely than chance to be categorized as neutral, and less likely than chance to be categorized as positive.

There was evidence for a mere exposure effect (Zajonc, 2001) in judgments about the target faces. Compared to neutral faces that

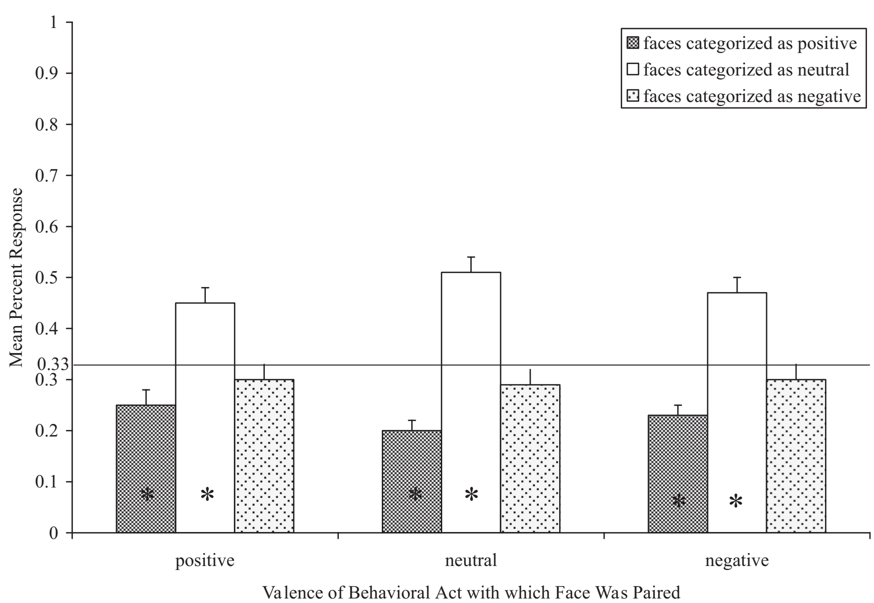

Figure 1. Pretest judgments of faces: Study 1. Columns with asterisks are different from chance. Means were compared to chance level responding (i.e., .33 or 33%) using a two-tailed 1-sample t test, $p < .05$. Error bars represent standard errors.

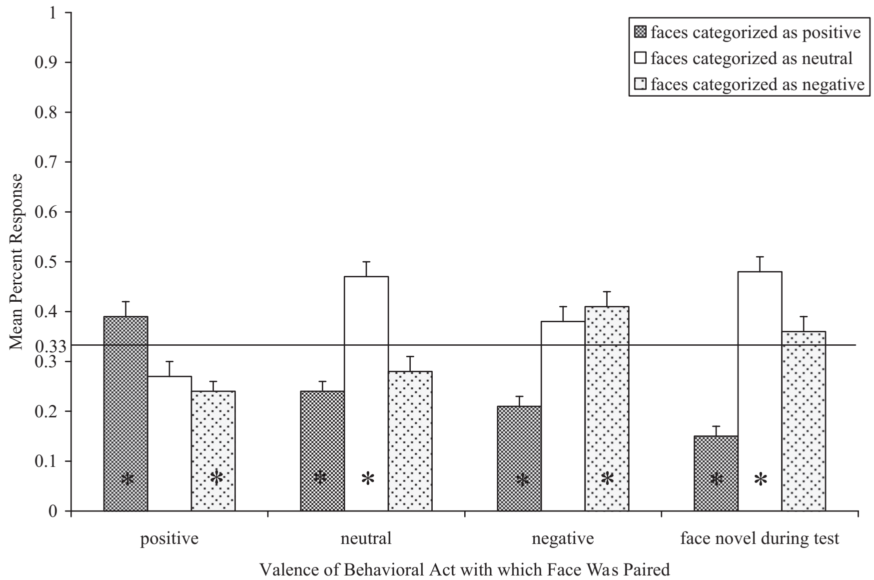

Figure 2. Mean percentage of categorizations based on valence of behavioral act with which face was paired: Study 1. Columns with asterisks are different from chance. Means were compared to chance level responding (i.e., .33 or 33%) using a two-tailed 1-sample *t* test, $p < .05$. Error bars represent standard errors.

had never been seen before (i.e., novel faces), participants were more likely to judge neutral faces as positive if they had seen those faces paired with neutral, nonaffective sentences during the learning phase, $t(39) = 2.61$, $p < .013$. To distinguish minimal positive affective learning from a mere exposure effect, we compared participants' propensity to make positive judgments about faces that had been paired with positive sentences during learning with their judgments of faces that had been paired with neutral sentences during learning. Participants were more likely to judge the former as positive when compared to the latter, $t(39) = 5.69$, $p < .0001$, indicating that the minimal positive affective learning that we observed was not only related to a mere exposure effect.

To determine whether social and nonsocial sentences provided equally potent contexts for minimal affective learning, we performed a 2 (content: social vs. nonsocial) × 3 (valence of behavioral acts: positive, neutral, or negative) repeated measures ANOVA on the affective learning data (i.e., mean percentage of trials on which participants categorized faces according to the valence of the behavioral act with which they were paired). Means and standard errors are presented in Figure 3. People were better able to learn the affective meaning of the faces that were paired with social as compared with nonsocial content, $F(1, 39) = 9.30$, $p < .004$, $\eta^2 = .193$. A significant content X valence interaction indicated that social content was particularly important for negative affective learning, $F(2, 78) = 15.61$, $p < .0001$, $\eta^2 = .286$, such that people were better able to learn about the negative affective meaning of faces that were paired with social sentences. Given that the mean percentage accuracy for faces paired with negative nonsocial behavioral acts was less than chance, whereas the mean percentage accuracy for faces paired with negative social behavioral acts was greater than chance ($M_{nonsocial} = .31$ vs. $M_{social} = .52$), we conclude that the overall learning effect for negative information was based on participants propensity to learn negative social information.

Discussion

Study 1 provided evidence of affective learning under minimal learning conditions. Neutral faces acquired affective value after only two pairings with sentences describing positive or negative behavioral acts. People came to see neutral faces as positive when those faces were previously paired with both social and nonsocial behavioral acts (over and above positivity because of mere exposure to the faces), whereas people came to see neutral faces as negative most clearly when faces were paired with negative behavioral acts that were social in nature. While there was evidence of a mere exposure effect (Zajonc, 2001) for faces paired with neutral sentences, we were able to rule out the possibility that the evidence of positive affective learning was due only to a mere exposure effect.

It is possible that as a result of completing the pretest ratings, participants were aware that they would be evaluating the faces after the learning phase and that knowledge influenced their posttest judgments. To address this issue, we eliminated the pretest judgment phase from future studies. Furthermore, in Study 2, face-sentence pairings were each presented four times to maintain minimal learning conditions whereas testing the possibility that affective learning of negative nonsocial information might require an increased number of associations between the neutral stimuli and the valenced stimuli.

Study 2

Method

Participants

Participants were 50 Boston College students (24 women and 26 men; $M_{age} = 19.55$, $SD_{age} = .90$). Participants were paid \$10 or received one departmental research credit as remuneration. Data

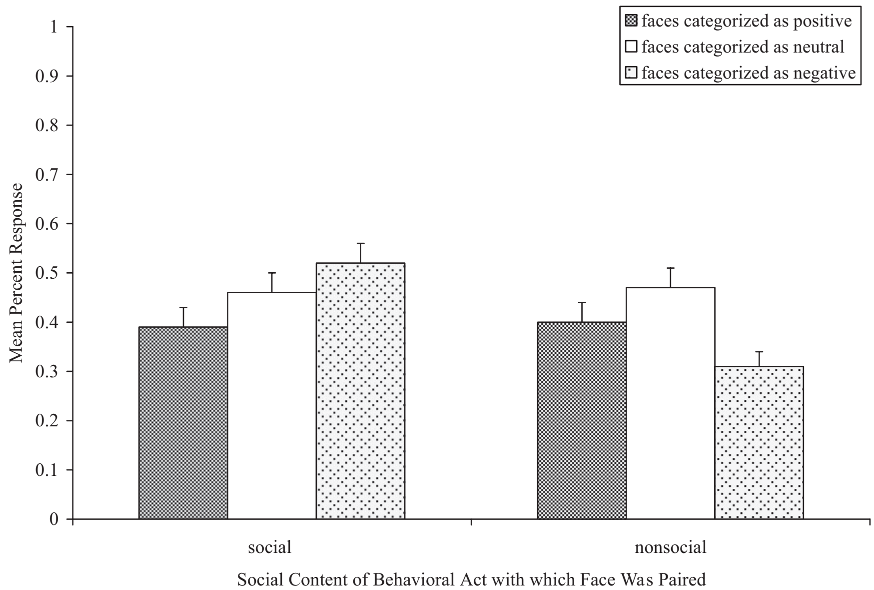

Figure 3. Mean percentage of accurate categorizations based on social content of behavioral act with which face was paired: Study 1. The data in this figure represents only trials on which participant categorized the face stimuli according to the valence of the sentence with which each stimulus was paired during learning. Error bars represent standard errors.

from one male participant were not included because of technical problems.

Materials and Procedure

The materials and procedure for Study 2 were identical to those in Study 1 except that face-sentence pairs were presented on four (rather than two) occasions, and participants did not make pretest judgments of the neutral faces.

Results

As predicted, the neutral face stimuli acquired valenced meaning under minimal affective learning conditions, replicating the findings from Study 1 (means, standard errors, and statistical tests of postlearning judgment data presented in Figure 4).

As in Study 1, there was evidence for a mere exposure effect in judgments about the target faces, insofar as participants were more likely to judge faces as positive if they had seen those faces before paired with neutral, nonaffective sentences, when compared to faces that had never been seen before (i.e., novel), $t(49) = 6.45$, $p < .0001$. As in Study 1, this mere exposure effect did not account for minimal positive affective learning, in that participants' propensity to judge faces as positive if they had been previously paired with positive sentences was larger than their tendency to judge faces as positive if they were paired with neutral sentences, $t(49) = 6.03$, $p < .0001$.

As in Study 1, a 2 (content: social vs. nonsocial) × 3 (learned valence: positive, neutral, or negative) repeated measures ANOVA indicated that people were better able to learn the affective meaning of the faces that were paired with social as compared with nonsocial content, $F(1, 49) = 23.84$, $p < .0001$, $\eta^2 = .327$. Means and standard errors for each condition are presented in Figure 5. People were also better able to learn the positive meaning of faces compared to negative or neutral meaning, $F(2, 98) = 4.79$, $p < .01$, $\eta^2 = .089$. Finally, as in Study 1, a significant content X valence interaction, $F(2, 98) = 31.38$, $p < .0001$, $\eta^2 = .390$ indicated that social content was particularly important for negative minimal affective learning, such that people were better able to learn the negative affective value of faces that were paired with social behavioral acts.

Discussion

As in Study 1, we found evidence of affective learning under minimal learning conditions. The findings in Study 2 were almost identical to those reported in Study 1: positive affective learning proceeded when faces were paired with both positive social and nonsocial acts, whereas negative affective learning was clearest for faces paired with negative social acts. Additionally, there was evidence of a mere exposure effect for faces paired with neutral sentences but we were also able to rule out that the evidence of positive affective learning was because of a mere exposure effect. Increasing the number of face-sentences presentations during the learning phase of the experiment, however, did not increase participants' propensity to learn to associate negative value to neutral faces paired with nonsocial behavioral acts.

It is not clear why negative social but not negative nonsocial content provides a context for affective learning. One possibility is that participants are better able to envision people enacting the negative social behaviors than the negative nonsocial behaviors. The task instructions specifically indicated that participants should imagine the person pictured performing the behavior indicated; as a result, the extent to which participants could imagine people performing the behaviors could have

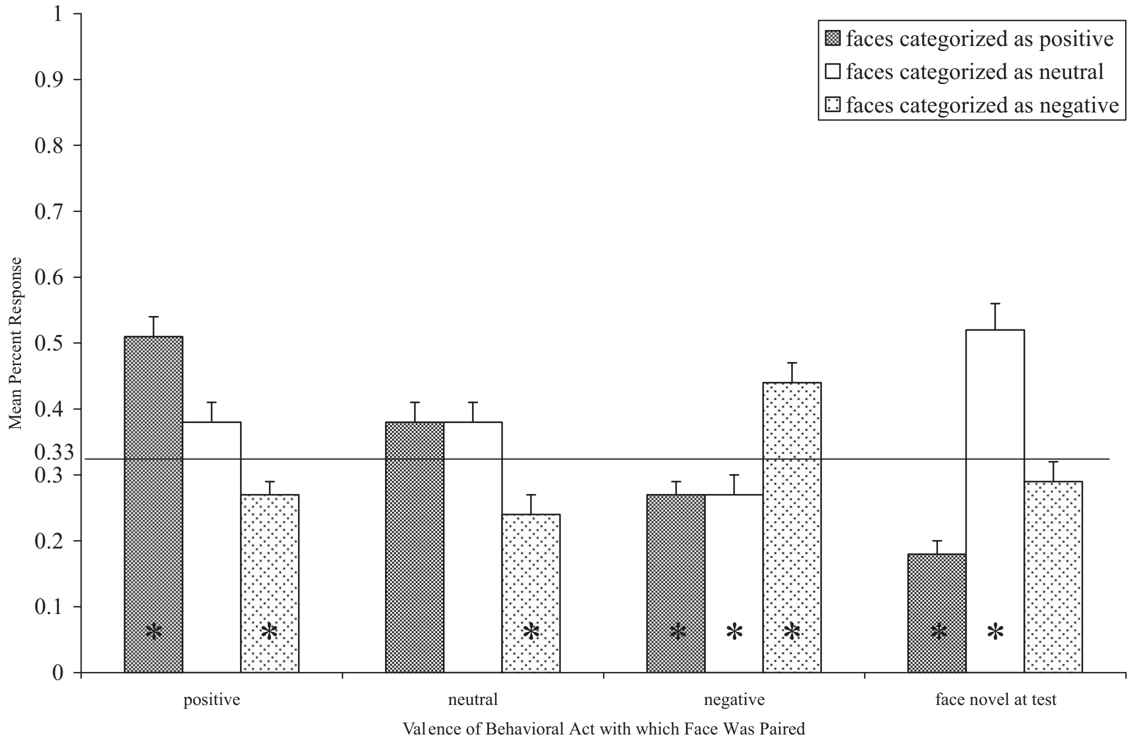

Figure 4. Mean percentage of categorizations based on valence of behavioral act with which face was paired: Study 2. Columns with asterisks are different from chance. Means were compared to chance level responding (i.e., .33 or 33%) using a two-tailed 1-sample t test, $p < .05$. Error bars represent standard errors.

influenced affective learning. Because a major goal of this research program is to investigate individual differences in affective learning, it was prudent to use only social behavioral descriptors in future studies as to eliminate variation between positive and negative affective learning within individuals. In Study 3, that is exactly what was done.

In both Studies 1 and 2, there was considerable variability in the extent to which people learned the affective value of the

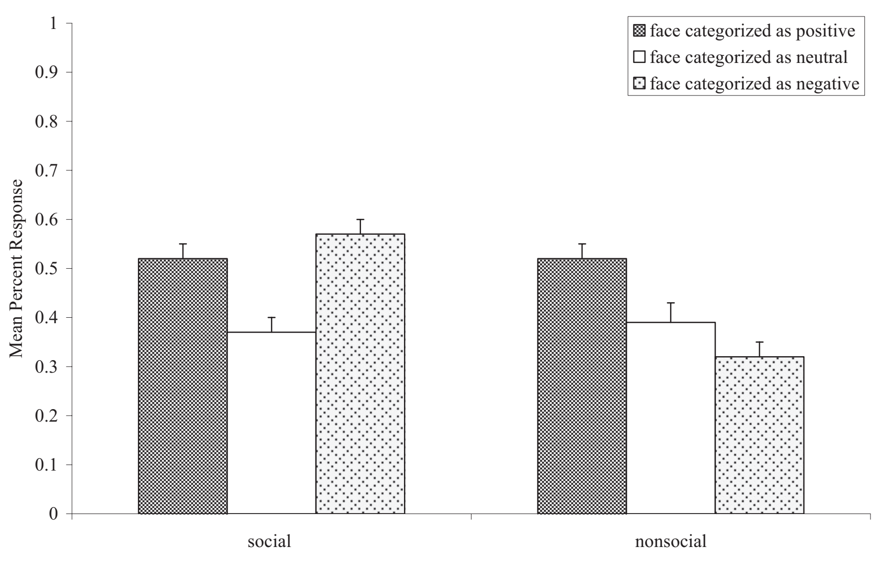

Figure 5. Mean percentage of accurate categorizations based on social content of behavioral act with which face was paired: Study 2. The data in this figure represents only trials on which participant categorized the face stimuli according to the valence of the sentence with which each stimulus was paired during learning. Error bars represent standard errors.

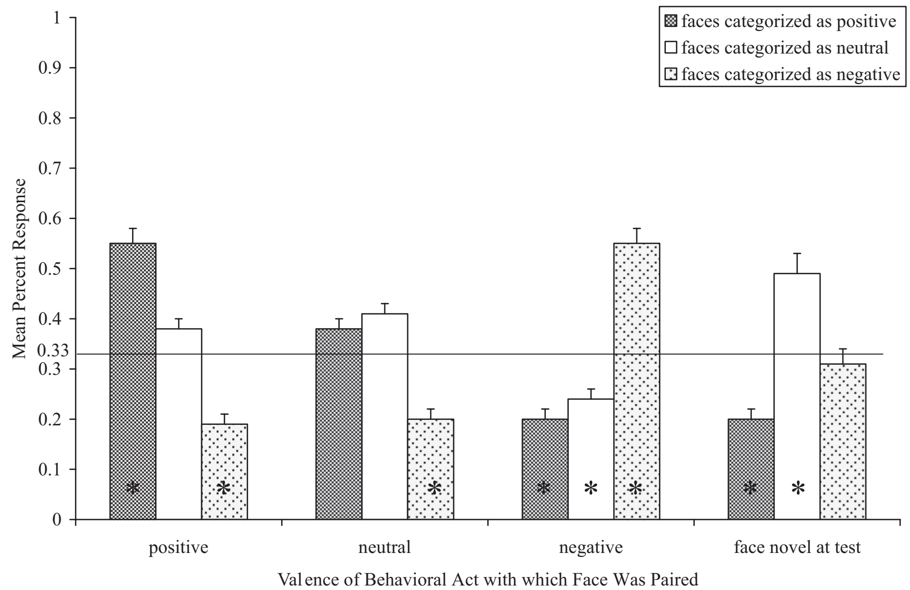

Figure 6. Mean percentage of categorizations based on valence of behavioral act with which face was paired: Study 3. Columns with asterisks are different from chance. Means were compared to chance level responding (i.e., .33 or 33%) using a two-tailed 1-sample *t* test, $p < .05$. Error bars represent standard errors.

neutral faces (as indexed by the standard deviation in valenced judgments). Thus, in Study 3, we again examined the degree of affective learning under minimal learning conditions, but this time with the goal of examining individual differences in the propensity to learn the affective value of faces. We predicted that individuals who are more sensitive to positive stimuli in the environment (as indexed by Extraversion) would be at an advantage for learning positive information. Similarly, we predicted that individuals who are more sensitive to negative stimuli in the environment (as indexed by Neuroticism) would be at an advantage for learning negative information.

Study 3

Method

Participants

Participants were 60 Boston College students (33 women and 27 men; $M_{age} = 20.08$, $SD_{\text{age}} = 3.30$). Participants were paid $10 or received one departmental research credit as remuneration.

Materials and Procedure

The materials and procedures for Study 3 were identical to those in Study 2, with two exceptions. First, the minimal learning task contained only descriptive sentences with social content (see Appendix B for a complete list of the sentences). Second, before completing the minimal learning task, participants completed a paper and pencil battery that contained the Neuroticism-Extraversion-Openness Personality-Inventory Revised (NEO-P-IR; Costa & McCrae, 1992), which we used to measure Neuroticism and Extraversion. Items from the Neuroticism and Extraversion subscales were each calculated according to standard procedures (Costa & McCrae, 1992). Participants' Extraversion scores ranged from 72 to 151 ($M = 113.88$, $SD = 16.68$) and their Neuroticism scores ranged from 44 to 149 ($M = 93.02$, $SD = 20.67$). Extraversion and Neuroticism were moderately negatively correlated, $r = -.29$, $p \leq .03$.

Results

As in Studies 1 and 2, neutral faces acquired affective value under minimal learning conditions (means, standard errors, and statistical tests for postlearning judgment data are presented in Figure 6). As in Studies 1 and 2, there was evidence for a mere exposure effect in judgments about the target faces, insofar as participants were more likely to judge faces as positive if they had seen those faces before paired with neutral, nonaffective sentences, when compared to never seen before (i.e., novel) faces, $t(59) = 6.19$, $p < .0001$. As in Studies 1 and 2, this mere exposure effect did not account for minimal positive affective learning, in that participants' propensity to judge faces as positive if they had been previously paired with positive sentences was larger than their tendency to judge faces as positive if they were paired with neutral sentences, $t(59) = 5.61$, $p < .0001$.

The degree of learning was regressed onto both Neuroticism and Extraversion scores using a series of Ordinary Least-Squares regression models.[5] Positive affective learning was operationalized as the percentage of faces which were paired with positive sentences during learning and subsequently

[5] We also analyzed the data using Hierarchical Linear Modeling (Raudenbush, Bryk, & Congdon, 2005) with a multivariate set-up (e.g., Barrett & Niedenthal, 2004). As the findings were identical, we present the OLS results here; the HLM analyses are available upon request.

judged as positive during the test phase. Similarly, negative learning was operationalized as the percentage of faces that were paired with negative sentences during learning and subsequently judged as negative during the test phase. As predicted, individuals describing themselves as high in Extraversion evidenced greater positive affective learning by judging as positive neutral faces that were paired with descriptions of positive behavioral acts, compared to those who scored lower in Extraversion ($b = .004$ ($SE = .002$), $B = .29$, $t = -2.23$, $p < .03$). Contrary to predictions, Neuroticism was not linked to the degree of negative affective learning ($b = .002$ ($SE = .002$), $B = .16$, $t = 1.24$, $p \leq .22$), although individuals describing themselves as high in Neuroticism were less likely to categorize neutral faces paired with negative sentences as being positive ($b = -.003$ ($SE = .001$), $B = -.331$, $t = -2.67$, $p < .01$).

Discussion

Study 3 replicated Studies 1 and 2 in providing further evidence of affective learning under minimal conditions and extended the findings by demonstrating individual variation in the magnitude of learning. Specifically, individuals who described themselves as responsive or sensitive to positive stimuli (i.e., high in Extraversion) were more likely to see a neutral face as positive when it was previously paired with a positive behavioral act. Importantly, individuals who reported being high in Extraversion did not have a general propensity to categorize stimuli as positive—Extraversion did not predict the propensity to judge novel faces or faces paired with neutral or negative sentences as being positive. One explanation for why Extraversion was linked to enhanced positive affective learning is that the content of the information being learned was social in nature (i.e., human faces and social behavioral descriptions). Extraversion has a strong sociality component, such that extraverts are differentially sensitive to social information (Ashton, Lee & Paunonen, 2002), and are particularly sensitive to positive social information (Lucas & Diener, 2001).

Self-descriptions of sensitivity to negative stimuli (i.e., Neuroticism), in contrast, did not predict a propensity for negative affective learning. Instead, individuals higher in Neuroticism made fewer mistakes when learning negative information, as evident in their decreased propensity to make positive categorizations of faces that were paired with negative information.

There are two possible explanations for why individuals high in Neuroticism did not show preferential learning of negative information. First, learning rates for socially relevant negative information were high in this study (replicating the findings from Studies 1 and 2), limiting our ability to observe individual differences in the magnitude of negative affective learning. This is consistent with findings that most people are vigilant for negative information (Cacioppo, Gardner, & Bernston, 1997; Pratto & John, 1991). A second possibility is that Neuroticism may influence the learning process in phases other than acquisition and encoding. It is possible that individuals who are high in neuroticism, and describe themselves as sensitive to negative or punishment cues in the environment, may be better at retaining negative affective learning. Study 4 was designed to investigate whether minimal affective learning is retained over time (2 days), and to examine whether personality would predict the degree of affective learning retention.

Study 4

Method

Participants

Participants were 73 Boston College students (39 women and 34 men; $M_{age} = 20.04$, $SD_{\mathrm{age}} = 1.74$). Participants were paid $20 or received two departmental research credits as remuneration. Data for one female participant and one male participant were not available for the second experimental session.

Materials and Procedure

The materials and procedures for Study 4 were identical to those in Study 3, with the exception that participants were recalled for a second laboratory session 2 days after the initial session. During the second session, participants rated all of the faces from the posttest of the learning task from Session 1 (i.e., the 60 faces that were associated with valenced information, plus 20 novel faces) as well as 20 additional novel faces from the same face set. Participants' Extraversion scores ranged from 61 to 157 ($M = 116.95$, $SD = 20.43$) and their Neuroticism scores ranged from 44 to 147 ($M = 90.15$, $SD = 22.64$). As in Study 3, Extraversion and Neuroticism were negatively correlated, $r = -.34$, $p \leq .001$.

Results

As in Studies 1, 2, and 3, neutral faces acquired affective value meaning under minimal learning conditions (analyses of postlearning judgment data are presented in Figure 7). As in all previous studies, there was mere exposure effect for faces paired with neutral sentences during learning, but this effect did not account for positive affective learning. Participants were significantly more likely to judge faces which had been paired with neutral sentences as being positive, compared to novel faces, $t(72) = 5.12$, $p < .0001$. Participants were also more likely to judge faces that had been paired with positive sentences as being positive, compared to faces that had been paired with neutral sentences, $t(72) = 8.54$, $p < .0001$.

Replicating Study 3, individuals who scored highly on Extraversion showed enhanced affective learning for neutral faces paired with descriptions of positive acts ($b = .003$ ($SE = .001$), $B = .23$, $t = 1.98$, $p \leq .05$). Individuals who scored highly on Neuroticism did not display evidence of enhanced affective learning for neutral faces paired with descriptions of negative acts; these individuals showed evidence of impaired affective learning for neutral faces paired with descriptions of positive acts ($b = -.002$ ($SE = .001$), $B = -.23$, $t = -1.98$, $p \leq .05$).

As predicted, we found that affective learning persisted over a period of 2 days (means, standard errors, and statistical tests of Session 2 data presented in Figure 8). Faces paired with positive sentences during the learning phase in Session 1, were significantly more likely than chance to be categorized as positive, and less likely than chance to be categorized as negative during Session 2. Faces paired with negative sentences

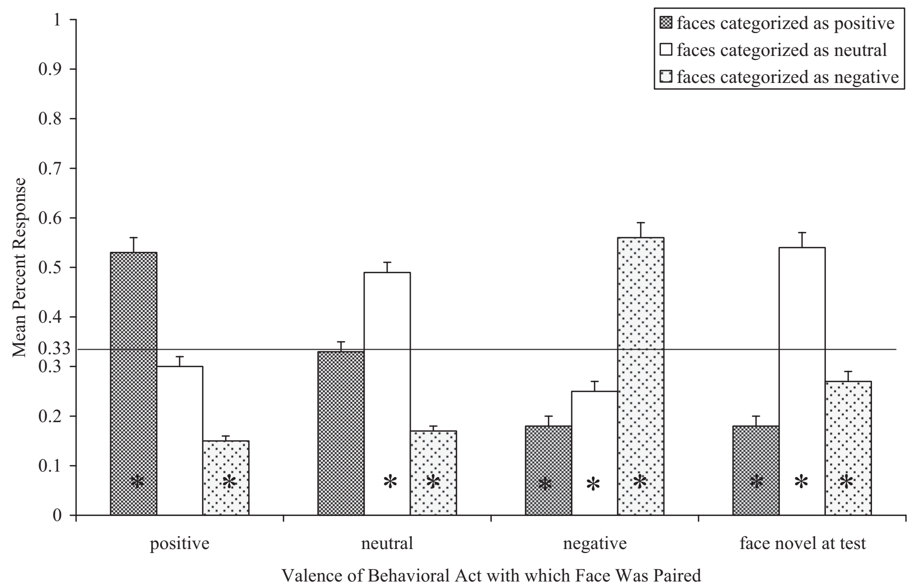

Figure 7. Mean percentage of categorizations immediately following learning based on valence of behavioral act with which face was paired: Study 4. Columns with asterisks are different from chance. Means were compared to chance level responding (i.e., .33 or 33%) using a two-tailed 1-sample t test, $p < .05$. Error bars represent standard errors.

were significantly more likely than chance to be categorized as negative, and less likely than chance to be categorized as positive. Faces paired with neutral sentences were significantly more likely than chance to be categorized as neutral and less likely than chance to be categorized as negative. Finally, participants were significantly more likely than chance to categorize faces that were novel in Session 1 and faces that were novel in Session 2 as neutral, and less likely than chance to categorize novel faces as positive or negative.

To examine the stability of affective learning over the 2 day test period, a 2 (Session: 1 vs. 2) × 3 (Sentence valence: positive, negative, neutral) × 2 (Participant response: positive, negative, or

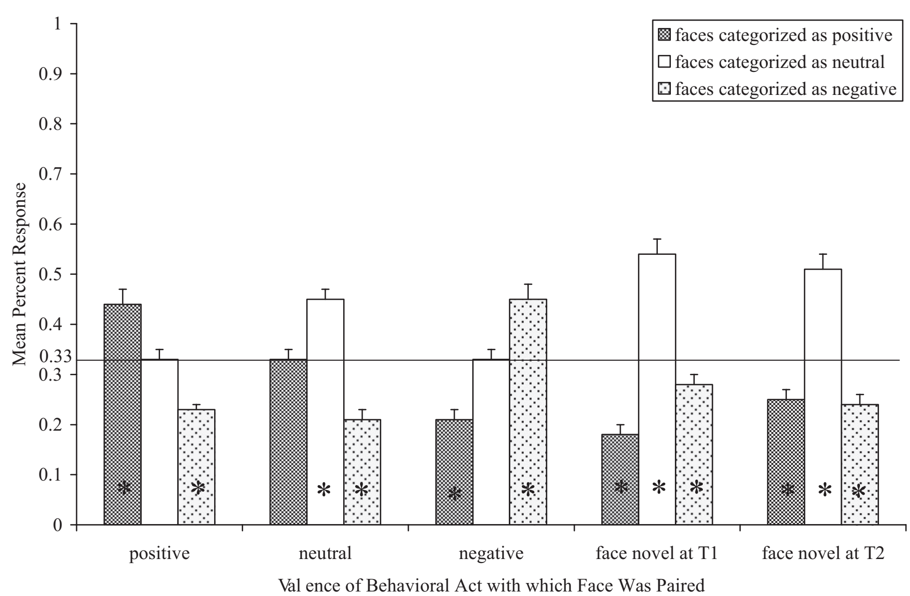

Figure 8. Mean percentage of categorizations two days after learning based on valence of behavioral act with which face was paired: Study 4. Columns with asterisks are different from chance. Means were compared to chance level responding (i.e., .33 or 33%) using a two-tailed 1-sample t test, $p < .05$. Error bars represent standard errors.

neutral) repeated measures ANOVA was performed on the posttest response data. There was a main effect of participant response, $F(2, 138) = 5.44$, $p < .005$, $\eta^2 = .073$, such that participants more likely to categorize faces as positive and neutral as compared with negative. There was a significant sentence by response interaction, $F(4, 276) = 116.01$, $p < .0001$, $\eta^2 = .627$, such that participants were most likely to categorize faces according to the sentence valence with which they were paired. Finally, a significant time by sentence by response interaction revealed that participants were more likely to categorize faces according to the valence of the sentence with which they were paired during the Session 1 as compared with Session 2, $F(4, 276) = 9.87$, $p < .0001$, $\eta^2 = .125$. Importantly, even during Session 2, participants were more likely to categorize faces according to the valence of the sentence with which they were paired as compared to the two other valences. Neither Extraversion nor Neuroticism predicted the propensity to retain learning from Session 1 to Session 2.

Discussion

Study 4 provides the first demonstration that minimal affective learning is retained over time. Seeing faces paired with either positive or negative information only four times cased those faces to be judged as positive or negative two full days later. Although there was some decay in affective learning from Session 1 to Session 2, during Session 2 participants were still more likely to categorize faces according to the valence of the sentence with which they were paired than as either of the other valences. As in Study 3, individuals high in Extraversion received a boost in positive affective learning, whereas Neuroticism was not linked to negative affective learning. Neither personality characteristics predicted the propensity to retain positive or negative learning over time, however.

General Discussion

Taken together, these four studies provide evidence that people can quickly and efficiently learn to navigate their social worlds in terms of what is pleasant or unpleasant, good or bad, in conditions that evoke rule-based processing. Pictures of other people depicting neutral expressions acquired affective value when people were instructed to imagine the target person performing either a positive or negative behavior. Interestingly, participants in all four studies rated neutral faces more positively when they had been previously exposed to those faces in the context of nondiagnostic, neutral behavioral information (i.e., a mere exposure effect; Zajonc, 2001), but this did not account for the degree of positive learning.

In contrast, participants readily learned negative information, but only when it was social in content. Furthermore, people's self-reported sensitivity to positive information, as indexed by their scores on an Extraversion scale, was related to the propensity to readily learn positive information, suggesting that person-level variables contribute to differential learning. Finally, the results of Study 4 suggest that minimal affective learning is retained overtime, such that valenced information learned about faces via minimal affective learning was retained 2 days later, although individual differences in valence sensitivity did not influence such retention.

Effective affective learning about the target faces may have occurred because the sentences they were paired with described behaviors that were diagnostic of future behavior (i.e., the behavioral act described was perceived to be "under the control" of the person). Although we did not directly assess the extent to which participants judged the behaviors to be diagnostic or controllable, we did have a separate group of raters assess about the extent to which the behavioral act described by each sentence could typically be controlled by a person. Overall, the raters were highly consistent in judging the behavioral acts described by the sentences as controllable (and thus we would argue, diagnostic of future behavior). In general, the social behavioral acts from Studies 1 and 2 were perceived to be more controllable than the nonsocial acts and the negative social acts were perceived to be significantly more controllable than the negative nonsocial acts. This is one possible explanation for why affective learning proceeded more robustly for faces paired with negative social as compared to nonsocial behavioral acts. The positive and negative acts from Studies 3 and 4 were perceived to be equally controllable and significantly more controllable than the neutral acts, which may explain why positive and negative affective learning was equally robust in Studies 3 and 4.

We cannot rule out the possibility that associative learning mechanisms contributed to the minimal affective learning we observed in Studies 1 through 4. The sentences that were paired with faces did not contain valenced trait words, but they did contain other types of valenced words. In our view, however, associative learning of this sort was unlikely to contribute to the learning we observed given the parameters of the task—many neutral stimuli were paired with mildly valenced stimuli only a few times. In general, associative learning requires many experiences with the stimuli pairs. In cases where associative learning does occur more quickly, neutral stimuli are generally paired with stimuli that are extremely aversive or rewarding.

Implications and Future Directions

Our results suggest that minimal affective learning is implicated in person perception, particularly in whether new people are liked or disliked after minimal interaction or when given little information about their behavior in advance of social interactions. What people know about others is anchored by what they learn initially. This idea is consistent with the findings that suggest that affective learning is indelible (e.g., Bouton, 2002, 2004; Delameter, 2004; Rescorla, 2001). In other words, once a person is associated with a positive or a negative outcome or event, that person is permanently valued as positive or negative, and any further affective learning about that person is controlled by context.

Our results suggest that even brief observation of, or explicit instruction about, a target person's behavior can influence a perceiver's evaluation of that target, which in turn will bias that the perceiver's expectations and potentially influence how he or she interacts with the target in a host of interpersonal settings (e.g., relationship formation, conflict resolution, teaching, therapy, and so on). It is not clear, however, if minimal affective learning serves to bias perception per se (i.e., how the perceiver literally sees a target face) or higher order person perception (i.e., how the perceiver categorizes a target face), or both. Future research should address the extent to which minimal affective learning about people takes place at a perceptual level (e.g., if following learning neutral faces are actually perceived to be positive or negative), and whether such learning can be demonstrated using implicit response methods (e.g., using evaluative priming).

It is possible, but unlikely, that participants did not come to perceive the target faces as positive or negative, but instead used the face stimuli as cues to explicitly recall the sentences from the learning phase to make the category judgments. This possibility is unlikely because participants were instructed to respond as quickly as possible and to indicate their "gut" reaction to or "snap" judgment about the faces. Furthermore, previous studies using that STI paradigm, on which our learning paradigm was based, have found that participants are able to explicitly recall only a small percentage of sentences from the learning phase and that the overall pattern of effects (i.e., rate at which participants made false trait inferences about faces) did not differ based on whether sentence content was accurately recalled for a given face stimulus (e.g., Todorov & Uleman, 2002). Additional findings from our own laboratory using the STI paradigm to assess attributions for male versus female emotional behaviors have replicated the finding that judgments about faces are in no way related to the explicit recall of the sentences with which they were paired (Barrett, Brennan, Yemelyanova, & Bliss-Moreau, 2008). Future studies, should, however, test whether participants can explicitly recall the sentence content or the valence of the sentences that were paired with the faces, after the test phase.

Our results also demonstrate that there are personality-related factors that may moderate or influence the degree of affective learning. People vary greatly in their affective reactions to the world—some individuals live a life of drama and are easily moved or perturbed by changes in their surroundings, while others live a life of tranquility and they are generally unaffected by the vicissitudes of life. Compared to "cool cats," "drama queens" live in world that is populated with people and objects that have acquired affective meaning because of early differences in affective learning. Our findings suggest that sensitivity to positive information and the pervasive experience of positive affect sets the stage for differential affective learning. Individuals high in Extraversion may have more opportunities to experience positive affect because more stimuli can serve as a foundation for positive affective learning (i.e., they may attend to more positive information in the environment and hence have more stimuli that will serve as USs), such that affective learning for positive value probably proceeds more quickly. This learning would then result in a stimulus environment that is populated with more positive objects, resulting in the experience of more positive affect. Further research is needed to examine this hypothesis, however.

Contrary to our hypotheses, Neuroticism was not linked to minimal affective learning of negative information. One possible explanation for this finding is that people are generally vigilant for negative information and therefore equally proficient at negative affective learning; this explanation is unlikely, however, given the variability in negative affective learning that was observed in Studies 1 and 2. Another possibility is that the negative behavioral acts described in the sentences were more intense than the positive acts and as a result, negative affective learning proceeded robustly for everyone, leaving little room for variability in negative learning. Given that the variance in negative affective learning was comparable to the variance in positive affective learning, we do not think this is a likely explanation. A further possibility is that Neuroticism, which is a multifaceted personality construct, is not precise enough to serve as a source of variability negative affective reactivity that is the foundation for affective learning. Future studies are needed to explore the possibility of individual differences in negative affective learning under minimal conditions.

There is evidence demonstrating that the primary learned response (i.e., CS predicts US) can reemerge after extinction when time elapses, when the US is presented again, or when the experimental context is changed, which is demonstrative of the fact that the initial learning is never eliminated (for reviews see Bouton, 2002, 2004). It is reasonable to expect that personality variables will play a role in the extent to which context influences learning and there is some evidence from traditional associative learning paradigms that extinction is related to personality. Individuals high in Extraversion are faster to extinguish conditioned responses (Mangan, 1978; Rauch, Milad, Orr, Quinn, Fischl, & Pittman, 2005), suggesting that their initial learning may be less durable, when compared to individuals low in Extraversion (i.e., Introverts). Future studies should investigate individual differences in extinction and reemergence of affective learning.

Affective learning about people does not occur only in a vacuum, but rather it often occurs in a rich social context. In one context, a personal attribute (e.g., ability to accurately and precisely shoot a gun) might be experienced as positive (in a war), whereas in another context that same attribute may be experienced as threatening (in an urban city street). Our studies set the stage for future research to examine such contextual influence in minimal affective learning. Moreover, it is possible that individual differences and personality may have their greatest effect in contextual influences on affective learning.

Finally, the robust and highly replicable finding that people can learn about affective value under minimal learning conditions sets the stage for future research on the mechanisms and generalizability of minimal affective learning effect.

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Appendix A

Sentences Describing Behavioral Acts for Studies 1 and 2

Behavioral act valence	Social	Nonsocial
Positive	Celebrated a child's birthday	Smelled fresh baked cookies
	Took a nice vacation with the family	Took a hot shower on a cold morning
	Gave a backrub to a loved one	Performed well on a test
	Complemented a coworker	Felt the warm sunshine
	Helped an elderly woman with her groceries	Saw the sunset over the ocean
	Received a present from a colleague	Won the lottery
	Greeted a good friend	Found $20 in a pocket
	Got a promotion at work	Read fantastic new book
	Celebrated a holiday with grandparents	Slept late on a Sunday morning
	Warmly hugged a sibling	Tasted a wonderful dessert
Negative	Was told a parent died	Hit finger with a hammer
	Cheated on a spouse	Missed a flight
	Made a racist comment	Cut finger with a knife
	Was arrested by a police officer	Bit into a rotten apple
	Arrived late to an important meeting	Became sick with the flu
	Cut in line at the bank	Got lost in the desert
	Hit a small child	Stepped in vomit on the street
	Fired an employee before Christmas	Walked up eight flights of stairs
	Stole from a blind person	Had a root canal performed
	Abandoned a partner	Got soaked in a rain storm
Neutral	Rode the elevator with a coworker	Brushed teeth in the morning
	Paid the collector for a subway token	Replaced the light bulb
	Asked the instructor for a pencil	Ate a sandwich for lunch
	Bought shampoo from the clerk	Drew the curtains in the room
	Read a story about the mayor	Cut coupons for groceries
	Mailed a letter to someone	Stapled two pieces of paper together
	Answered the ringing phone	Purchased a new raincoat
	Passed a man on the street	Drank a glass of water
	Talked to a cabdriver	Locked the door to the house
	Saw a person across the room	Left shoes on the doormat

Appendix B

Sentences Describing Behavioral Acts for Studies 3 and 4

Behavioral act valence	
Positive	Celebrated a child's birthday
	Took a nice vacation with the family
	Gave a backrub to a loved one
	Complemented a coworker
	Helped an elderly woman with her groceries
	Gave up seat on the bus to a pregnant lady
	Took a niece to the playground
	Held the door open for a boy on crutches
	Celebrated a holiday with grandparents
	Warmly hugged a sibling
	Threw a surprise birthday party for a parent
	Cooked a fabulous dinner for spouse
	Tutored a struggling classmate for free
	Was elected by the community to city council
	Gave a well deserved award to an employee
	Bought ice cream for a young child on a sunny day
	Helped the blind man pick out items in the grocery store
	Read a book out loud to residents of a nursing home
	Surprised significant other at work with flowers
	Picked up friend at the airport after a long trip
Negative	Provoked the man into a fistfight
	Cheated on a spouse
	Made a racist comment
	Was arrested by a police officer
	Threw a chair at her classmate
	Cut in line at the bank
	Hit a small child
	Fired an employee before Christmas
	Stole from a blind person
	Abandoned a partner
	Killed a child's pet
	Vomited in a friend's new car
	Defecated on the crowded street
	Yelled at a bus driver
	Cursed at the flight attendant
	Slammed the door in the face of the salesman
	Spilled boiling water on friend
	Crashed a friend's car
	Lost all of the company's money
	Lied to the investigator about the crime
Neutral	Rode the elevator with a coworker
	Paid the collector for a subway token
	Asked the instructor for a pencil
	Bought shampoo from the clerk
	Read a story about the mayor
	Mailed a letter to someone
	Answered the ringing phone
	Passed a man on the street
	Told the cabdriver the destination
	Saw a person across the room
	Washed the family's laundry
	Drove to someone's house
	Stopped at the stop sign as people crossed the street
	Was handed mail by the mail carrier
	Printed a document for a coworker
	Sat next to a woman on the train
	Asked the store owner about a product on the shelf
	Asked the gas station attendant to pump gas
	Asked the doorman for directions
	Dropped the children off at school

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