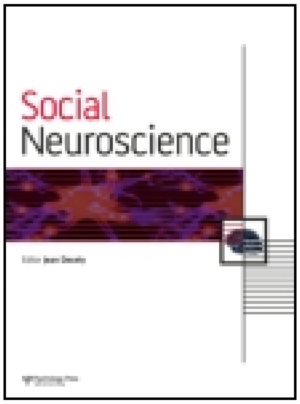

Social Neuroscience
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/psns20

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Published online: 15 Sep 2011.

SOCIAL NEUROSCIENCE, 2012, 7 (3), 240–251

Psychology Press
Taylor & Francis Group

The effects of expectancy violations on early attention to race in an impression-formation paradigm

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Previous research has demonstrated that early attentional components of the event-related potential (ERP) reflect differential attention to race during person perception. There is also evidence that inconsistency between stereotypic information following impression formation leads to greater neural processing in later ERP components. However, research has not examined how expectancy violations following impression formation affect the early attentional processing of race. The current study examined this issue by leading White participants to form impressions of targets based on positive or negative behaviors associated with stereotypes about Blacks or Whites, with the purpose of creating an expectation of Black or White targets. Following each impression formation trial, a target face whose race either violated or confirmed this expectancy was displayed. Participants indicated whether this target could have performed the previous behavior. Results demonstrated that reaction times and early attentional components of the ERP varied as a function of the match between expectancy and the race of target faces, with stereotypic expectancy violating trials yielding longer reaction times and greater N1 and N2 amplitudes than expectancy-confirming trials. Implications for impression formation and person perception are discussed.

Keywords: Expectancy violation; Early attention; ERPs; Impression formation; Race.

Within the last decade, great strides have been made in understanding the cognitive processes that are involved in person perception. Work in social neuroscience has demonstrated that perceivers process social information differently depending on the content of the racial information present, such as skin color or stereotypes. Most of this work has focused on how the race of a perceived face affects the processing of early attentional components of the event-related potential (ERP) (Ito & Bartholow, 2009). Another area of interest for researchers interested in person perception has focused on stereotypic impression formation and has shown that later ERP components (e.g., P3) are enhanced when information does not match stereotypic expectancies (e.g., Osterhout, Bersick, & McLaughlin, 1997). The social neuroscience literature, however, has largely ignored how violations of stereotypic impression formations may affect the attentional processing of race. The current study was designed to address this omission in the literature.

ATTENTION TO RACE DURING PERSON PERCEPTION

Social psychologists interested in examining attention to faces that vary by race have used ERPs to measure attention. ERPs are determined by averaging electroencephalogram (EEG) signals obtained from the scalp over time and across multiple presentations of stimuli, a procedure that separates activity associated with stimulus processing from background EEG activity (Cacioppo, Crites, Gardner, & Berntson, 1994; Stern, Ray, & Quigley, 2001). Researchers interested in examining the processing of race have used ERPs because they are not dependent on the speed of motor processes and task requirements (Ito & Cacioppo, 2000), and because of their excellent temporal resolution, which provides a direct manifestation of processing related to a face (Fabiani & Donchin, 1995). In addition, ERPs are particularly useful because a single stimulus-locked waveform contains multiple compo-

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www.psypress.com/socialneuroscience http://dx.doi.org/10.1080/17470919.2011.609906

nents, each reflecting an arguably distinct aspect of cognitive processing, such as attention and evaluation (Bartholow & Dickter, in press).

Researchers examining ERPs in the processing of race have focused on the short-latency, early attentional endogenous components of the ERP, most notably N1, P2, and N2. Studies investigating these components suggest that the racial categorization of a person takes place in the first 100–200 ms after stimulus presentation (Ito & Urland, 2003). The P2 and N2 components in particular are thought to represent the automatic encoding of racial category information (see Bartholow & Dickter, in press). The P2 is typically larger to racial outgroup than ingroup faces (e.g., Dickter & Bartholow, 2007; Ito & Urland, 2003, 2005; Willadsen-Jensen & Ito, 2006, 2008). These results were originally interpreted to be due to an implicit threat response to minority faces associated with violence (e.g., Blacks) (Ito & Urland, 2003, 2005), although recent studies demonstrating outgroup race effects in the P2 in racial minority participants viewing White outgroup faces suggest that the P2 most likely reflects the processing of outgroup faces rather than threat perception associated with stereotypic knowledge (Dickter & Bartholow, 2007; Willadsen-Jensen & Ito, 2008).

The N2, on the other hand, has been associated with racial ingroup processing, with larger N2 amplitudes to racial ingroup than outgroup faces (Dickter & Bartholow, 2007, 2010; Ito & Urland, 2003, 2005). This ingroup attentional bias was correlated with an ingroup advantage in categorization (Dickter & Bartholow, 2007), suggesting a potential functional role for early differentiation of ingroup and outgroup targets. The N2 has also been linked with the avoidance of inappropriate responses, which may occur when there is response conflict between prepotent but inappropriate response tendencies and alternative responses (Bartholow et al., 2005; Kopp, Rist, & Mattler, 1996; Nieuwenhuis, Yeung, van den Wildenberg, & Ridderinkhof, 2003; van Veen & Carter, 2002). Recent work examining the role of response conflict in the processing of race has demonstrated that the N2 is sensitive to compatibility between a target face and competing information, but only when the face belongs to a racial ingroup (Dickter & Bartholow, 2010).

Less research has focused on how the processing of faces is manifested in the early attentional component N1. One study conducted by Ito and Urland (2003) found larger amplitude N1s in White participants to outgroup Black faces relative to ingroup White faces. As the literature lacks additional evidence that the N1 is associated with greater processing of racial outgroup faces, more research is needed to examine the role of the N1 in the processing of racial information.

EXPECTANCY VIOLATIONS FOLLOWING IMPRESSION FORMATION

Forming expectancies about the behaviors of individuals and groups is an important part of person perception (Jones, 1990), as it leads people to avoid potentially threatening individuals (Olson, Roese, & Zanna, 1996). People tend to form category-based expectancies that reflect their expectation that members of specific groups will share similar behaviors (Jones, 1990). When group members violate expectancies by acting in a stereotype-inconsistent manner, social perceivers experience greater affective arousal, relative to times when targets behave in a stereotype-consistent way (Jussim, Coleman, & Lerch, 1987). This affective arousal can lead social perceivers to evaluate group members who violate stereotypes more extremely, relative to those who confirm expectancies (Bettencourt, Dill, Greathouse, Charlton, & Mulholland, 1997; Jackson, Sullivan, & Hodge, 1993).

In addition to increasing affective arousal, expectancy violations also affect the cognitive processing of person perception-related information. Due to a discrepancy between new information and preexisting person concepts, expectancy violations lead to working memory updating (e.g., Bargh & Thein, 1985; Bartholow, Fabiana, Gratton, & Bettencourt, 2001). Thus, more cognitive processing occurs for information inconsistent with expectancies, compared to information that is consistent with expectancies (e.g., Stern, Marrs, Millar, & Cole, 1984), leading to better memory for violating than confirming information (e.g., Bartholow et al., 2001; Stangor & McMillan, 1992). When confronted with stereotype-incongruent behavior, perceivers experience an expectancy violation, which leads to greater cognitive processing as well (e.g., Bettencourt et al., 1997).

Research using psychophysiological measures has shown that the P3 component of the ERP, thought to be an electrocortical index of working memory updating (e.g., Donchin & Coles, 1988), is sensitive to the neural processes associated with expectancy violations (see Bartholow & Dickter, in press). For example, in a study by Bartholow et al. (2001), participants formed impressions of individuals and were subsequently presented with behaviors that were inconsistent or consistent with this impression. Results indicated larger P3 amplitudes to expectancy-violating behaviors than expectancy-confirming behaviors, and greater P3 amplitudes to negative versus positive behaviors. A similar study conducted by Osterhout, Bersick, and McLaughlin (1997) found larger P3 amplitudes to words that violated gender stereotypes, compared to words that confirmed these stereotypes. Finally, Bartholow, Dickter, and Sestir (2006) showed that following the presentation of White faces, Black-stereotypic traits elicited enhanced P300 amplitudes, relative to White-stereotypic traits; the opposite pattern was found with Black face primes. Thus, a robust literature has illustrated that there are differences in the neural processing of stereotypic-violating and -confirming information, as indexed by the P3.

THE CURRENT STUDY

The work reviewed above has demonstrated that early attentional components of the ERP are sensitive to race (e.g., Dickter & Bartholow, 2007). In addition, research has shown that the processing of information stereotypically inconsistent with target information can be manifested in later processing, as indexed by the P3 (e.g., Osterhout et al., 1997). The purpose of the current study is to examine whether stereotypic expectancies can affect the early attentional processing of faces, a topic that has not been previously investigated. Examining this topic is important, as social perceivers may attend more to group members who engage in counter-stereotypic behaviors, and this may lead to more extreme evaluations compared to those who confirm stereotypic expectancies (e.g., Bettencourt et al., 1997). In addition, the early processing of target race facilitates later racial categorization (Dickter & Bartholow, 2007), which could have implications for prejudicial behavior.

In the current study, an impression-formation paradigm was used in which perceivers viewed the behavior of a target to form an expectation of the target's race. This information was followed by the presentation of a target face that either matched or did not match the race of the previously formed stereotypic impression. EEG activity was recorded to index the early neural processing of race, and we tested whether this was affected by the stereotypic impression formed previously (i.e., an expectation of the race of the target individual). Positive and negative Black and White stereotypic impressions were used with the purpose of uniquely examining the effects of valence and race of the stereotypic expectancies on the early processing of faces. Most previous studies using the P3 to examine the neural indices of expectancy violations have solely manipulated the consistency of the stereotype content (e.g., Osterhout et al., 1997), and have ignored valence. A study by Bartholow et al. (2001), however, found that negative expectancy-violating behaviors elicit more negative affect than positive expectancy-violating behaviors early in processing; these findings are consistent with a robust literature indicating that negative information about others during impression formation may be processed more deeply than positive information (e.g., Sherman & Frost, 2000; Ybarra, 2002). Furthermore, previous work has suggested that the valence and content of stereotypes each differentially predict positive and negative feelings about a future interracial interaction (Gordijn, Finchelescu, Brix, Wijnants, & Koomen, 2008). No studies, to our knowledge, have simultaneously examined the effects of expectancies formed on the basis of stereotype content and valence. It was hypothesized that greater processing would occur for trials with expectancy violations, which would yield longer reaction times (RTs) and more neural activity in the N1, P2, and N2, relative to expectancy-confirming trials. There were no specific hypotheses regarding potential differences in interactions between the race of the face and either valence or race of the impression for different early attentional components.

METHOD

Participants

Twenty-five White (13 women) undergraduates ($M_{\text{age}} = 19.16$) enrolled in an introductory psychology course at a medium-sized public university participated for partial fulfillment of course credit. All participants were healthy and right-handed, and had normal or corrected-to-normal vision. All procedures were approved by the college's Protection of Human Subjects Committee, and written informed consent was obtained from each participant.

Stimuli and experimental paradigm

Participants were presented with a series of trials in which an impression-formation sentence was displayed on a computer screen, followed by a picture of a male target's face. The purpose of the paradigm was to lead participants to expect a target individual belonging to a racial category, and then to present a target individual whose race either violated or confirmed that expectation. The presented sentences described actors engaging in various behaviors that were consistent with stereotypes associated with Black and White Americans. All sentences were derived from a series of three pilot studies using different samples from the same population of college students. The first pilot test was part of a larger project that examined stereotype content in regard to various social groups. In Pilot Study 1, participants ($N = 188$) completed a free response task in which they listed stereotypes about Black and White males in American culture. During the second pilot study, the most frequent racial stereotypes from Pilot Study 1 were selected and participants ($N = 68$) indicated the applicability of these words separately for Black males and White males on a 7-point scale from *"not at all applicable*" to "*extremely applicable*." Those stereotypes rated as most applicable for Black males and White males were selected for inclusion in this research; traits rated as similarly applicable for both Blacks and Whites were excluded. In the third pilot test, participants ($N = 49$) were asked to produce sentences that reflected, but did not explicitly use, each trait from Pilot Study 2 to create a series of sentences describing behaviors that reflected the most commonly applied stereotypes for the two social groups. For each stereotype, four commonly used sentence prototypes were identified. For example, 20 of the sentences created by participants to describe the stereotype "strong" involved an individual lifting heavy weights, so the sentence "Person 1 bench-pressed over 200 pounds" was one of the sentences used to describe a "strong" target.

For the current study, picture stimuli consisted of 40 full-color photographs each of Black and White males. All pictures were obtained from Jennifer Eberhardt and were pilot-tested to be similar in attractiveness, stereotypicality, and age (Eberhardt, Davies, Purdie-Vaughns, & Johnson, 2006). Individuals in the pictures displayed neutral facial expressions and direct eye gaze; only the head and part of the neck were shown.

Stimuli were presented on an LCD computer monitor using E-Prime software (Psychology Software Tools, Inc., Pittsburgh, PA, USA). Trials for the current study consisted of 80 sentence-face pairs, presented in five blocks of 16 trials each. At the beginning of each trial, a message notifying participants that the next trial was about to begin was presented for 1000 ms. Next, a fixation cross appeared in the center of the screen for 500 ms, followed by the impression-formation sentence, which was displayed until participants indicated they were finished reading the sentence; upon this button press, the target picture appeared for 500 ms. Participants then indicated whether the target could be the person described in the sentence by pressing one of two keys on the keyboard; this key press was counterbalanced across participants. Each target stimulus depicted a different person so that the same face was not seen more than once. The intertrial interval varied randomly between 2000 and 4000 ms (for an experiment schematic, see Figure 1).

Procedure

Testing was conducted with one participant at a time in an electrically shielded Faraday cage. Upon arriving at the laboratory, participants completed a consent form, and the electrodes were attached and tested. All participants were seated approximately 70 cm from the computer screen. Participants were asked to stay

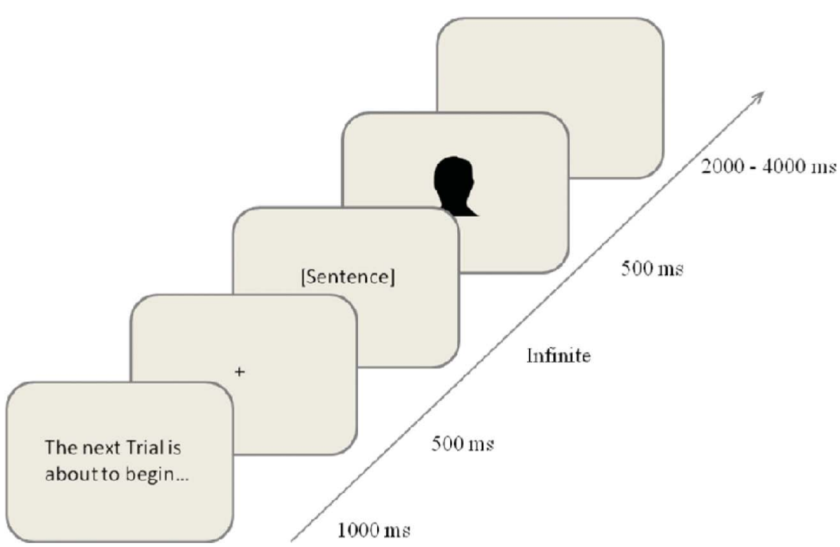

Figure 1. Task schematic of the impression-formation paradigm.

as still as possible during the trials in order to reduce the amount of extraneous noise in the EEG data. All participants were told that the computer task involved the presentation of a series of trials, each composed of a sentence describing an action performed by a target person, followed by a picture of a man's face. They were instructed to form an impression about the target person based on the sentence they read and to push the space bar after they had formed the impression, after which the face would appear. Participants were told to indicate by button press whether the target could be the person described in the sentence. After the instructions were given, participants completed a practice block of 10 trials to familiarize themselves with the task. They then completed the experimental trials, consisting of five blocks of 16 trials each, presented in a random order for each participant. When finished, participants were debriefed and given credit for their participation. All participants completed the study within an hour and a half.

Electrophysiological recording and analysis

EEG data were recorded with a DBPA-1 Sensorium Bioamplifier (Sensorium, Inc., Charlotte, VT, USA) with an analog high-pass filter of 0.01 Hz and a low-pass filter of 500 Hz (four-pole Bessel). The EEG was recorded from 74 Ag-AgCl sintered electrodes in an electrode cap, placed with the expanded International 10–20 electrode placement system. All electrodes were referenced to the tip of the nose, and the ground electrode was placed in the middle of the forehead, slightly above the eyebrows. Eye movement and blinking were recorded from bipolar electrodes placed on the lateral canthi and perioccular electrodes on the superior and inferior orbits, aligned with the pupils. Before data collection was initiated, all impedances were adjusted to within 0–20 kilohms. EEG was recorded continuously throughout the computer task, and was analyzed off-line by EMSE software (Source Signal Imaging, San Diego, CA, USA). Data were undersampled at 500 Hz. The data were corrected for eye-movement artifacts, using independent component analysis (Jung, Makeig, Westerfield, Townsend, Courchesne, & Sejnowski 2000). Channels containing extreme values (± 300 mV) in more than 40% of the sweeps were spatially interpolated. All EEG data were filtered (FIR) at low-pass 20 Hz (Luck, 2005). The data were segmented between 200 ms prior to stimulus onset and 1000 ms post-stimulus onset. After baseline correction over the pre-stimulus interval, segmented data was averaged for each subject in each of the conditions (Fabiani, Gratton, & Federmeier, 2007; Luck, 2005). Sample-wide ERPs were identified from the grand-averaged waveforms.

RESULTS

Analyses were conducted on data from all 25 participants unless otherwise specified. Greenhouse–Geisser-adjusted p values are reported for all analyses with multiple numerator degrees of freedom.

ERP results

ERP components

Visual inspection of grand-averaged waveforms was used to identify epochs for the component amplitudes of interest, as well as to determine scalp locations where neural activation was maximal for the corresponding components. The N1 component was largest at the Fz (frontal midline) electrode, and was quantified as the average voltage between 85 and 120 ms at that electrode. The P2 was largest at the Pz (parietal midline) electrode, and was quantified as the average voltage between 170 and 240 ms at Pz. The N2 component was quantified as the average voltage between 210 and 280 ms at Fz.

Analytic approach

The data collected from one participant (White female) were not included due to excessive noise in the EEG recording. Thus, EEG data analysis was conducted with 24 White participants (12 women). In order to examine the neural effects of stereotype-consistent and -inconsistent conditions, several 2 (Target Race: Black, White) × 2 (Stereotype Race: Black, White) × 2 (Stereotype Valence: Positive, Negative) repeated-measures ANOVAs were conducted. In order to test for potential participant gender effects, the data were first analyzed with gender as a between-subjects variable; as gender did not interact with any other variable, all analyses below are collapsed across gender.

N1

The N1 data revealed a significant Target Race × Stereotype Valence interaction, $F(1, 23) = 5.13$, $p = .034$, $\eta^2 = .19$, suggesting that activation to the faces differed as a function of the valence of the impression

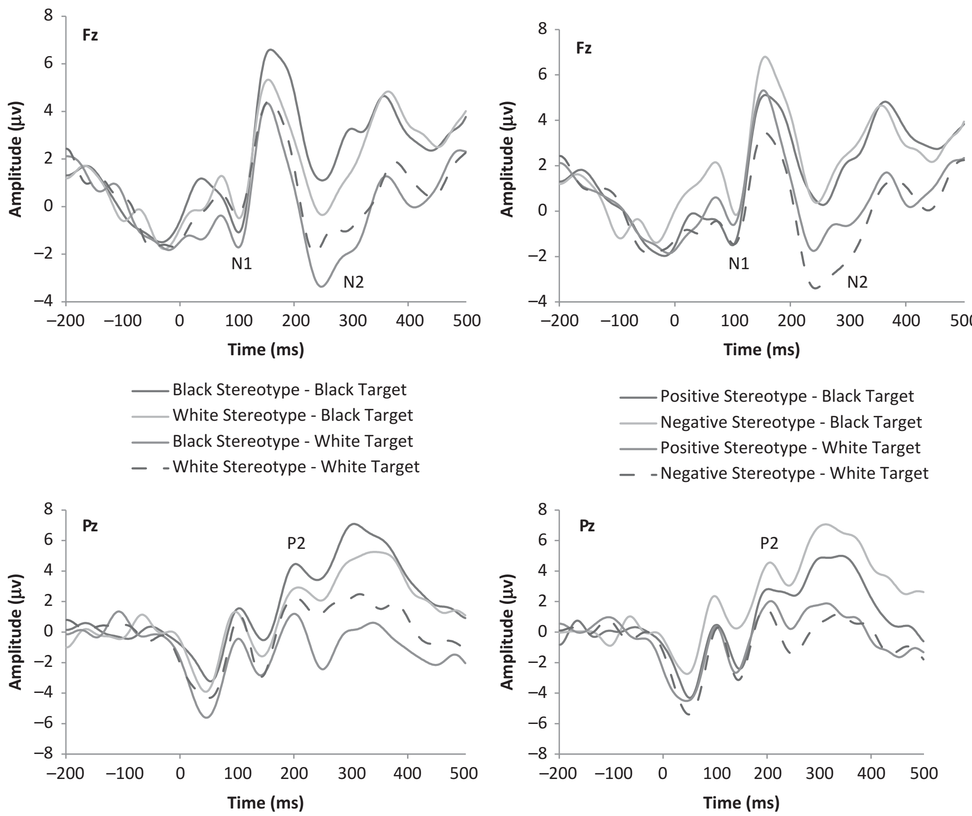

Figure 2. Neural activation elicited by Black and White targets as a function of expectancy. The top panels show waveforms measured from the frontal midline electrode (Fz), where the N1 and N2 were largest. The bottom panels show waveforms measured from the parietal midline electrode (Pz), where the P2 was maximal. The panels on the left show activation as a function of the race (i.e., Black or White) of the expectancy, whereas the panels on the right show activation as a function of the valence (i.e., positive or negative) of the expectancy.

formed (Figure 2). Planned comparisons revealed that the negative Stereotype–White Target and the positive Stereotype–Black Target conditions yielded a significantly larger amplitude N1 than the other two conditions, ts > 2.19, ps < .05 (Table 1). These results suggest that trials in which a negative impression was followed by a White target and a positive impression was followed by a Black target yielded greater processing than trials in which a positive impression was followed by a White target and a negative impression was followed by a Black target.

TABLE 1
N1 amplitude as function of Target Race and Stereotype Valence

Condition	*Mean*	*SE*
Positive Stereotype–Black Target	-1.00^{cd}	0.85
Positive Stereotype–White Target	-0.11^{bc}	0.60
Negative Stereotype–Black Target	0.55^{ad}	1.19
Negative Stereotype–White Target	-1.04^{ab}	0.78

Note: Means are in microvolts. Significant differences ($p < .05$) between conditions are marked with the same letter.

P2

The analysis of the P2 component revealed larger amplitudes in response to Black faces (M = 2.29, SE = 1.59) relative to White faces (M = 0.41, SE = 1.31), but the effect of Target Race failed to reach conventional levels of statistical significance, $F(1, 23) = 4.04$, $p = .056$, $\eta^2 = .14$. However, the data produced a significant Target Race × Stereotype Race interaction, $F(1, 23) = 5.29$, $p = .031$, $\eta^2 = .19$ (Figure 2). Planned comparisons revealed that the Black Stereotype–Black Target condition (M = 2.74, SE = 1.60) yielded a larger amplitude than the Black Stereotype–White Target condition (M = –0.53, SE = 1.54), $t(23) = 3.24$, $p = .004$, and the White Stereotype–Black Target condition (M = 1.71, SE = 1.73), $t(23) = 2.11$, $p = .046$. These results demonstrated that Black faces following a description of stereotypically Black behavior elicited more processing than other combinations.

N2

The analysis of the N2 component revealed a main effect for Target Race, $F(1, 23) = 8.08$, $p = .009$, $\eta^2 = .26$, such that more neural activation was recorded following White faces ($M = -2.12$, $SE = 1.31$) relative to Black faces ($M = 0.50$, $SE = 1.37$). This main effect was qualified by a Target Race × Stereotype Valence interaction, $F(1, 23) = 4.41$, $p = .047$, $\eta^2 = .16$ (Figure 2). Planned comparisons revealed that the negative White Target condition yielded significantly larger amplitudes than the three other conditions (see Table 2 for means), suggesting that negative behaviors followed by White targets yielded the most processing, and also suggesting that expectancy violations may capture more attention when they involve negative impressions regarding ingroup targets.

There was also a Target Race x Stereotype Race interaction, $F(1, 23) = 4.86$, $p = .038$, $\eta^2 = .17$ (Figure 2). Planned comparisons revealed that the Black Stereotype–White Target condition yielded significantly larger amplitudes than the Black Stereotype–Black Target condition and the White Stereotype–Black Target condition (see Table 3 for means).

TABLE 2
N2 amplitude as function of Target Race and Stereotype Valence

Condition	*Mean*	*SE*
Positive Stereotype–Black Target	0.32[a]	1.30
Positive Stereotype–White Target	−1.12[b]	1.20
Negative Stereotype–Black Target	0.67[c]	1.61
Negative Stereotype–White Target	−3.11[abc]	1.55

Note: Means are in microvolts. Significant differences ($p < .05$) between conditions are marked with the same letter.

TABLE 3
N2 Amplitude as function of Target Race and Stereotype Race

Condition	*Mean*	*SE*
Black Stereotype–Black Target	1.16[a]	1.46
Black Stereotype–White Target	−2.87[ab]	1.46
White Stereotype–Black Target	−0.15[b]	1.39
White Stereotype–White Target	−1.36	1.39

Note: Means are in microvolts. Significant differences ($p < .05$) between conditions are marked with the same letter.

Behavioral data

RT

In order to assess whether behavioral responses to the face stimuli in the decision-making task varied as a function of the impression formed from the sentence preceding the faces, RTs to the faces were examined. For each participant, trials with RTs smaller than or greater than 3 *SD* from the mean were excluded from the analyses. Data were subjected to 2 (Target Race: Black, White) × 2 (Stereotype Valence: Positive, Negative) × 2 (Stereotype Race: Black, White) × 2 (Response: Yes, No) repeated-measures analyses of variance (ANOVA). All significant effects are reported below.

Results revealed a main effect for Stereotype Valence, $F(1, 24) = 14.15$, $p = .001$, $\eta^2 = .37$, qualified by a Target Race × Stereotype Valence × Stereotype Race × Response interaction, $F(1, 24) = 4.56$, $p = .043$, $\eta^2 = .16$ (Table 4). To clarify the interaction, it was decomposed by conducting separate 2 (Target Race: Black, White) × 2 (Stereotype Valence: Positive, Negative) × 2 (Stereotype Race: Black, White) repeated-measures ANOVAs for each response (i.e., Yes, No). On trials in which participants indicated that the target could not have performed the preceding action, there were no significant results. For trials in which participants indicated that the action could have been performed by the individual, the data showed a main effect for Stereotype Valence, $F(1, 24) = 21.65$, $p < .001$, $\eta^2 = .45$, such that participants responded faster when the target was preceded by a positive stereotype ($M = 1143.57$, $SE = 61.27$) than a negative stereotype ($M = 1249.46$, $SE = 59.49$). Additionally, there was a Target Race × Stereotype Race interaction, $F(1, 24) = 5.02$, $p = .035$, $\eta^2 = .17$ (Figure 3). Planned comparisons revealed

TABLE 4
Reaction time as a function of Stereotype Race, Stereotype Valence, and Target Race for "Yes" responses

Condition	*Mean*	*SE*
Positive		
Black Stereotype–Black Target	1154.93	62.96
Black Stereotype–White Target	1111.32	63.76
White Stereotype–Black Target	1172.32	63.92
White Stereotype–White Target	1135.70	70.03
Negative		
Black Stereotype–Black Target	1200.37	70.39
Black Stereotype–White Target	1253.48	63.40
White Stereotype–Black Target	1331.33	70.66
White Stereotype–White Target	1212.65	65.25

Note: Means and *SE* are presented in milliseconds.

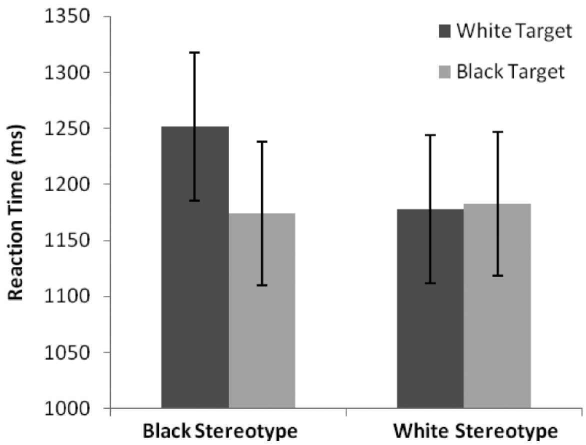

Figure 3. Reaction time as a function of Stereotype Race and Target Race for "Yes" responses. Errors represent *SE*.

that the Black Stereotype–White Target condition (M = 1251.83 ms, SE = 63.57) was significantly slower than both the Black Stereotype–Black target condition (M = 1177.65, SE = 61.99), $t(24) = -2.62$, $p = .015$, and the White stereotype–White Target condition (M = 1174.18, SE = 66.49), $t(24) = 2.54$, $p = .018$. These results indicate that the quickest responses were made in the conditions in which there was no expectancy violation. Participants were slower to respond in the expectancy-violation conditions, especially when the impression formed was consistent with a White target and was followed by a Black target.

Response

To examine whether response differed as a function of the conditions, the proportion of "Yes" responses to the total number of responses in each condition was subjected to a 2 (Target Race: Black, White) × 2 (Stereotype Valence: Positive, Negative) × 2 (Stereotype Race: Black, White) repeated-measures ANOVA. Results revealed a Target Race × Stereotype Race interaction, $F(1, 24) = 17.21$, $p < .001$, $\eta^2 = .41$ (see Table 5 for means). Planned comparisons indicated that participants were more likely to respond that the Black and White targets were capable of the Black and White stereotypic behaviors, respectively, than the conditions in which the target race violated the previous expectation (i.e., Black Stereotype–White Target, White Stereotype–Black Target).

The data also revealed a Target Race × Stereotype Valence interaction, $F(1, 24) = 9.21$, $p = .006$, $\eta^2 = .28$. Planned comparisons indicated that participants were more likely to indicate that a Black target was capable of a negative stereotypic behavior

TABLE 5
Proportion of "Yes" responses as a function of Stereotype Race and Target Race

Condition	*Mean*	*SE*
Black Stereotype–Black Target	0.72[ab]	0.03
Black Stereotype–White Target	0.64[bde]	0.04
White Stereotype–Black Target	0.57[acd]	0.05
White Stereotype–White Target	0.71[ce]	0.04

Note: Significant differences ($p < .05$) between conditions are marked with the same letter.

($M = 0.70$, $SE = 0.04$) than a Black target was capable of a positive stereotypic behavior ($M = 0.61$, $SE = 0.04$), $t(24) = -2.20$, $p = .038$, or a White target was typical of a negative stereotypic behavior ($M = 0.60$, $SE = .04$), $t(24) = -3.50$, $p = .002$.

Taken together, these results indicate that participants were more likely to indicate that the action could have been performed by the individual about whom they had formed a previous impression in the stereotypically consistent conditions relative to the stereotype-inconsistent conditions.

DISCUSSION

The current study examined how early attention to race differs on the basis of previously formed stereotypic expectancies. Although previous research has demonstrated that early attentional ERP components are affected by the race of the face (e.g., Dickter & Bartholow, 2007; Ito & Urland, 2003) and that expectancy-violating information leads to greater neural processing as indexed by the P3 (e.g., Bartholow et al., 2001; Osterhout et al., 1997), past efforts have not examined whether stereotypic impression formation affects the early attentional processing of the race of a target face. In the current study, the hypothesis that RTs and early attentional components of the ERP would be sensitive to interactions between stereotypic impressions formed and the race of target faces was supported.

First, psychophysiological results suggested that early attention, as assessed by N1, P2, and N2, to Black and White target faces was moderated by the expectation set up by the content of the impression formed before the presentation of the target faces. N1 results suggested that this occurred as quickly as 100 ms into processing. Specifically, a larger amplitude N1 was found when negative impressions were formed and White faces followed and when positive impression formation was followed by Black faces, compared to other conditions. Although it is well documented that behaviors that are inconsistent with formed impressions elicit larger late positive potentials (e.g., Osterhout et al., 1997), this is the first documentation that expectancy violations can elicit differences in neural activity to a target face 100 ms after the violation. The finding that perceivers are able to encode racial information within the first few hundred milliseconds of processing is not new (Bartholow & Dickter, 2006; Dickter & Bartholow, 2007; Ito & Urland, 2003, 2005), but our results suggest that attention to race at this stage can be affected by positive or negative expectancies. Thus, it appears that targets that violate expectancies yield greater attention in the N1 than those who confirm prior expectancies.

The N2 was also sensitive to interactions between stereotypic information and target race. Specifically, participants showed the greatest N2 amplitude to conditions in which White targets represented violations of valence or stereotypicality, with the largest amplitudes to White targets following negative expectancies and Black stereotypic impressions. Thus, at a slightly later stage during processing, participants showed sensitivity to the compatibility between their formed impression and the race of the target face. That the N2 was largest when expectancy violations involved White target faces is consistent with previous research demonstrating the largest N2 effects for ingroup targets on high conflict trials (Dickter & Bartholow, 2010), and suggests that expectancy violations may capture more attention when they involve negative impressions regarding ingroup targets. Together, the N1 and N2 results suggest that expectancy violations yield more early attention than expectancy confirmations.

The behavioral results in the current study support the N1 and N2 results reported above. That is, participants were more likely to indicate that the target face could be the actor about whom they had formed a previous impression in the stereotypically consistent conditions relative to the stereotype-inconsistent conditions. Participants also responded most quickly to the conditions in which there was no expectancy violation and were slower to respond when there was an expectancy violation, especially when they formed an impression consistent with a White ingroup member and were shown a Black outgroup target. This finding supports a robust literature on expectancy violations suggesting that surprising information is cognitively processed more deeply than expected information (e.g., Bargh & Thein, 1985; Fiske, 1980; Hastie, 1984), yielding longer RTs (Stern et al., 1984). Researchers have suggested that this increased processing may occur because perceivers attempt to reconcile discrepancies in presented information with existing schemas in memory (Hastie, 1984; Stern et al., 1984). RT results, however, were only consistent with ERP results on the trials in which participants reported that the target could have enacted the preceding behavior; this is surprising, as perceivers take longer to process an expectancy violation (Stern et al., 1984), which should lead them to indicate that the target could not have performed the action. The differences in results for each response suggest that attentional biases resulting from expectancy violations may not map directly onto later behavior. To investigate this, we conducted a correlational analysis to examine whether there was a relationship between attention to the targets as assessed by the early ERP components and the RTs for each condition. Analyses revealed no significant relationships between early attentional amplitudes and later RT for any conditions, suggesting that controlled responses to the task were unrelated to early automatic cognitive processing. Thus, it seems that attentional biases to expectancy violations in the current study are unrelated to differences in RT later in processing. This effect is consistent with previous work examining the effect of stereotypic expectancy violations on later ERP components, in which larger P3 amplitudes were found to stereotypic expectancy violations, but they were independent of self-reported judgments (Osterhout et al., 1997).

The pattern of findings in the P2 component was consistent with previous research identifying the P2 as an outgroup component (e.g., Dickter & Bartholow, 2007; Ito & Urland, 2003, 2005; Willadsen-Jensen & Ito, 2008), although the main effect of Target Race was only marginally significant. Similar to the N1 and N2 components, the P2 also showed that activation was significantly moderated by the stereotypic impression formed previously. That is, Black faces following a description of stereotypically Black behavior elicited more processing than other combinations. These results are consistent with the idea that the P2 component reflects the motivated perception of social threat (Schutter, de Haan, & van Honk, 2004), as outgroup faces may be viewed as particularly threatening when preceded by information consistent with stereotypic outgroup behavior.

This paradigm enabled us to separately examine the effects of Stereotype Race and Stereotype Valence, without confounding the two. Previous research has been limited by using only Black negative and White positive stereotypes (e.g., Bartholow & Dickter, 2008). Our findings suggest that White perceivers may be affected by different aspects of their previously formed impression at different stages during person perception. The N1 findings that participants were solely affected by the compatibility of valence with the race of the target face suggest that, at this early stage in processing, participants may have been relying on simple learned heuristics of negativity and positivity associated with Blacks and Whites, respectively, in our society (Donnerstein, Donnerstein, Simon, & Ditrichs, 1972; Duncan, 1976; Gaertner & Dovidio, 1977; McConahay, 1983; Sigall & Page, 1971). Later in processing, however, participants may have become more sensitive to the compatibility of the stereotypes themselves rather than simple valence, and this may have led to the P2 and N2 results. Future research should further investigate the timeline of processing information related to stereotype content and valence. The current findings may have implications for judgments about and behavior towards those who violate stereotypic associations and for minority group members who act in a positive way or majority group members who act in a negative way. As such situations seem to yield greater neural processing, this may lead to more extreme evaluations of target individuals (Bettencourt et al., 1997; Jussim et al., 1987). Future research should investigate the potential behavioral results of these processes.

The current study has several important limitations. First, we included only White participants; this limits the generalizability of our findings, but also ignores the important role of perceiver race in the processing of race-related information in the early attentional ERP components (Dickter & Bartholow, 2007; Willadsen-Jensen & Ito, 2008). Future research should examine how minority group members process stereotype-related expectancy violations. Additionally, we included only male targets in the experimental paradigm. The decision to include only a male target instead of adding female targets was made because of time limitations; that is, adding a second gender group would entail doubling the number of trials. We chose male targets because racial stereotypes are often more associated with male than female targets (Gyurovski & Dickter, 2010), but future studies should investigate whether racial expectancy violations are processed differently for males and females.

Although the findings of this study are preliminary and more work needs to be done to further this line of research, the current study provides compelling evidence that attention to race early in processing as indexed by early attentional ERP components is moderated by the consistency of stereotypic information presented during impression formation. These findings have important implications for person perception, as individuals use category-based expectancies about the behaviors of individuals and groups during person perception (Jones, 1990). The current study demonstrates that group members who violate expectancies by acting in a stereotype-inconsistent manner may lead social perceivers to attend more to these individuals, which can have implications for later evaluations (e.g., Bettencourt et al., 1996). These results also provide the first evidence that expectancy violations are processed within several hundred milliseconds and can be triggered at different stages by inconsistencies between the valence or the racial content of a stereotypic behavior and the race of a target individual.

Original manuscript received 6 April 2011
Revised manuscript accepted 29 July 2011
First published online 15 September 2011

REFERENCES

Bargh, J. A., & Thein, R. D. (1985). Individual construct accessibility, person memory, and the recall-judgment link: The case of information overload. *Journal of Personality and Social Psychology*, *49*(5), 1129–1146. doi: 10.1037/0022–3514.49.5.1129

Bartholow, B. D., & Dickter, C. L. (2008). A response conflict account of the effects of stereotypes on racial categorization. *Social Cognition*, *26*(3), 314–332. doi: 10.1521/soco.2008.26.3.314

Bartholow, B. D., & Dickter, C. L. (in press). Person perception. In J. Decety & J. Cacioppo (Eds.), *Handbook of social neuroscience*. New York: Oxford University Press.

Bartholow, B. D., Dickter, C. L., & Sestir, M. A. (2006). Stereotype activation and control of race bias: Cognitive control of inhibition and its impairment by alcohol. *Journal of Personality and Social Psychology, 90*, 272–287.

Bartholow, B. D., Fabiana, M., Gratton, G., & Battencourt, B. A. (2001). A psychophysiological examination of cognitive processing of and affective responses to social expectancy violations. *Psychological Science*, *12*(3), 197–204. doi: 10.1111/1467–9280.00336

Bartholow, B. D., Pearson, M. A., Dickter, C. L., Sher, K. J., Fabiani, M., & Gratton, G. (2005). Strategic control and medial frontal negativity: Beyond errors and response conflict. *Psychophysiology*, *42*(1), 33–42. doi: 10.1111/j.1469–8986.2005.00258.x

Bettencourt, B. A., Dill, K. E., Greathouse, S. A., Charlton, K., & Mulholland, A. (1997). Evaluations of ingroup and outgroup members: The role of category-based expectancy violation. *Journal of Experimental Social Psychology*, *33*(3), 244–275. doi: 10.1006/jesp.1996.1323

Cacioppo, J. T., Crites, S. L., Gardner, W. L., & Berntson, G. G. (1994). Bioelectrical echoes from evaluative categorizations. I. A late positive brain potential that varies as a function of trait negativity and extremity. *Journal of Personality and Social Psychology*, *67*(1), 115–125. doi: 10.1037/0022–3514.67.1.115

Dickter, C. L., & Bartholow, B. D. (2007). Racial ingroup and outgroup attention biases revealed by event-related brain potentials. *Social Cognitive and Affective Neuroscience*, *2*(3), 189–198. doi: 10.1093/scan/nsm012

Dickter, C. L., & Bartholow, B. D. (2010). Ingroup categorization and response conflict: Interactive effects of target race, flanker compatibility, and infrequency on N2 amplitude. *Psychophysiology*, *47*(3), 596–601. doi: 10.1111/j.1469–8986.2010.00963.x

Donchin, E., & Coles, M. G. (1988). Is the P300 component a manifestation of context updating?

Behavioral and Brain Sciences, *11*(3), 357–427. doi: 10.1017/S0140525X00058027

Donnerstein, E., Donnerstein, M., Simon, S., & Ditrichs, R. (1972). Variables in interracial aggression: Anonymity, expected retaliation, and a riot. *Journal of Personality and Social Psychology, 22*(2), 236–245. doi:10.1037/h0032597

Duncan, B. L. (1976). Differential social perception and attribution of intergroup violence: Testing the lower limits of stereotyping of Blacks. *Journal of Personality and Social Psychology*, *34*, 590–598.

Eberhardt, J. L., Davies, P. G., Purdie-Vaughns, V., & Johnson, S. L. (2006). Looking deathworthy: Perceived stereotypicality of black defendants predicts capital-sentencing outcomes. *Psychological Science*, *17*(5), 383–386. doi: 10.1111/j.1467–9280.2006.01716.x

Fabiani, M., & Donchin, E. (1995). Encoding processes and memory organization: A model of the von Restorff effect. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*(1), 224–240. doi: 10.1037/0278-7393.21.1.224

Fabiani, M., Gratton, G., & Federmeier, K. (2007). Event related brain potentials. In J. T. Cacioppo, L. G. Tassinary, & G. C. Berntson (Eds.), *Handbook of psychophysiology* (3rd ed., pp. 85–119). New York, NY: Cambridge University Press.

Fiske, S. T. (1980). Attention and weight in person perception: The impact of negative and extreme behavior. *Journal of Personality and Social Psychology*, *38*(6), 889–906. doi: 10.1037/0022-3514.38.6.889

Gaertner, S. L., & Dovidio, J. F. (1977). The subtlety of white racism, arousal, and helping behavior. *Journal of Personality and Social Psychology*, *35*, 691–707.

Gordijn, E., Finchilescu, G., Brix, L., Wijnants, N., & Koomen, W. (2008). The influence of prejudice and stereotypes on anticipated affect: Feelings about a potentially negative interaction with another ethnic group. *South African Journal of Psychology*, *38*(4), 589–601.

Gyurovski, I. I., & Dickter, C. L. (2010, May). *Examining the determinants of stereotype content: The effects of race and gender.* Poster presented at the annual meeting of the Association for Psychological Science, Boston,MA.

Hastie, R. (1984). Causes and effects of causal attribution. *Journal of Personality and Social Psychology*, *46*(1), 44–56. doi: 10.1037/0022-3514.46.1.44

Ito, T. A., & Bartholow, B. D. (2009).The neural correlates of race. *Trends in Cognitive Sciences*, *13*(12), 524–531. doi: 10.1016/j.tics.2009.10.002

Ito, T. A., & Cacioppo, J. T. (2000). Electrophysiological evidence of implicit and explicit categorization processes. *Journal of Experimental Social Psychology*, *36*(6), 660–676. doi: 10.1006/jesp.2000.1430

Ito, T. A., & Urland, G. R. (2003). Race and gender on the brain: Electrocortical measures of attention to the race and gender of multiply categorizable individuals. *Journal of Personality and Social Psychology*, *85*(4), 616–626. doi: 10.1037/0022-3514.85.4.616

Ito, T. A., & Urland, G. R. (2005). The influence of processing objectives on the perception of faces: An ERP study of race and gender perception. *Cognitive, Affective, & Behavioral Neuroscience*, *5*(1), 21–36. doi: 10.3758/CABN.5.1.21

Jackson, L. A., Sullivan, L. A., & Hodge, C. N. (1993). Stereotype effects of attributions, predictions, and evaluations: No two social judgments are quite alike. *Journal of Personality and Social Psychology*, *65*(1), 69–84. doi: 10.1037/0022-3514.65.1.69

Jones, E. E. (1990). *Interpersonal perception*. New York, NY: W. H. Freeman/Times Books/Henry Holt.

Jung, T. P., Makeig, S., Westerfield, M., Townsend, J., Courchesne, E., & Sejnowski, T. J. (2000). Removal of eye activity artifacts from visual event-related potentials in normal and clinical subjects. *Clinical Neurophysiology, 111*, 1745–1758.

Jussim, L., Coleman, L. M., & Lerch, L. (1987). The nature of stereotypes: A comparison and integration of three theories. *Journal of Personality and Social Psychology*, *52*(3), 536–546. doi: 10.1037/0022-3514.52.3.536

Kopp, B., Rist, F., & Mattler, U. (1996). N200 in the flanker task as a neurobehavioral tool for investigating executive control. *Psychophysiology*, *33*(3), 282–294. doi: 10.1111/j.1469-8986.1996.tb00425.x

Luck, S. J. (2005). *An introduction to the event-related potential technique*. Cambridge, MA: MIT Press.

McConahay, J. B. (1983). Modem racism and modern discrimination: The effects of race, racial attitudes, and context on simulated hiring decisions. *Personality and Social Psychology Bulletin*, *9*, 551–558.

Nieuwenhuis, S., Yeung, N., Van, D. W., & Ridderinkhof, K. R. (2003). Electrophysiological correlates of anterior cingulate function in a go/no-go task: Effects of response conflict and trial type frequency. *Cognitive, Affective, & Behavioral Neuroscience*, *3*(1), 17–26. doi: 10.3758/CABN.3.1.17

Olson, J. M., Roese, N. J., & Zanna, M. P. (1996). Expectancies. In A. W. Kruglanski & E. T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (pp. 211–238). New York, NY: Guilford Press.

Osterhout, L., Bersick, M., & McLaughlin, J. (1997). Brain potentials reflect violations of gender stereotypes. *Memory & Cognition*, *25*(3), 273–285.

Schutter, D. J. L. G., de Haan, E. H. F., & van Honk, J. (2004). Anterior asymmetrical alpha activity predicts Iowa gambling performance: Distinctly but reversed. *Neuropsychologia*, *42*(7), 939–943. doi: 10.1016/j.neuropsychologia.2003.11.014

Sherman, J. W., & Frost, L. A. (2000). On the encoding of stereotype-relevant information under cognitive load. *Personality and Social Psychology Bulletin*, *26*, 26–34.

Sigall, H., & Page, R. (1971). Current stereotypes: A little fading, a little faking. *Journal of Personality and Social Psychology*, *18*, 247–255.

Stangor, C., & McMillan, D. (1992). Memory for expectancy-congruent and expectancy-incongruent information: A review of the social and social developmental literatures. *Psychological Bulletin*, *111*(1), 42–61. doi: 10.1037/0033-2909.111.1.42

Stern, L. D., Marrs, S., Millar, M. G., & Cole, E. (1984). Processing time and the recall of inconsistent and consistent behaviors of individuals and groups. *Journal of Personality and Social Psychology*, *47*(2), 253–262. doi: 10.1037/0022-3514.47.2.253

Stern, R. M., Ray, W. J., & Quigley, K. S. (2001). *Psychophysiological recording.* New York, NY: Oxford University Press.

Stern, R. M., Ray, W. J., & Quigley, K. S. (2003). Psychophysiological recording. *Psychophysiology*, *40*(2), 314–315. doi: 10.1111/1469–8986.00033

Van Veen, V., & Carter, C. S. (2002). The anterior cingulate as a conflict monitor: FMRI and ERP studies.*Physiology*

& Behavior, *77*(4–5), 477–482. doi: 10.1016/S0031–9384(02)009307

Willadsen-Jensen, E., & Ito, T. A. (2006). Ambiguity and the timecourse of racial perception. *Social Cognition*, *24*(5), 580–606. doi: 10.1521/soco.2006.24.5.580

Willadsen-Jensen, E., & Ito, T. A. (2008). A foot in both worlds: Asian Americans' perceptions of Asian, white, and racially ambiguous faces. *Group Processes & Intergroup Relations*, *11*(2), 182–200. doi: 10.1177/1368430207088037

Ybarra, O. (2002). Naive causal understanding of valenced behaviors and its implications for social information processing. *Psychological Bulletin*, *128*, 421–441.