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Social status level and dimension interactively influence person evaluations indexed by P300s

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ABSTRACT
Functional neuroimaging research suggests that status-based evaluations may not solely depend on the level of social status but also on the conferred status dimension. However, no reports to date have studied how status level and dimension shape early person evaluations. To explore early status-based person evaluations, event-related brain potential data were collected from 29 participants while they indicated the status level and dimension of faces that had been previously trained to be associated with one of four status types: high moral, low moral, high financial, or low financial. Analysis of the P300 amplitude (previously implicated in social evaluation) revealed an interaction of status level and status dimension such that enhanced P300 amplitudes were observed in response to targets of high financial and low moral status relative to targets of low financial and high moral status. Implications of these findings are discussed in the context of our current understanding of status-based evaluation and, more broadly, of the processes by which person knowledge may shape person perception and evaluation.

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ERP; P300; social status; social evaluation; person perception

Social status typically refers to the relative rank conferred to individuals within a hierarchy based on valued social dimensions by its comprising members (Anderson & Kilduff, 2009; Cheney & Seyfarth, 2008; Cloutier, Cardenas-Iniguez, Gyurovski, Barakzai, & Li, 2016; Fiske, 2010; Flynn, Reagans, Amanatullah, & Ames, 2006; Hare & Tomasello, 2004; Magee & Galinsky, 2008; Ridgeway & Walker, 1995). Among non-human primates, status is often based on physical prowess or overt displays of dominance (Cheney & Seyfarth, 2008; Hare & Tomasello, 2004; Maestripieri, 1996), whereas social status in humans can be based on various characteristics deemed socially relevant to the members of the hierarchy (Berger, Cohen, & Zelditch, 1972; Fiske, 2010; Magee & Galinsky, 2008). Two dimensions of social status relevant to human interactions are financial status and moral status (Cloutier et al., 2016). To date, research on status has focused on status level (high versus low) with almost no efforts aimed at exploring the relationship between status dimension and status level. However, previous research predicts a divergence in how people evaluate targets as a function of status level and dimension (e.g., Cloutier, Ambady, Meagher, & Gabrieli, 2012; Cloutier & Gyurovski, 2014). The current research tests this posit by exploring the temporal components of person evaluations.

Social status can shape how individuals perceive and evaluate conspecifics (Anderson & Kilduff, 2009; Cloutier et al., 2016; Fiske, 2010; Flynn et al., 2006; Ridgeway & Walker, 1995). For instance, macaques have been shown to sacrifice primary rewards, such as juice, in order to view faces of high-status conspecifics (Deaner, Khera, & Platt, 2005). Similarly, among humans, higher relative social rank is often associated with positive evaluations from others, such that high-status individuals are perceived to be more competent, valuable to the group, generous, and reputable, compared with peers of lower social rank (Anderson & Kilduff, 2009; Fiske, 2010; Flynn et al., 2006; Ridgeway & Walker, 1995). However, research within this area often fails to consider the social dimensions conveying status and instead assume that high-status individuals will be evaluated positively regardless of the type of status conferred to them. Given that status can be based on a variety of socially valued dimensions, it is important to consider whether these dimensions differentially influence status-based evaluations (Cloutier et al., 2016; Fiske, Cuddy, Glick, & Xu, 2002). For example, possessing high moral status may consistently lead to positive evaluations, whereas possessing high financial status may confer high relative rank, but fail to elicit positive evaluations from others (Cloutier & Gyurovski, 2014; Cloutier et al., 2012; Fiske et al., 2002; Ribstein, 2009;

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Ridgeway & Walker, 1995; Yzerbyt & Demoulin, 2010). In fact, Cloutier and Gyurovski (2014) found greater explicit positive evaluations of high moral versus high financial targets. These findings imply that status dimensions can shape explicit evaluations differentially.

A growing body of brain-imaging research has begun to explore the effects of social status on how we perceive and evaluate others (Chiao, 2010; Cloutier et al., 2016). Whereas many of the studies have focused on perceptual characteristics, such as dominance, inferred from facial expression and body posture (Chiao et al., 2008; Freeman, Rule, Adams, & Ambady, 2009; Marsh, Blair, Jones, Soliman, & Blair, 2009; Mason, Magee, & Fiske, 2014), recent fMRI research demonstrates that knowledge of social standing also shapes brain responses during person perception, in particular the ventromedial prefrontal cortex (VMPFC) (Cloutier & Gyurovski, 2014; Cloutier et al., 2012). Cloutier and Gyurovski (2014) found preferential response to targets with higher compared with lower moral status as well as greater responses to targets with lower compared with higher financial status. Findings from these studies converge with a broader literature on person evaluation (Bzdok et al., 2012; Croft et al., 2010; Karafin, Tranel, & Adolphs, 2004; Mende-Siedlecki, Said, & Todorov, 2013; Roy, Shohamy, & Wager, 2012) to suggest that the VMPFC is involved in status-based evaluations (Cloutier & Gyurovski, 2014) and also provide preliminary support for greater person evaluations to high moral and low financial targets rather than to just high-status targets in general.

In contrast to the emerging fMRI literature on status-based evaluations, to the best of our knowledge, event-related brain potentials (ERPs) have not been utilized to explore how status dimensions and levels shape person evaluations (Cloutier et al., 2016; Mattan, Kubota, & Cloutier, in press; Yusoff, Salim, Mustafar, Abdullah, & Mohamad, 2014). This method offers the advantage of high temporal resolution that provides opportunities to identify components associated with various aspects of implicit social cognition (Bartholow & Dickter, 2011), including evaluative processes (Fabiani & Donchin, 1995; Ito & Cacioppo, 2000). Furthermore, using ERPs to investigate status-based evaluations will improve our understanding of social evaluations based on available person knowledge (i.e., social status), as opposed to social perception and evaluation based solely on perceptual features. We accomplished this by having participants *memorize* the social status of each target prior to ERP data collection and not presenting any perceptual indicators of social status during the task (i.e., no facial cues or background cues conveying status except identity). In this way, we explored how knowledge (not perceptual or features differences) shapes early social-evaluative processing.

Although ERP research focusing on social evaluations based on person knowledge is scant, some reports indicate that P300 amplitudes may be modulated by evaluatively relevant perceptual characteristics of targets (Bartholow, Fabiani, Gratton, & Bettencourt, 2001; Cacioppo, Crites, Gardner, & Berntson, 1994; Duval, Moser, Huppert, & Simons, 2013; Hietanen & Astikainen, 2013). The P300 component is a positive-going deflection, peaking between 350 and 800 ms poststimulus onset. It is often referred to as an endogenous component, meaning that it is influenced not by the perceptually available features of the stimulus or its physical characteristics but rather by the subject's reaction to the stimulus of interest (Donchin, Ritter, & McCallum, 1978; Verleger, 1988). In addition to indexing preferential responses to evaluatively inconsistent stimuli (Amodio, Bartholow, & Ito, 2014; Kubota & Ito, 2007), the P300 amplitude is typically enhanced in response to negatively valenced stimuli (Bartholow, Dickter, & Sestir, 2006; Bartholow et al., 2001; Duval et al., 2013; Hietanen & Astikainen, 2013; Ito, Larsen, Smith, & Cacioppo, 1998; Peeters & Czapinski, 1990). Specifically relevant in the context of the current project, variation in this component has also been shown to indicate person evaluation (Cacioppo et al., 1994) where enhanced amplitudes are recorded in response to processing negatively evaluated conspecifics (Bartholow et al., 2001; Ito & Cacioppo, 2000; Kubota & Ito, 2007). Nieuwenhuis, Aston-Jones, and Cohen (2005) have refined the definition of the P300, suggesting that amplitudes changes in P300s reflect the task-relevance or motivational significance of the stimulus. Integrating this previous research with the fMRI research on social status leads to the prediction that low moral and high financial status, both of which can be negatively evaluated, may result in greater P300 amplitudes potentially because of their motivationally significant attributes.

Whereas the P300 component may index processes supporting person evaluation, no studies to our knowledge have examined how status affects P300 amplitudes. Additionally, although perceptual features describing a target appear to impact P300 responses, less research has tested whether evaluatively relevant person knowledge affects the P300 amplitude. The current study examines the variation in P300 amplitude in response to the presentation of targets, trained to be associated with distinct status labels indicative of either high or low, financial or moral status. Building upon previous experiments (Cloutier & Gyurovski, 2014; Cloutier, Norman, Li, & Berntson, 2013), we expected a dissociation in P300s[1] in response to targets varying in social status, such that greater amplitudes should be observed in response to high financial and low moral status targets relative to low financial and high moral status targets. In addition, to understand the temporal characteristics of status processing, we will explore ERP components that vary to social stimuli, including the N100, P200, and N200 to test whether status effects manifest at earlier ERPs (e.g., Kubota & Ito, 2009, 2016). These findings would not only converge with previous work suggesting the importance of considering how the dimension along which status is conferred may differentially shape status-based evaluations but would also offer novel ERP insights into the impact of person knowledge on the neural processes supporting person evaluation.

Method

Participants

Twenty-nine (16 females) participants aged 19–42 (M_{age} = 23.68) were recruited. Among them, one had an associate's degree, one was a first-year college student, three were second-year college students, four were third-year college students, eight were fourth-year college students, five were college graduates, and seven were first-year graduate students. Four were excluded due to excessive electrical noise, due to head movement ($n = 2$), or poor connection between the scalp and the electrode ($n = 2$). Two were excluded due to failure to comply with task requirements. The final analyses include 23 participants (11 females) between the ages of 19 and 42 (M_{age} = 23.00). Participants were recruited through SONA, a campus-wide participant recruiting system. All participants were healthy, right-handed, and reported normal or corrected-to-normal vision. No participants reported major head injuries or significant abnormal neurological history. Participants gave informed consent in accordance with the guidelines set by the Social and Behavioral Sciences Institutional Review Board at the University of Chicago and were compensated $20 for their participation.

Stimuli and procedure

Stimuli were composed of 20 color photographs of college-age White males (approximately 18–25 years old) from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015). Individuals in the photographs assumed a neutral facial expression, wore gray shirts, and were superimposed on a white background. The faces were equated to be average on attractiveness, masculinity, and perceived threat. Pictures were of the same size (490 pixels width × 700 pixels height).

Participants were initially trained (adapted from Cloutier & Gyurovski, 2013, 2014; Cloutier et al., 2013) to associate each target with one of two possible status levels (either high or low; represented by either a darker or lighter shade background, respectively) along with one of two possible status dimensions (either financial or moral; represented by either a blue or red background, respectively). Thus, every target face was trained to be associated with a single status level and dimension combination (e.g., high financial status). During the first phase of training, participants learned the color status associations by (1) first presenting participants with the different shade backgrounds (without faces) with the social status level and dimension labeled (five times for each background, $n = 20$); and (2) then subsequently testing color/status learning during which participants were required to accurately identify 40 sequential and randomized presentations of the backgrounds (without faces and the status label). Upon successful completion of the first phase of training, participants progressed to the second phase where they learned to associate faces of individual targets with a corresponding status level and dimension (indicated by the background color). Twenty target faces (five in each condition) were superimposed on the colored backgrounds. Target faces, background colors (red or blue), and their corresponding shades (lighter or darker) were counterbalanced across the four conditions (i.e., High Moral, Low Moral, High Financial, and Low Financial) and across participants. As an example, for some of the participants, a darker red-colored background indicated high financial status, whereas a lighter blue-colored background indicated a low moral status. After familiarizing with the individual target faces (presented twice each, $n = 40$ encoding trials), participants again completed an accuracy task, where they had to correctly identify the status level and dimension of each face, superimposed against a colored background, on all 100 trials. During the third and final phase of training, the colored backgrounds were *removed*, which was also the case while EEG data were recorded during the main experiment, and

[1]Although the hypothesis of the current project pertains to the P300, we also provide analyses of ERP components previously implicated in responding to perceptually available features of target stimuli, such as race, during person perception (Bartholow et al., 2011). Given that these earlier visually evoked components vary as a function of perceptual differences in target stimuli, we did not expect to observe differences at the N100, P200, or N200 as a function of person knowledge.

participants were asked to categorize the status dimension and level of each target face (20 faces and 5 trials per target, n = 100 trials) with 100% accuracy to proceed to the main ERP experiment. The ERP experiment commenced immediately following training.

The current paradigm was used to examine the neural activation in response to acquired person knowledge, a novel approach. This was accomplished by three means. First, we had participants memorize the status of each target during training. Second, the target faces did not vary in perceptually available physical characteristics across conditions (i.e., background colors were completely counterbalanced across conditions). Third, the status training procedure allowed us to subsequently explore how learned status affects neural activation in response to faces with no additional status cues available during ERP data collection (i.e., there was no perceptual cue that indicated status level, expect face identity).

Before the EEG recording session, participants were told that the experiment was similar to the final training phase and involved a series of 600 trials organized in 6 blocks with short breaks between blocks. Participants categorized, via button press, the status dimension and level of each face (i.e., High Moral, Low Moral, High Financial, and Low Financial). Stimuli were presented on an LCD computer using E-Prime software (Psychology Software Tools, Inc., Pittsburgh, PA). Participants were seated approximately 100 cm from the computer screen and instructed to be still and minimize blinking during trial presentation. Face presentation was randomized within block and each face was presented five times per block. Each trial began with a centrally presented fixation cross for 1000 ms, followed by a target face for 800s. Importantly, *each face was presented without a colored background*, ensuring that the face identity alone allowed for the inference of previously trained status level and dimension. Following face presentation, on the following screen, participants were prompted to categorize targets ("What is the status of this individual?"). The question and four responses (High Moral, Low Moral, High Financial, and Low Financial) remained on the screen for 1000 ms regardless of response time. The four answer options were labeled "1", "2", "3", and "4" on the computer monitor as well as on the response box available to the participants to make their response. We used a four-keyed EGI response pad intended for use with the E-Prime Workstation 2 NTP. The response box was situated on a height-adjustable stand in direct proximity to the participant's dominant (right) arm. Intertrial intervals varied randomly between 1000 and 1500 ms (Figure 1). Following EEG recording, participants completed a short demographic questionnaire and were compensated, debriefed, and thanked.

Electrophysiological recording and analysis

EEG data were recorded at the High-Performance Electrical Neuroimaging Laboratory at the University of Chicago using the EGI (Electrical Geodesics, Inc., Eugene, OR) Net Amps 400 system with 128 HydroCel GSN scalp sites. Electrical impedances were between 0 and 50 kΩ prior to commencing the experiment. This range is within standard EGI operating procedures. Channels were referenced to Cz (channel 129) and

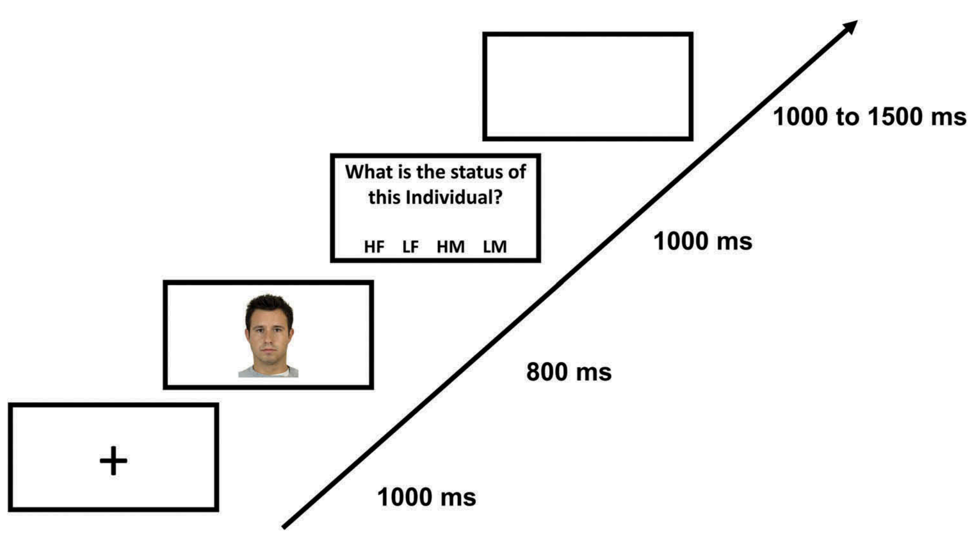

Figure 1. Status identification task. The task consisted of 6 blocks, each of 100 trials. Each block was followed by a short break. ERPs were locked to the onset of the face, which were not superimposed on the colored backgrounds (used only for training purposes) during EEG data collection.

offline rereferenced to an average (Bertrand, Perrin, & Pernier, 1985; Tucker, 1993). EEG were recorded continuously and analyzed with ERPLAB (Lopez-Calderon & Luck, 2014). Data were bandpass filtered from 0.1 Hz to 30 Hz and downsampled at 250 Hz. ERPs were stimulus-locked to face onset and epochs were created around face presentation from 200 ms prior to stimulus onset to 800 ms poststimulus onset, after which baseline correction of the prestimulus interval (200 ms) was conducted. Artifact detection included a moving window peak-to-peak threshold with a window size of 200 ms and a step of 50 ms. Epochs with amplitudes greater than 75 µV were rejected. Visual inspection of EOG channels was also conducted. To account for blinks, we computed the vertical EOG as the difference between the electrodes above and below the eyes, where shared EEG signal is subtracted leaving signal attributed to eye movements. To account for lateral eye movements, we computed the horizontal EOG as the difference between electrodes medial and lateral to each eye. In these EOG channels, polarity inversions indicate that EOG artifact detection has failed (Luck, 2014). We did not observe polarity inversions among the participants' data, indicating that EOG artifacts were successfully removed. Epoched and artifact-free data were then averaged in each of the four conditions.

Visual inspection of the grand average waveform was used to identify the epoch for the P300 component amplitude, as well as to determine scalp location where neural activation was maximal. Five electrodes were averaged for each of three scalp regions of interest. According to the international 10–20 electrode system, frontal sites included F1, F2, Fz, F3, and F4 (19, 4, 11, 24, and 124 HydroCel GSN scalp sites), central sites included C1, C2, Cz, C3, and C4 (30, 105, 129, 36, and 104 HydroCel GSN scalp sites), and parietal sites included P1, P2, Pz, P3, and P4 (60, 85, 62, 52, and 92 HydroCel GSN scalp sites). The N100 component, maximal over frontal electrodes, was quantified as the average negative amplitude between 50 and 125 ms. The P200, maximal over parietal electrodes, was quantified as the average positive amplitude between 125 and 200 ms. The N200, maximal over frontal electrodes, was quantified as the average negative voltage between 180 and 270 ms. The P300, maximal over parietal electrodes, was quantified as the average positive voltage between 350 and 650 ms. In order to examine the neural effects of status-based valuations, a 3 (Scalp Region: Frontal, Central, Parietal) × 2 (Status Level: High, Low) × 2 (Status Dimension: Financial, Moral) repeated measures ANOVA was conducted. Based on our hypothesis and previous experiments (Cloutier & Gyurovski, 2014; Cloutier et al., 2013), planned comparisons were subsequently conducted to delineate the effect of each condition on P300 amplitude as we expected a dissociation in P300s amplitudes in response to targets varying in social status, such that greater amplitudes should be observed in response to high financial and low moral status targets relative to low financial and high moral status targets. ERPs were computed using all trials as participants' accuracy was at ceiling (see Results). Greenhouse–Geisser-adjusted *p*-values are reported for all analyses with multiple numerator degrees of freedom.

Results

ERP amplitude analyses

N100

For the N100, only the Scalp Region main effect reached significance, $F_{(2,44)} = 27.425$, $p = 0.001$, $\eta^2 = 0.555$. There were no effects of status level or status dimension. These data revealed enhanced N100s at frontal ($M = -1.43$ µV, $SE = 0.21$) relative to central ($M = -0.52$ µV, $SE = 0.09$), $t_{(22)} = -4.376$ $p = 0.001$, $\eta^2 = 0.465$, and parietal electrodes ($M = 0.98$ µV, $SE = 0.24$), $t_{(22)} = -5.822$, $p = 0.001$, $\eta^2 = 0.606$. In addition, enhanced N100 amplitudes were observed at central ($M = -0.52$ µV, $SE = 0.09$) relative to parietal electrodes ($M = 0.98$ µV, $SE = 0.24$), $t_{(22)} = -5.979$, $p = 0.001$, $\eta^2 = 0.619$.

P200

For the P200, only the Scalp Region main effect reached significance, $F_{(2,44)} = 29.246$, $p = 0.001$, $\eta^2 = 0.549$. There were no effects of status level or status dimension. These data revealed enhanced P200s at parietal ($M = 1.59$ µV, $SE = 0.28$) relative to central ($M = -0.66$ µV, $SE = 0.22$), $t_{(22)} = -5.53$, $p = 0.001$, $\eta^2 = 0.581$, and frontal electrodes ($M = -2.35$ µV, $SE = 0.46$), $t_{(22)} = -5.969$, $p = 0.001$, $\eta^2 = 0.618$. In addition, enhanced P200 amplitudes were observed at central ($M = -0.66$ µV, $SE = 0.22$) relative to frontal electrodes ($M = -2.35$ µV, $SE = 0.46$), $t_{(22)} = -4.140$, $p = 0.001$, $\eta^2 = 0.437$.

N200

For the N200, only the Scalp Region main effect reached significance, $F_{(2,44)} = 33.386$, $p = 0.001$, $\eta^2 = 0.603$. There were no effects of status level or status dimension. These data revealed enhanced N200s at frontal ($M = -2.35$ µV, $SE = 0.46$) relative to central ($M = -0.46$ µV, $SE = 0.19$), $t_{(22)} = -4.865$ $p = 0.001$, $\eta^2 = 0.518$, and parietal electrodes ($M = 2.81$ µV, $SE = 0.46$), $t_{(22)} = -5.969$, $p = 0.001$, $\eta^2 = 0.618$. In addition, enhanced N200 amplitudes were observed at central (M = −0.46 μV, SE = 0.19) relative to parietal electrodes (M = 2.81 μV, SE = 0.46), $t_{(22)} = -5.722$, $p = 0.001$, $\eta^2 = 0.598$.

P300

The P300 revealed a significant Scalp Region main effect, $F_{(2,44)} = 56.263$, $p = 0.001$, $\eta^2 = 0.719$. These data revealed enhanced P300s at parietal (M = 3.87 μV, SE = 0.37) relative to central (M = 0.20 μV, SE = 0.25), $t_{(22)} = -7.857$ $p = 0.001$, $\eta^2 = 0.737$, and frontal electrodes (M = −3.15 μV, SE = 0.56), $t_{(22)} = -7.894$, $p = 0.001$, $\eta^2 = 0.739$. In addition, enhanced P300 amplitudes were observed at central (M = 0.20 μV, SE = 0.25) relative to frontal electrodes (M = −3.15 μV, SE = 0.56), $t_{(22)} = -6.059$, $p = 0.001$, $\eta^2 = 0.625$. Consistent with hypotheses, the Scalp Region main effect was qualified by both a Status Level × Status Dimension interaction, $F_{(1,22)} = 8.550$, $p = 0.008$, $\eta^2 = 0.280$ (Figure 2), as well as by a Region × Status Level × Status Dimension interaction, $F_{(2,44)} = 4.158$, $p = 0.045$, $\eta^2 = 0.159$. There were only small variations in the status effects across scalp region (Figure 3); therefore, we focus our analyses on the Status Level × Status Dimension interaction across scalp region, but also provide the Status Level × Status Dimension effects at each scalp region.

As predicted, planned comparisons revealed enhanced P300s in response to targets with high financial status (M = 0.42 μV, SE = 0.16) relative to targets of low financial status (M = 0.16 μV, SE = 0.17), $t_{(22)} = 3.353$, $p = 0.003$, $\eta^2 = 0.338$, and marginally greater amplitudes relative to targets of high moral status (M = 0.23 μV, SE = 0.18), $t_{(22)} = 2.039$, $p = 0.054$, $\eta^2 = 0.150$. Targets of low moral status (M = 0.41 μV, SE = 0.16) yielded significantly greater P300s relative to targets of high moral status (M = 0.22 μV, SE = 0.17), $t_{(22)} = -2.098$, $p = 0.048$, $\eta^2 = 0.166$, and targets of low financial status (M = 0.16 μV, SE = 0.17), $t_{(22)} = -3.037$, $p = 0.006$, $\eta^2 = 0.295$. No significant differences in P300 amplitude were observed between targets of high financial status (M = 0.42 μV, SE = 0.16) and those of low moral status (M = 0.41 μV, SE = 0.16), $t_{(22)} = 0.057$, $p = 0.955$, $\eta^2 < 0.000$, and also between targets of low financial status (M = 0.16 μV, SE = 0.17) and targets of high moral status (M = 0.23 μV, SE = 0.18), $t_{(22)} = -1.163$, $p = 0.257$, $\eta^2 = 0.057$.

ERP latency analyses

N100

For the N100, only the Scalp Region main effect reached significance, $F_{(2,44)} = 11.733$, $p = 0.001$, $\eta^2 = 0.348$. There were no effects of status level or status dimension. These data revealed slower average latency at frontal (M = 95.16 ms, SE = 2.42) relative to parietal electrodes (M = 77.96 ms, SE = 2.96), $t_{(22)} = 4.157$ $p = 0.001$, $\eta^2 = 0.440$, but not relative to central electrodes (M = 90.89 ms, SE = 2.3), $t_{(22)} = 1.543$, $p = 0.137$, $\eta^2 = 0.097$. In addition, slower N100 latencies were observed at central (M = 90.89 ms, SE = 2.3) relative to parietal electrodes (M = 77.96 ms, SE = 2.96), $t_{(22)} = -3.206$, $p = 0.004$, $\eta^2 = 0.317$.

P200

The repeated measures ANOVA of the P200 latencies yielded no main effects or interactions reaching statistical significance.

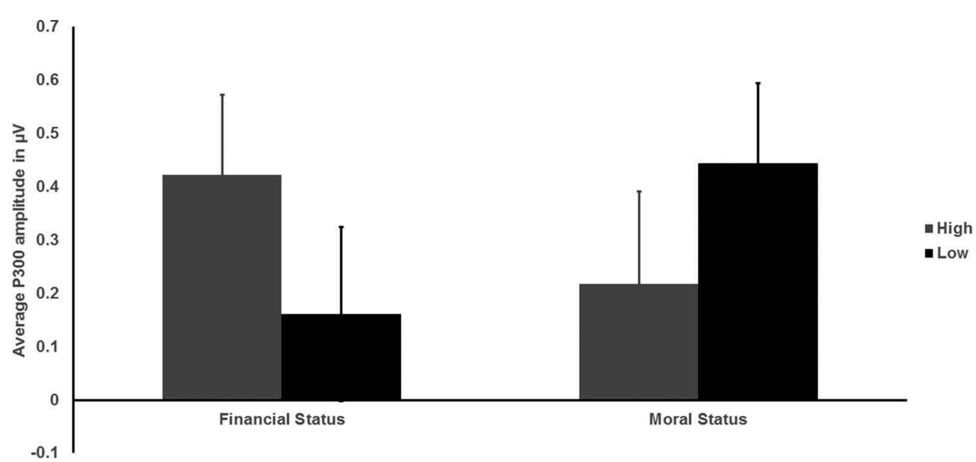

Figure 2. Status dimension and level interactively influence P300 amplitudes. The graph displays the mean P3 amplitude averaged across all electrode sites (frontal [F1, F2, Fz, F3, F4], central [C1, C2, Cz, C3, C4], and parietal [P1, P2, Pz, P3, P4]) in μV for each trial type (High Financial, Low Financial, High Moral, and Low Moral). These data reveal an interaction between status level and dimension, such that enhanced P300 amplitudes are observed in response to high financial and low moral status targets compared with low financial and high moral status targets.

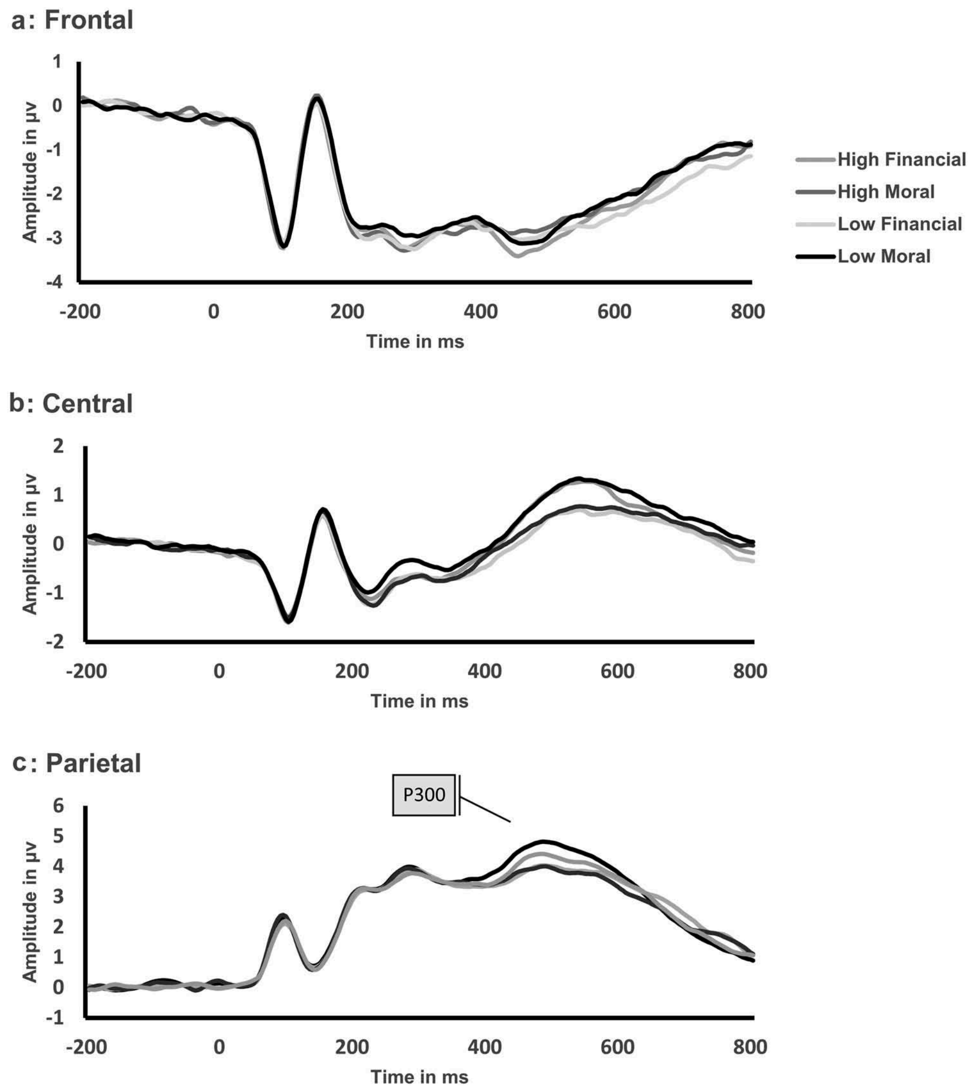

Figure 3. Grand average waveforms. The graph displays grand average waveforms at frontal electrode sites (F1, F2, Fz, F3, F4) (Panel A), central electrode sites (C1, C2, Cz, C3, and C4) (Panel B), and parietal electrode sites (P1, P2, Pz, P3, and P4) (Panel C) in μV for each trial type (High Financial, Low Financial, High Moral, Low Moral). Faces were presented at time 0.

N200

For the N200, the Scalp Region main effect, $F_{(2,44)} = 27.296$, $p = 0.001$, $\eta^2 = 0.554$, as well as the Status Dimension main effect reached significance, $F_{(2,44)} = 4.777$, $p = 0.040$, $\eta^2 = 0.178$. These data revealed slower N200 latencies at frontal (M = 247.77 ms, SE = 3.97) relative to central (M = 237.55 ms, SE = 5.36), $t_{(22)} = 2.925$, $p = 0.008$, $\eta^2 = 0.279$, and parietal electrodes (M = 209.48 ms, SE = 3.57), $t_{(22)} = 6.263$, $p = 0.001$, $\eta^2 = 0.640$. In addition, slower N200 latencies were observed at central (M = 237.55 ms, SE = 5.36) relative to parietal electrodes (M = 209.48 ms, SE = 3.57), $t_{(22)} = -4.627$, $p = 0.001$, $\eta^2 = 0.493$. Finally, slower N200 latencies were observed in response to financial (M = 232.69 ms, SE = 3.06) relative to moral status (M = 230.51 ms, SE = 3.18).

P300

For the P300, only the Scalp Region main effect reached significance, $F_{(2,44)} = 6.377$, $p = 0.004$, $\eta^2 = 0.225$. There were no effects of Status Level or Status Dimension. These data revealed slower average latency at central (M = 556.43 ms, SE = 8.60) relative to frontal (M = 516.51 ms, SE = 16.05), $t_{(22)} = -2.665$, $p = 0.014$, $\eta^2 = 0.243$, and parietal electrodes (M = 493.43 ms, SE = 12.42), $t_{(22)} = 4.561$, $p = 0.001$, $\eta^2 = 0.485$.

Behavioral data

In order to assess whether status identification of target faces varied as a function of status level and status dimension, participants' reaction times and accuracy were subjected to a 2 (Status Level: High, Low) × 2 (Status Dimension: Financial, Moral) repeated measures ANOVA.

Reaction times

Because of a positive skew, reaction times were log transformed to normalize the distributions (see Fazio, 1990). Analyses were based on these transformed data; however, for ease of interpretation, the untransformed means (in ms) are reported.

Consistent with the interactive influence of status level and dimension on P300s, data revealed a Status Dimension main effect, $F_{(1,22)} = 11.346$, $p = 0.003$, $\eta^2 = 0.340$, qualified by a Status Level × Status Dimension interaction, $F_{(1,22)} = 14.038$, $p = 0.001$, $\eta^2 = 0.390$ (Figure 4).[2] Simple contrasts revealed that participants were significantly faster to identify the status of high financial targets (M = 298.48 ms, SE = 19.79) relative to targets of high moral status (M = 342.19 ms, SE = 17.24), $t_{(22)} = -4.741$, $p = 0.001$, $\eta^2 = 0.476$, to targets of low financial status (M = 338.36 ms, SE = 17.16), $t_{(22)} = -4.041$, $p = 0.001$, $\eta^2 = 0.426$, and to targets of low moral status (M = 313.57 ms, SE = 18.41), $t_{(22)} = -3.575$, $p = 0.002$, $\eta^2 = 0.367$. Targets of high moral status (M = 342.19 ms, SE = 17.24) yielded significantly longer reaction times, relative to targets of low moral status (M = 313.57 ms, SE = 18.41), $t_{(22)} = 2.997$, $p = 0.007$, $\eta^2 = 0.289$, but did not significantly differ from responses to targets of low financial status, $t_{(22)} = 1.140$, $p = 0.267$, $\eta^2 = 0.055$. Finally, participants were significantly faster to indicate the status of low moral status targets, relative to targets of low financial status, $t_{(22)} = 2.390$, $p = 0.026$, $\eta^2 = 0.206$.

Accuracy

Accuracy results revealed no main effects or interaction (Status Level [$F_{(1,22)} = 0.188$, $p = 0.669$, $\eta^2 = 0.008$]; Status Dimension [$F_{(1,22)} = 0.103$, $p = 0.752$, $\eta^2 = 0.005$]; Status Level × Status Dimension [$F_{(1,22)} = 2.878$, $p = 0.104$, $\eta^2 = 0.116$]). Participants were at ceiling in accuracy. Mean proportions of correct responses across participants were high and roughly equal to one another (High Financial [M = 98.4%, SE = 0.5]; High Moral [M = 98%, SE = 0.6]; Low Financial [M = 98.1%, SE = 0.6]; Low Moral [M = 98.4%, SE = 0.5]).

Discussion

The current study examined the neural time course of status-based evaluations. The results revealed a dissociation in P300 amplitudes in response to targets varying in social status, such that greater amplitudes were observed in response to high financial and low moral status targets, relative to low financial and high moral status targets. The current research not only extends recent brain-imaging findings (Cloutier & Gyurovski, 2014; Cloutier et al., 2013) but also earlier behavioral reports (Fiske et al., 2002; Ribstein, 2009; Ridgeway & Walker, 1995; Yzerbyt & Demoulin, 2010) on the impact of social status on person evaluation by demonstrating that low moral and high financial targets may, in some situations, be evaluated negatively.

The results did not reveal early ERP amplitude differences as a function of status dimension and status level at the N100, P200, and N200, rather amplitude differences emerged at the P300, indicating these evaluative

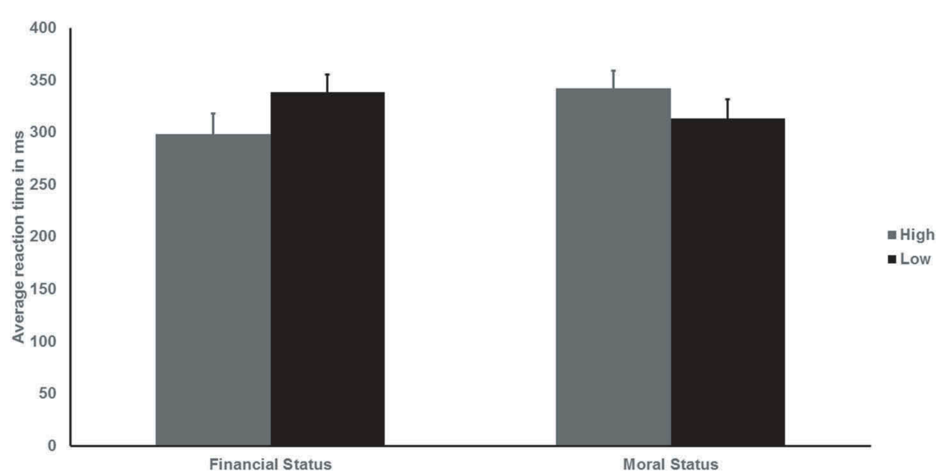

Figure 4. Reaction times. The graph displays average reaction times (ms) across participants as a function of status level and status dimension. Errors represent SE. These data reveal an interaction between status level and dimension such that individuals are faster in classifying high financial and low moral status targets compared with low financial and high moral status targets.

[2]The pattern of significance remains the same when analyzing raw millisecond untransformed data as with log transformed data.

processes manifest later in the information processing stream. These findings are also consistent with a broader ERP literature showing enhanced P300 amplitudes in response to negatively evaluated task or motivationally relevant targets (Bartholow et al., 2001; Cacioppo et al., 1994; Duval et al., 2013; Ito & Cacioppo, 2000; Kubota & Ito, 2007; Nieuwenhuis et al., 2005). Notably, in contrast to the majority of studies implicating the P300 in social evaluation, the current research utilized target faces that were perceptually equivalent (i.e., faces were counterbalanced across conditions and no color cues were presented while EEG data were collected). For most of the components, ERP latencies did not differ as a function of status dimension or status level. Participants were, however, faster to categorize low moral and high financial targets. Our findings, therefore, provide novel evidence of the impact of person knowledge (i.e., differing social status) on the neural processes supporting person evaluation.

The current pattern of findings is consistent with earlier work examining the P300 component's hypothesized role in person evaluation, where enhanced P300 amplitudes were recorded in response to facial expressions of negative emotions. Indeed, fearful (Eimer & Holmes, 2002; Holmes, Vuilleumier, & Eimer, 2003), angry (Duval et al., 2013; Schupp, Junghöfer, Weike, & Hamm, 2003; Schupp et al., 2004), and sad facial expressions elicit larger P300s relative to neutral and happy faces (Hietanen & Astikainen, 2013). Although most social-cognitive investigations of the P300's involvement in social evaluation rely on perceptually available characteristics of the targets, such as their emotional expressions or their race (e.g., Ito & Cacioppo, 2000; Kubota & Ito, 2007), the P300 has also been shown to be sensitive to the valence of behavioral information describing a target individual. In fact, in addition to showing enhanced P300 amplitudes to violations of expectations, Bartholow et al. (2001) found that negative behaviors elicited enhanced P300 amplitudes relative to positive behaviors (Bartholow et al., 2001), providing evidence for the rapid processing of evaluative person knowledge.

Bearing in mind that the P300 component has been among the most widely studied ERP components (Polich, 2011; Verleger, 1988), it is important to consider alternative interpretations of the current findings. Differences in P300 amplitudes have been identified as a function of stimulus novelty (Friedman, Cycowicz, & Gaeta, 2001), encoding strength (Karis, Fabiani, & Donchin, 1984), and enhanced P300 amplitudes can be observed in response to infrequent events (Donchin & Coles, 1988; Duncan-Johnson & Donchin, 1977; Squires, Squires, & Hillyard, 1975). Along these lines, enhanced P300 amplitudes have been observed in response to evaluatively inconsistent when compared with evaluatively consistent stimuli (Crites, Cacioppo, Gardner, & Berntson, 1995; Ito et al., 1998). However, although our findings may be interpreted as compatible with increased perceived salience or relevance of high financial and low moral status targets compared with targets of low financial and high moral status, it seems unlikely that factors such as novelty of the targets or violations of expectations can explain the obtained pattern of neural responding. Although it is possible that individuals encounter high financial and low moral status individuals less frequently in everyday life, it seems unlikely that this discrepant frequency in everyday encounters would explain the results. For one, stimuli frequency and novelty were held constant in the task. In addition, negative emotional expressions can elicit greater P300s even though individuals encounter those expressions less in their daily life (see Kubota & Ito, 2007, 2014 for a discussion). In contrast, a person evaluation or motivational salience interpretation of the P300 findings is consistent with earlier ERP research showing that the P300 is affected by negatively valenced social stimuli (Duval et al., 2013; Eimer & Holmes, 2002; Holmes et al., 2003; Ito & Cacioppo, 2000; Kubota & Ito, 2007; Nieuwenhuis et al., 2005; Schupp et al., 2003, 2004), as well as previous behavioral and brain-imaging research (Cloutier & Gyurovski, 2014; Cloutier et al., 2013; Fiske et al., 2002; Ribstein, 2009; Ridgeway & Walker, 1995; Yzerbyt & Demoulin, 2010).

Whereas individuals with high financial status, relative to their low financial status counterparts, may enjoy a range of benefits, such as better mating prospects, health, education, and standards of living (Boushey & Weller, 2008; Ellis, 1993; Marmot, 2004; Singh, 1995; Werner, Malaspina, & Rabinowitz, 2007), they may also be evaluated negatively and perceived as less warm (Fiske et al., 2002; Ribstein, 2009). In contrast, high moral status may reliably confer positive evaluations. Interestingly, morality has been posited to play a fundamental role in predicting positive person evaluations and guiding impression formation (Brambilla & Leach, 2014; Goodwin, 2015; Goodwin, Piazza, & Rozin, 2014). Furthermore, morality-based rather than wealth-based evaluation of conspecifics may serve an evolutionary advantage, as previous research has shown that the former is often seen as central to the maintenance of human social hierarchies (Boehm, 2012; Rai & Fiske, 2011; Swencionis & Fiske, 2014). The P300 findings are consistent with this previous behavioral research and theorizing, indicating that high financial and low moral status targets are negatively evaluated.

These results converge with recent fMRI studies reporting similar dissociations in VMPFC activity in response to targets varying in either moral or financial status (Cloutier et al., 2012; Cloutier & Gyurovski, 2014). Although the VMPFC has been implicated in status-based evaluations (Freeman, Penner, Saperstein, Scheutz, & Ambady, 2011; Karafin et al., 2004; Marsh et al., 2009) and, more broadly, in person evaluation (Bzdok et al., 2012; Croft et al., 2010; Karafin et al., 2004; Mende-Siedlecki et al., 2013; Roy et al., 2012), it is currently unclear whether activity in this regions may relate to the P300 component (Polich, 2011). However, current theorizing about P300 amplitudes suggests that the locus coeruleus–norepinephrine system is responsible for its generation (Nieuwenhuis et al., 2005). Simultaneous EEG and fMRI experiments would help address this intriguing question and provide insights into the neural mechanisms underlying person evaluation.

Given that gender, race, and age may often serve as cues to infer social status (Fiske, 2010), it will be important to study the intersection of perceptually available features and person knowledge relevant to social standing. Accordingly, although the current study's focus was on investigating the impact of status level and dimension on P300 amplitudes, the fact that only White male targets were included as stimuli represents a limitation to the generalizability of the obtained findings and future research should explore how gender and status influence ERP responses. Additionally, although participants were given explicit definitions of moral and financial status, culture may influence the evaluation of these dimensions (e.g., Chiao, 2010; Han et al., 2013). Future research should explore how culture influences status processing and evaluations. Finally, the current sample of participants was predominantly composed of undergraduate and first-year graduate students. Future research would benefit from including greater diversity of participants, including older adults, as the manifestation of neural activation in response to status perception may vary across the life span.

Our event-related potential findings highlight the importance of studying social status as a complex and multifaceted construct that may exert distinct influence on status-based evaluations of conspecifics depending on the dimensions along which status is conferred. Individuals rapidly process status level and dimension and incorporate both aspects of social status in their evaluation of others. Possessing greater relative rank in society does not guarantee one will be seen in a more positive light than his or her counterparts. Rather, in order to better understand whether recognition, importance, and prestige arise from high-status one ought to consider the relevant social dimension conferring status to individuals. More broadly, the current findings may provide insights into proximal mechanisms by which social status shapes stress and health (Cloutier et al., 2013; Sapolsky, 2004), influences individual goal pursuit (Fiske, 2010; Leary, Jongman-Sereno, & Diebels, 2014), and affects behaviors within groups and organizations (Anderson & Willer, 2014; Magee & Galinsky, 2008). Accordingly, enriching our knowledge of these processes will not only benefit our understanding of how social status impacts person evaluation and perception but may also help us better characterize the pervasive influence of social status on everyday life.

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