LEARNING RATES OF INDIVIDUATING INFORMATION PAIRED WITH FACES VARYING IN RACE

by

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ABSTRACT

Humans can rely on diverse sources of information to evaluate others, including person-knowledge (e.g., occupation, likes and dislikes, education, etc.) and perceptual cues (e.g., attractiveness, race, etc.). Our memory for others, and brain regions supporting impression formation, have been shown to depend on the characteristics of others (e.g., race), but are these memory biases a result of variability in exposure and person-knowledge valence? In study 1, White participants (*n* = 70) learned about Black and White men paired with either no information, exclusively positive person-knowledge, or exclusively negative person-knowledge then were tested on their memory. They completed five sessions of encoding and testing. Results reveal a robust advantage for White targets and differences in the benefit of person-knowledge training depending on the specificity of information recalled, such that participants were more accurate at recognizing faces paired with person-knowledge but less accurate when attributing the type of information compared to faces that were just perceptually familiar. In study 2 (*n* = 26), we seek to replicate and extend study 1 by examining the learning rates of person-knowledge over the five days and the neural correlates of race-based impression formation as a function of person-knowledge (i.e., DMPFC, VMPFC) and familiarity (i.e., precuneus). We additionally examined the impact of these factors on neural regions associated with general face perception and social salience (e.g., FFA, amygdala). We explore how learning rates are influenced by target race (Black, White) and knowledge

type (positive, negative, none) and the individual differences that may shape our memory of others in an increasingly multi-racial environment.

Chapter 1

INTRODUCTION

Impression formation is the process of gathering and integrating available environmental information (e.g., first and/or secondhand information, perceptual cues) to arrive at evaluations of and inferences about others. We constantly form impressions and evaluate others based on a variety of available information, such as social categories and traits from physical (i.e., perceptual) cues and personal (i.e., individuating) information. Individuation refers to the process of considering others in terms of their distinctive characteristics and behaviors rather than their category-level memberships, such as age, race, or gender (Brewer, 1988; Fiske & Neuberg, 1990; Hugenberg, Miller, & Claypool, 2007). When we encounter others, we usually have a diverse variety of information we can use to form impressions and evaluations of them (e.g., perceptual cues, context cues, accents, etc.).

However, in most studies of impression formation perceptual cues are often the only available information from which we assume group membership (e.g., race, age, gender). Impression formation based on perceptual cues is adaptive because we often must quickly assess whether to approach or avoid someone (Hugenberg & Sacco, 2008; Zebrowitz & Montepare, 2008). Relying on stereotypes activated by perceptual cues diagnostic of social categories allows us to use relatively quick evaluations to guide future interactions by simplifying judgments and conserving cognitive effort (Brewer, 1988; Fiske, Lin, & Neuberg, 2018; Macrae, Milne, & Bodenhausen, 1994; Sherman, Macrae, & Bodenhausen, 2011). For example, our assessments of others can be influenced by perceptual cues categorizing someone as part of our ingroup or outgroup (Hugenberg & Sacco, 2008; Miller, Maner, & Becker, 2010) or assessing their facial trustworthiness in the absence of any personal information (Todorov, 2008). Research has demonstrated that physical cues indicating group membership (e.g., race) can elicit social expectations (e.g., stereotypes and prejudices of racialized groups) and influence impressions even in the absence of person-knowledge (Freeman, Penner, Saperstein, Scheutz, & Ambady, 2011). Perceptual cues are influential in impression formation because they are often the only source of information, and they may anchor current and future interactions.

If we have available person-knowledge, this individuating information may override or shape our initial impressions based on perceptual cues (Fiske & Neuberg, 1990; Gobbini, Leibenluft, Santiago, & Haxby, 2004; Haxby, Hoffman, & Gobbini, 2002). Evaluating others based on specific information we have about their past behavior, beliefs, goals, etc. (i.e., person-knowledge) often leads to more complex and individuated impressions than impressions based on perceptual cues alone (Fiske & Neuberg, 1990; Gobbini et al., 2004; Haxby et al., 2002). For example, if we see a tall college student, we may assume that they are a basketball player. However, once we get to know them better, we may find out that they are not into sports and prefer volunteering at the local animal shelter.

Even after we have formed an impression of another person based on perceptual cues and/or person-knowledge, whether we remember them or update our initial impressions during future interactions may depend on the type of person-knowledge we acquired about them and whether they are an ingroup or outgroup member. For example, faces paired with person-knowledge are better recalled than faces that are just perceptually familiar (Mattarozzi, Todorov, & Codispoti, 2014) and faces of racial ingroup members are better recalled than faces of racial outgroup members (Ackerman et al., 2006; Anthony, Cooper, & Mullen, 1992; Meissner & Brigham, 2001; Sporer, 2001). However, most research on the topic has focused on single-shot interactions. Less is known about the dynamic changes in accuracy in identifying and recalling person-knowledge about others over multiple exposures. As many social interactions involve getting to know someone over time, it is important to understand how we learn about people over multiple interactions.

This dissertation examines how learning rates of faces varying in race (Black, White) interact with perceptual familiarity and the type of available person-knowledge (positive, negative) acquired about them. First, I provide a brief discussion of the psychological processes of impression formation. The following sections of the introduction detail how impression formation is influenced by perceptual cues and/or available person-knowledge, with a focus on race and person-knowledge valence. Then I discuss psychological factors that may influence learning rates of individuating information paired with faces varying in race, such as the other race effect, negativity bias, and affectively incongruent person-knowledge. The review ends with a summary of the neural correlates of impression formation based on perceptual cues or person-knowledge. Finally, I describe two extensive studies that examine how learning rates of faces varying in race are influenced by experimentally manipulated perceptual familiarity and person-knowledge valence.

The first study consists of three behavioral studies examining how well participants learn valenced individuating information about faces varying in race and the generalization of this learning on evaluative priming and recognition of different faces. The second study consists of a replication of two behavioral studies from study 1 and an fMRI study to examine neural correlates of impression formation. As in study 1, we examine the learning rates of individuating information and its influence on recognition of different faces. Additionally, participants also undergo fMRI neuroimaging to examine activity in social-cognitive brain regions while forming impressions of these learned and novel faces.

1.1 The Psychological Process of Impression Formation

Dual process models of impression formation separate the process into two main categories depending on if the psychological process is driven by categorical information or person-specific information (Bodenhausen, Macrae, & Sherman, 1999; Gawronski & Creighton, 2013; Moskowitz, 2005). When first encountering someone, people may rely on categorical information from salient perceptual cues (e.g., gender, race, age) unless motivated to individuate and engage in more thoughtful processing (Brewer, 1988; Fiske et al., 2018; Fiske & Neuberg, 1990). When the target is relevant, perceivers use available person-knowledge to form a more individuated impression (Brewer, 1988; Fiske et al., 2018; Fiske & Neuberg, 1990). Dual process models emphasize that whether initial impressions based on perceptual cues are modified by available person-knowledge depends on the perceiver's motivations.

In contrast to these dual-process models in which the steps for impression formation are serial, there are other models of impression formation in which lower-order and higher-order social cognition reciprocally affect each other (e.g., Freeman & Ambady, 2011; Kunda & Thagard, 1996; Read & Miller, 1998; Van Overwalle & Labiouse, 2004; Zebrowitz, Fellous, Mignault, & Andreoletti, 2003). These dynamic models emphasize that perceptual cues, available person-knowledge, stereotypes, and perceiver motivation reciprocally affect each other during the entire impression formation process.

Both types of models explain that impression formation begins with perception of environmental cues (e.g., perceptual cues) that are shaped by stereotypes, availability of person-knowledge, and motivations that eventually lead to impressions and evaluations. Therefore, both kinds of models posit that perceptual cues and person-knowledge are not inherently orthogonal dimensions and are often perceived in tandem in the real-world and may reciprocally affect perception of each other.

1.2 Impression Formation Based on Perceptual Cues

When encountering novel people, we form impressions based on assumptions from their physical appearance. For example, when we see a stranger on the street, we often form impressions about them from the social categories we assume they belong based on perceptual cues that are available by simply looking at the person (e.g., race, age, gender). Perceptual cues provide valuable information that can be gleaned just from looking at another person. For example, we can make assumptions about strangers' race, age, and gender based on their facial features, affiliations based on their clothing (e.g., college sweaters, sports teams), traits based on emotions (e.g., smile, furrowed brows), etc. For example, participants are able to make trustworthiness judgments of faces after extremely brief exposures (167 ms) to the faces and the level of agreement among participants does not improve with longer exposure to faces (Todorov, Pakrashi, & Oosterhof, 2009). We often form quick and efficient impressions of other people such as those conveying social traits like trustworthiness (Oosterhof & Todorov, 2008; Todorov, Said, Engell, & Oosterhof, 2008; Willis & Todorov, 2006), dominance (Hall, Coats, & LeBeau, 2005), competence or warmth (Fiske, 2018; Fiske, Cuddy, & Glick, 2007), or group membership, such as political party (Rule & Ambady, 2010; Samochowiec, Wänke, & Fiedler, 2010), sexual orientation (Rule, Ambady, Adams, & Macrae, 2008; Rule, Ambady, & Hallett, 2009), or gender (Cloutier, Mason, & Macrae, 2005; Fazio, Jackson, Dunton, & Williams, 1995) based on minimal perceptual information.

Many social cognitive processes vary depending on perceived target race. For example, different stereotypes are spontaneously activated (Bargh, Chen, & Burrows, 1996; Devine, 1989; Eberhardt, Purdie, Goff, & Davies, 2004; Gaertner & Dovidio, 2005) and implicit racial attitudes and affective biases may influence our initial impressions (Amodio, Harmon-Jones, & Devine, 2003; Greenwald & Banaji, 1995;

Nosek et al., 2007). In regards to Black Americans, research has demonstrated that both implicit and explicit negative stereotypes influence impressions of Black people (Amodio et al., 2003; Devine & Elliot, 1995; Greenwald & Banaji, 1995; Nosek et al., 2007). Explicit associations are consciously reportable and deliberate, such as beliefs and attitudes reported on self-report measures or though observable actions (Dovidio, Kawakami, & Gaertner, 2002). In contrast to explicit associations, implicit associations are thoughts and feelings that are at least partially outside of conscious awareness, such as "gut" reactions as inferred from task performance via the Implicit Association Task (IAT) and others (Fazio & Olson, 2003; Greenwald, McGhee, & Schwartz, 1998; Nosek et al., 2007). For example, White, Asian, and Hispanic participants displayed a strong implicit pro-White bias but displayed a weaker explicit pro-White bias (Nosek et al., 2007). They also displayed a stronger implicit association between weapons and Black people compared to White people (Nosek et al., 2007). During in person interactions, White participants' implicit racial attitudes were associated with more spontaneous behaviors, such that participants with greater pro-White implicit attitudes rated themselves and were rated by others as less non-verbally friendly towards Black partners (e.g., less pleasant, more unfriendly; Dovidio et al., 2002). On the other hand, explicit racial attitudes were associated with relatively more controllable behaviors, such that participants with greater pro-White explicit attitudes rated themselves and were rated by others as less verbally friendly towards Black partners (Dovidio et al., 2002). Americans are aware of specific negative stereotypes of Black Americans even if they themselves do not endorse these stereotypes due to the ubiquity of these associations in American culture (Devine, 1989; Devine & Elliot, 1995). Therefore, both explicit and implicit attitudes are influenced by societal expectations.

1.3 Impression Formation Based on Person-knowledge

While the use of perceptual cues in person perception can be efficient (Adams et al., 2012; Brewer, 1988; Cloutier & Macrae, 2007; Cloutier et al., 2005), failing to individuate others may lead to misidentification and adverse feelings for both the perceiver and target (Fiske & Neuberg, 1990; Hugenberg et al., 2007). For example, we may be embarrassed when we fail to recognize or remember a co-worker we previously met. However, when we see someone for whom we have individuating information (i.e., person-knowledge), we can recall their distinctive traits and behaviors. This leads to a more differentiated impression and better memory for this individual (Mattarozzi, Colonnello, Russo, & Todorov, 2019).

In contrast to impressions and evaluations based solely on perceptual cues, within our social networks we constantly form impressions and evaluate others based on person-knowledge (i.e., individuating information about someone's traits, likes, past behaviors, etc.). These individuated impressions and evaluations are often based on personal information that is not inferred from appearance (e.g., details that set them apart from others of their presumed social categories; Brewer, 1988; Fiske & Neuberg, 1990; Gobbini et al., 2004; Haxby et al., 2002). Though our impressions of others are often first shaped by these visual categories, person-knowledge can be used to form more differentiated and specific impressions compared to impressions based solely on physical appearance (Brewer, 1988; Fiske & Neuberg, 1990). Knowing information about an individual's unique characteristics or behaviors, in addition to their perceptual features, may therefore enable impressions beyond the scope of social categories and contribute to enhanced person-memory. Indeed, previous studies have found that when explicitly instructed to attend to the unique characteristics of others, people are typically motivated to be accurate in their recognition and recall of individuating statements (Brewer, 1988; Fiske & Neuberg, 1990). Therefore, when perceivers have access to person-knowledge, they tend to form more complex impressions of other individuals.

Humans are sensitive to the presence of person-knowledge and make trait inferences in the absence of explicit goals or instructions to form impressions. For example, sentence recall was more accurate when cued with disposition cues versus semantic cues even when not previously instructed to make trait inferences from the presented sentences (Winter & Uleman, 1984). Furthermore, these trait inferences are linked to a target's face and lead to false-recognition to similar traits when cued with the face (Todorov & Uleman, 2002, 2003, 2004).

While there have been many investigations into the effects of perceptual cues on facial-recognition performance (e.g., Lovén, Herlitz, & Rehnman, 2011; Malpass & Kravitz, 1969; Mattarozzi et al., 2014), there have been fewer studies exploring the impact of social categories on recall of individuating information. Prior research has examined the effects of gender (Pratto & Bargh, 1991) and age (O'Sullivan & Durso, 1984) stereotypes on person-knowledge memory; however, the influence of target race on learning rates of valenced individuating information over multiple exposures has not been evaluated. In the present studies, we therefore investigate whether the ability to recognize someone and recall individuating information is affected by the race of the target and/or the valence of the paired person-knowledge.

1.4 Other-race Effect

One factor that may influence recognition, is the other race effect (ORE). The ORE is the tendency to have a better memory for own race faces compared to other race faces (Anthony et al., 1992; Hugenberg et al., 2007; Meissner & Brigham, 2001; Sporer, 2001). White individuals, for example, are typically better at remembering White faces compared to Black faces (Ackerman et al., 2006). This may be influenced by attitudes, motivation, race-specifying features, and expertise (Correll, Hudson, Guillermo, & Earls, 2017; Guillermo & Correll, 2020).

1.4.1 Face Recognition

From the time we are infants, our memory for own-race faces is much more accurate than for other races (Di Martino et al., 2008; Kelly et al., 2009; Quinn, Lee, Pascalis, & Xiao, 2020). Ingroup perceptual expertise has been found across multiple cultures, with one study demonstrating Chinese infants' enhanced ability to discriminate faces within their own race (Kelly et al., 2009). Importantly, the implications of the ORE are not only confined to laboratory recognition tasks, but also apply to real-life circumstances. Especially noteworthy is the presence of other-race eyewitness misidentifications in criminal justice proceedings (Wells & Olson, 2001). As misidentification may lead to wrongful convictions, it is necessary to investigate the driving factors behind the ORE.

Multiple attempts at explaining the psychological mechanisms guiding the ORE focus either on perceptual expertise or social-cognitive motivation (Singh et al., 2021). The perceptual expertise model characterizes the memory of faces as a unique skill that is continuously strengthened from infancy onward (Goldstein & Chance, 1985; Kelly et al., 2009; Quinn et al., 2020). Other-race faces may be processed in a more piecemeal inexpert manner based on facial features, unlike own-race faces which typically are processed in a configural, expert way (Cloutier & Macrae, 2007; Michel, Rossion, Han, Chung, & Caldara, 2006). Given that individuals tend to primarily encounter own-race faces in their everyday lives, this imbalance in perceptual training and piecemeal face processing may give rise to poorer performance in other-race facial recognition (DeGutis, Wilmer, Mercado, & Cohan, 2013; Richler, Cheung, & Gauthier, 2011; Wang, Li, Fang, Tian, & Liu, 2012).

The social-cognitive motivational view, on the other hand, asserts that perceiver motivation to attend to the unique characteristics of other individuals influences the accuracy of facial recognition (Handley, Kubota, Li, & Cloutier, 2021; Hehman, Mania, & Gaertner, 2010). Previous research has demonstrated that perceivers tend to think individually about in-group members and categorically about out-group members (Levin, 2000). Specifically, when encoding in-group faces, perceivers search for individuating facial features that will distinguish one person from another. However, when encoding out-group faces, perceivers tend to look for features tied to social categories, such as skin tone, sacrificing their attention to more memorable, unique features (Hugenberg et al., 2007; Hugenberg & Sacco, 2008). As a result of this focus on categorical features in other-race targets, perceivers tend to have difficulty distinguishing between members of other races. Ultimately, various outgroup members are encoded as exemplars of the same category rather than unique individuals (Hugenberg, Young, Bernstein, & Sacco, 2010). However, when increasing motivation to individuate for example by increasing a target's power (e.g., occupational roles), participants can increase their other-race face recognition (Shriver & Hugenberg, 2010). Therefore, perceivers can overcome the ORE if motivated to individuate.

However, an integration of both the perceptual expertise and social-cognitive motivation perspectives contend that both perceptual expertise and social-cognitive motivation interact to produce the ORE (Correll et al., 2017; Guillermo & Correll, 2020; Hugenberg, Wilson, See, & Young, 2014; Young & Hugenberg, 2012). Specifically, low levels of experience with other-race faces combined with low motivation may lead to the ORE (Correll et al., 2017; Hugenberg et al., 2014; Young & Hugenberg, 2012). Perceptual cues should provide a richer source of individuating information for same-race faces compared to other-race faces due to differential weighting of physical cues stemming from differences in past experience processing faces (Correll et al., 2017). For example, in experimental research biases in attention to people of different races may be due to low-level image properties of the stimuli, stereotypes of threat and vigilance, differential explicit goals to individuate, or individual differences in racial attitudes (Guillermo & Correll, 2020). However, high levels of either experience with other-race faces or motivation can attenuate the ORE (Hugenberg et al., 2014; Young & Hugenberg, 2012). For example, categorical thinking is malleable and can be reduced with experimenter-manipulated motivation (Hugenberg et al., 2007). When participants are informed of the other-race effect and instructed to attend to the unique characteristics of other races, the bias in memory is eliminated even without extensive perceptual training (Hugenberg et al., 2007). Thus, given instructions to individuate other-race faces, individuals can increase their motivation to recall other-race faces and accompanying statements.

These explanations of the ORE suggest that interracial contact should decrease the ORE as people get more experience with perceptual processing of people of different races and as the need to individuate people of different races increases (Singh et al., 2021). Indeed two meta-analyses reveal similar, but small, effects of interracial contact on decreasing the ORE (Meissner & Brigham, 2001; Singh et al., 2021). In one study, Chinese and White participants were first asked to rate Chinese and White faces (Hancock & Rhodes, 2008). Then they were presented with these learned faces and a matched race novel face and asked to indicate which face they had already seen (Hancock & Rhodes, 2008). Results indicate that greater levels of self-reported interracial contact was associated with a reduction in the ORE for both Chinese and White participants (Hancock & Rhodes, 2008). In another study examining the effect of individuation training on the ORE, White participants were asked to either individuate or categorize Black faces over multiple sessions (Lebrecht, Pierce, Tarr, & Tanaka, 2009). After five sessions of training, participants were shown these familiar faces and novel faces and asked to indicate if they have seen the face before (Lebrecht et al., 2009). Results indicate that after training, the participants who individuated compared to those who categorized, displayed a reduction in the ORE (Lebrecht et al., 2009). Taken together, the research suggests that increased experience with other race faces, either through contact or training, can reduce the ORE.

1.4.2 Mentalizing

Research on other-race mentalizing indicates that mentalizing may also differ as a function of target race (Adams et al., 2010). Mentalizing, inferring others' mental states, is a critical social-cognitive task that enables us to navigate complex social situations (Frith & Frith, 2006; Schurz, Radua, Aichhorn, Richlan, & Perner, 2014). One task that is used to measure mentalizing ability is the Reading the Mind in the Eyes (RME) task which assesses how accurately perceivers can infer mental states from photographs of the eye region (Adams et al., 2010; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Handley, Kubota, Li, & Cloutier, 2019). Using a version of the RME task using White and East Asian targets with White American and Japanese participants, researchers found that participants were more accurate at inferring mental states from same-race targets than from other-race targets (Adams et al., 2010).

However, higher levels of interracial contact may impact how perceivers perceive mental states of others (Handley, Kubota, & Cloutier, 2022; Handley et al., 2021). For example, in a behavioral study using the RME task, interracial contact and motivation to attend to faces influenced White participants' ability to infer mental states from both

White and Black targets (Handley et al., 2021). Specifically, when motivated to attend to the task, high-contact White participants were more accurate at inferring both Black and White targets' mental states while the opposite was true for low-contact perceivers (Handley et al., 2021). Because target race did not interact with interracial contact, contact may be associated with general changes in mentalizing irrespective of target race potentially because perceivers with more interracial contact process Black and White faces more similarly (Handley et al., 2021). Taken together, we see that interracial contact is associated with general changes in social cognition regardless of target race.

1.5 Negativity Bias

Negativity bias, the tendency to give greater weight to negative events, objects, traits, etc., may also influence accuracy in recognizing and recalling information about others (Ito & Cacioppo, 2005; Norris, Larsen, Crawford, & Cacioppo, 2011; see Rozin & Royzman, 2001 for a review of general negativity bias; see Skowronski & Carlston, 1989; for an overview of negativity bias in impression formation). People tend to attend more to negative information (Dijksterhuis & Aarts, 2003; Gaillard et al., 2006; Hansen & Hansen, 1988; Nasrallah, Carmel, & Lavie, 2009; Pinkham, Griffin, Baron, Sasson, & Gur, 2010; Pratto & John, 1991) and have better memory for negative information (Ohira, Winton, & Oyama, 2016; Ortony, Turner, & Antos, 1983; Robinson-Riegler & Winton, 2010; Rozin & Royzman, 2001). People also tend to weigh negative information more heavily when forming impressions of others (Anderson, 1965; Feltz, 2007; Fiske, 1980). In a classic experiment, participants were presented with extremely positive (e.g., truthful), moderately positive (e.g., persuasive), extremely negative (e.g., abusive), or moderately negative (e.g., unpopular) adjectives conveying trait information of a person and were asked to rate them on likability (Anderson, 1965). Unsurprisingly, results indicated that people paired with solely extremely positive information were rated more positively than those paired with moderately positive information and those paired with extremely negative information were rated more negatively than those paired with moderately negative information (Anderson, 1965). Additionally, people described with negative information were judged more extremely in likability than those with positive information (Anderson, 1965).

Individuals may attend to negative information more intensely to avoid threatening situations or other people, resulting in a more vivid memory of negative stimuli (Kensinger, 2009). Furthermore, it is important to attend to negative information when forming an impression of another individual as it guides future behavior or interactions. For example, previous work has found enhanced source memory for faces associated with a history of cheating (Buchner, Bell, Mehl, & Musch, 2009; Chiappe et al., 2004) and for faces associated with disgusting behaviors (Bell & Buchner, 2010). In other words, perceivers are better at recalling the context in which a threatening face is presented compared to other contexts. Therefore, if negative information is more memorable, individuals should remember negative face-statement pairs more than positive face-statement pairs. However, one study posits that the negativity bias is not as pervasive when all the available information is consistently immoral because perceivers exert little cognitive effort in processing the information compared to when there is a mix of immoral and moral behavior available (Lupfer, Weeks, & Dupuis, 2000).

In contrast to the negativity bias, there is also a positivity bias where positive occurrences are more memorable and impactful (Calvo & Beltrán, 2013; Goh, Yap, Lau, Ng, & Tan, 2016; Leppänen & Hietanen, 2004; Petro, Tong, Henley, & Neta, 2018). Individual differences may influence the tendency to form more negative or positive evaluations (Ito & Cacioppo, 2005; Norris, 2019; Norris et al., 2011). For example, in one study people with stronger positivity offsets formed more positive impressions of targets described by only neutral information and people with stronger negativity biases formed even more negative impressions of targets described by negative information (Ito & Cacioppo, 2005).

Research on intergroup negativity bias has revealed persistent negative biases towards outgroups. However, participants are able to control their explicit negative biases relative to their implicit negative biases (Dovidio et al., 2002; Ratliff & Nosek, 2011). For example, in one study, White participants were given negative or positive information about a racial ingroup (i.e., White) and a racial outgroup (i.e., Black) member then their explicit and implicit attitudes towards these targets as well as a different member of each group was assessed (Ratliff & Nosek, 2011). Participants explicitly rated the Black-negative pair less negatively than the White-negative pair and the Black-positive pair more positively than the White-positive pair (Ratliff & Nosek, 2011). However, participants displayed an implicit preference for the White-positive pair compared to the Black-positive pair (Ratliff & Nosek, 2011). For the new targets that were not themselves paired with valenced information, both positive and negative explicit attitudes did not generalize to new targets regardless of race but both positive and negative implicit attitudes generalized to new outgroup targets but not new ingroup targets (Ratliff & Nosek, 2011). In all, although participants were able to control their explicit negative ratings for the Black-negative pair, they were unable to control their implicit attitudes (Ratliff & Nosek, 2011).

Another study demonstrated that participants overestimated outgroup negativity towards their ingroup (Lees & Cikara, 2019). A study on candidate preferences revealed robust negativity anchoring regardless of political group membership, contrary to predictions of motivated reasoning for ingroup members, possibly demonstrating the impact of initial negative information on impressions (Boydstun, Ledgerwood, & Sparks, 2017). From the literature reviewed, the influence of negative information may differ depending on target characteristics, such as race.

1.6 Affectively Incongruent Person-knowledge

Regardless of personal beliefs, people are aware of societal stereotypes and the overall positivity or negativity associated with racial groups (Devine, 1989). When individuals possess surprising attributes in relation to stereotypes about their group membership, perceivers must reconcile their preconceptions with the reality of presented information (Macrae, Bodenhausen, Schloerscheidt, & Milne, 1999). In doing so, perceivers must attend to individual characteristics rather than relying on categorical knowledge based on perceptual cues (Brewer, 1988; Fiske et al., 2018). Trait or stereotype incongruent behaviors are typically remembered better (Heider et al., 2007; Macrae & Bodenhausen, 2000; Quadflieg et al., 2011; Srull & Wyer, 1989) and result in increased individuation compared to congruent behaviors (Brewer, 1988; Fiske et al., 2018). In one study participants were shown advertisements for products that varied on gender stereotypicality; for example, alcohol as a more stereotypical male product and laundry detergent as a stereotypical female product, that were paired with either a man or woman in the ad (Lo, King, & Lin, 2020). Participants were then tested on their recognition of these previously shown ads and new ads. Participants displayed better memory for gender-incongruent (a woman advertising alcohol) than gender-congruent ads (a woman advertising laundry detergent). Researchers posit that stereotype-incongruent information demands greater cognitive resources to encode, leading to deeper processing and more successful retrieval (Lo et al., 2020). In another study, participants learned person-knowledge about a gay man that was either stereotype-congruent (e.g., studied dance) or stereotype-incongruent (e.g., likes football) then were tested on their memory of presented statements. Results indicated that high-prejudice participants made more stereotypical judgments and remembered more stereotype-incongruent statements compared to low-prejudice participants (Sherman, Stroessner, Conrey, & Azam, 2005). This is possibly because high-prejudice participants were more carefully encoding inconsistent than consistent information but were not using the behaviors as a basis for their impressions, while low-prejudice participants were equally encoding consistent and inconsistent information (Sherman et al., 2005). To replicate and extend these finds, the authors conducted another study in which participants learned person-knowledge about a Black man that was either stereotype-congruent (e.g., insulted the old woman) or stereotype-incongruent (e.g., visited a friend who was sick in the hospital) then were tested on their memory of presented statements either while under cognitive load or not (Sherman et al., 2005). Results again indicated that high-prejudice participants made more stereotypical judgments and remembered more stereotype-incongruent statements compared to low-prejudice participants, but only when not under cognitive load (Sherman et al., 2005). When under cognitive load, participants did not display any differences in memory regardless of prejudice level (Sherman et al., 2005). Taken together, the authors suggest that prejudice may be related to biased processing of either consistent or inconsistent information (Sherman et al., 2005).

Given that Black individuals tend to be associated with negative stereotypes and White individuals with positive stereotypes in the United States (Devine & Elliot, 1995; Weisbuch, Pauker, & Ambady, 2009), recall of positive person-knowledge of Black individuals and negative person-knowledge of White individuals may be the most accurate because counter stereotypical information is unique to the individual and the perceiver individuated that person based on the idiosyncratic piece of information. For example, an aggressive Black man matches racial stereotypes in the United States and thus may not be very memorable (O'Sullivan & Durso, 1984). In contrast, a meek Black man contradicts racial stereotypes in the United States and may therefore lead to individuation based on person-knowledge rather than perceptual categories (Fiske & Neuberg, 1990). In turn, memory for this meek individual may be stronger because of the additional mental processing that must be conducted when person-knowledge counters stereotypes.

1.7 The Influence of Perceptual and Knowledge-based Familiarity on the Neural Substrates of Impression Formation

In the present study, we examine neural regions of interest (ROIs) associated with familiarity and the availability of person-knowledge during impression formation. We employ fMRI because it allows researchers to assess impression formation in real-time and simultaneously assess multiple psychological processes with relatively high spatial resolution (Logothetis, 2008). There is also emerging brain-imaging research on evaluations based on person-knowledge, allowing for guided hypotheses and ROIs based on existing research. Therefore, fMRI is an ideal methodology to identify the specific ROIs that support impression formation in the presence of person-knowledge.

For example, researchers have assessed how congruence between assumptions from perceptual cues and person-knowledge impacts engagement of social cognitive processes in ROI (Cloutier, Gabrieli, O'Young, & Ambady, 2011; Harris & Fiske, 2010; Knutson, Wood, Spampinato, & Grafman, 2006; Li, Cardenas-Iniguez, Correll, & Cloutier, 2016; Westen, Blagov, Harenski, Kilts, & Hamann, 2006). In an fMRI study examining whether social expectations can influence the neural processing of perceptual face and body information, participants either reported the gender of each target (i.e., social categorization) or the color of a dot on the image (i.e., non-social task; Quadflieg et al., 2011). Importantly, the targets were either dressed in gender-stereotype consistent (e.g., a female florist or a male judge) or inconsistent clothing (e.g., a female soccer player or a male cleaner; Quadflieg et al., 2011). The results indicated that evaluating stereotype-incongruent targets (e.g., female pilots) increased neural activity in areas involved in person perception (e.g., fusiform face area (FFA)) and executive control (i.e., dorsolateral prefrontal cortex (DLPFC)) only during social tasks (Quadflieg et al., 2011). In another study researchers found greater dorsomedial prefrontal cortex (DMPFC) and bilateral temporo-parietal junction (TPJ) activity when forming impressions of targets who were stereotypically incongruent (i.e., Democratic politician paired with typical Republican views) versus congruent (i.e., Democratic politician paired with typical Democratic views; Cloutier, Gabrieli, et al., 2011). These regions commonly implicated in mentalizing were preferentially recruited when forming impressions of individuals violating expectations possibly because the incongruent targets required further individuation (Cloutier, Gabrieli, et al., 2011).

Other studies examining more affective responses find similar neural activity. In another fMRI study, participants classified Black and White faces displaying either happy or angry expressions (Hehman, Ingbretsen, & Freeman, 2014). The DMPFC and anterior cingulate cortex (ACC) displayed greater activity when classifying faces that were incongruent with stereotypical expectations (i.e., White-angry and Black-happy; Hehman et al., 2014). The ACC also exhibited greater functional connectivity with the lateral fusiform cortex, a region implicated in face processing, when viewing stereotypically incongruent (relative to congruent) targets (Hehman et al., 2014). Finally, participants with stronger behavioral tendencies to link race and emotion stereotypically during categorization showed greater DLPFC activity to stereotypically incongruent targets (Hehman et al., 2014). Again, replicating these fMRI studies, participants made approach judgments of trustworthy or untrustworthy faces that were paired with congruent or incongruent person-knowledge (Cassidy & Gutchess, 2015). Results revealed greater medial prefrontal cortex (MPFC) and DLPFC responses for incongruent (e.g., an untrustworthy face paired with person-knowledge about helping the homeless) over congruent targets (e.g., a trustworthy face paired with person-knowledge about enjoying a good laugh), suggesting increased mentalizing and control when encountering incongruent appearance-behavior information (Cassidy & Gutchess, 2015). In another study, when forming impressions of White and Black faces paired with valenced descriptive words, White perceivers displayed greater DMPFC activity to evaluatively incongruent targets (i.e., White faces paired with negative traits and Black faces paired with positive traits) compared to congruent targets (i.e., White faces paired with positive traits and Black faces paired with negative traits; Li et al., 2016). This pattern was driven by perceivers' internal motivation to avoid being prejudiced, such that only those low in internal motivation to respond without prejudice showed this difference in DMPFC activity (Li et al., 2016). Additionally, external motivation to avoid being prejudiced did not impact DMPFC activity (Li et al., 2016). The results provide further evidence for the reciprocal influence of bottom-up visual features and top-down goals or expectations on neural activity.

Specifically, we were interested in the role of the dorsomedial prefrontal cortex (DMPFC), ventromedial prefrontal cortex (VMPFC), precuneus, and amygdala in these processes. Based on previous research implicating the DMPFC in the retrieval of available person-knowledge (Gobbini & Haxby, 2007), the VMPFC in integrating available information (Roy, Shohamy, & Wager, 2012) and in positive evaluations based on person-knowledge (Dang, Mattan, Kubota, & Cloutier, 2019), the precuneus in perception of visually familiar faces (Gobbini & Haxby, 2006; Lee, Leung, Lee, Raine, & Chan, 2013), and the amygdala in salience detection (Santos, Mier, Kirsch, & Meyer-Lindenberg, 2011) we focus on these region as our confirmatory ROIs. We were additionally interested in exploring the role of the nucleus accumbens (NAcc), FFA, and hippocampus due to the face processing and memory components of this study. In the following section, we review the impression formation literature as it pertains to our ROIs and provide predictions of their involvement in the current study.

1.7.1 Medial Prefrontal Cortex

Although a network of brain region supports impression formation based on person-knowledge, the medial prefrontal cortex (MPFC) is believed to be central in learning and retrieving knowledge about the self and others (Amodio & Frith, 2006; Cloutier, Kelley, & Heatherton, 2011; Mitchell, 2009; Wagner, Haxby, & Heatherton, 2012). Specifically, the DMPFC appears to be involved in retrieving person-knowledge during impression formation and mentalizing more generally, whereas the VMPFC appears to be preferentially active when forming *positive* evaluations based on person-knowledge.

The DMPFC has been implicated in various aspects of thinking about people including the retrieval of person-knowledge (Gobbini & Haxby, 2007; Natu & O'Toole, 2011; Todorov, Gobbini, Evans, & Haxby, 2007), the formation and updating of impressions (Bhanji & Beer, 2013; Cloutier, Gabrieli, et al., 2011; Ferrari et al., 2016; Wagner et al., 2012), and mentalizing (Denny, Kober, Wager, & Ochsner, 2012; Frith & Frith, 2006; Lee & Siegle, 2012). In a study where participants were exposed to previously novel faces to create conditions of faces that were novel, only perceptually familiar, or paired with person-knowledge, results indicated that novel and perceptually familiar faces paired with person-knowledge elicited more DMPFC activity than novel and perceptually familiar faces not paired with person-knowledge, respectively (Cloutier, Kelley, et al., 2011). In another study participants observed faces paired with valenced behaviors or presented alone (Baron, Gobbini, Engell, & Todorov, 2011). The DMFPC displayed more activity in response to faces associated with behaviors than faces not associated with behaviors and did not respond differently as a function of behavior valence (Baron et al., 2011). These studies provide support for the hypothesis that the DMPFC is particularly sensitive to social-cognitive aspects of impression formation and accessing person-knowledge because the judgments eliciting DMPFC activity require the person-knowledge.

The DMPFC is also frequently implicated in mentalizing. Mentalizing, also referred to as "theory of mind," is the process that allows people to predict and understand the mental states of other social agents (including their motivations, goals, and feelings), making it essential for effective social interactions and intention inferences

(Amodio & Frith, 2006; Frith & Frith, 2006; Mitchell, 2009; Mitchell, Banaji, & Macrae, 2005). The DMPFC is also preferentially responsive when perceiving others for which person-knowledge is available even in the absence of explicit instructions to engage in social cognition (Gobbini & Haxby, 2007; Wagner, Kelley, & Heatherton, 2011), particularly when trait diagnostic information is available (Mitchell, Cloutier, Banaji, & Macrae, 2006). For example, when performing a perceptual task that does not require social evaluations or the use of person-knowledge (i.e., n-back task), faces previously associated with behaviors evoke greater DMPFC activity than novel faces (Todorov et al., 2007). In another study, participants were presented with either a person's body or name paired with either sentences conveying trait-diagnostic person-knowledge (e.g., "She stole office supplies") or neutral statements (e.g., "He sharpened his pencil"; Greven, Downing, & Ramsey, 2016). Results indicated greater DMPFC activity when presented with bodies paired with trait-diagnostic person-knowledge compared to neutral statements. In another study where participants were either instructed to simply read or infer traits from trait diagnostic or non-diagnostic sentences, simply reading trait-diagnostic sentences led to greater DMPFC activity than reading non-trait diagnostic sentences (Ma, Vandekerckhove, van Overwalle, Seurinck, & Fias, 2011). Furthermore, explicit instructions to infer traits was associated with more activity for diagnostic versus irrelevant sentences in the DMPFC (Ma et al., 2011). In all, activity in regions consistently implicated in mentalizing (e.g., DMPFC) increases in response to trait-diagnostic information.

On the other hand, the VMPFC is believed to support relatively explicit social evaluations based on person-knowledge, with typically greater activity for positively evaluated people (Cloutier, Ambady, Meagher, & Gabrieli, 2012; Cloutier & Gyurovski, 2014; Croft et al., 2010; Delgado et al., 2016; Lin, Adolphs, & Rangel, 2012; Mattan, Kubota, & Cloutier, 2017). Consistent with its sensitivity to both social and evaluative information (Chavez & Heatherton, 2015), meta-analyses and reviews of the literature purport that the VMPFC more broadly supports the flexible generation of affective meaning by integrating evaluation-relevant information from multiple dimensions and time points (Delgado et al., 2016; Flagan & Beer, 2013; Mende-Siedlecki, Said, & Todorov, 2013; Roy et al., 2012). In other words, the VMPFC is suggested to support the process of combining current environmental cues and past knowledge, possibly to predict future outcomes. In the context of person evaluation, the VMPFC is sensitive to explicit positive evaluations based on previous knowledge (Cloutier et al., 2012; Cloutier & Gyurovski, 2014; Dang et al., 2019; Mattan et al., 2017). For example, greater VMPFC activity is observed when person-knowledge about someone's high status is available (Barth, Mattan, Dang, & Cloutier, 2020; Cloutier et al., 2012; Cloutier & Gyurovski, 2014; Mattan, Kubota, Dang, & Cloutier, 2018), for increasingly positive evaluations based on person-knowledge (Dang et al., 2019), and high-status social network position (Parkinson, Kleinbaum, & Wheatley, 2017; Zerubavel, Bearman, Weber, & Ochsner, 2015). Moreover, the VMPFC is sensitive to personally relevant and well liked individuals about whom perceivers have extensive knowledge (D'Argembeau, 2013;

Jenkins, Macrae, & Mitchell, 2008; Jenkins & Mitchell, 2011; Krienen, Tu, & Buckner, 2010).

A recent study examining how the availability and use of person-knowledge shapes neural responses during percept- and knowledge-based evaluations found that the VMPFC is particularly responsive to positive social evaluations requiring the use of person-knowledge (Dang et al., 2019). In this study, participants were scanned while explicitly instructed to perform one of three evaluations: (1) attractiveness evaluations of unknown models (i.e., absence of person-knowledge), (2) attractiveness evaluations of well-known actors (i.e., availability of person-knowledge that is irrelevant to evaluations), and (3) likability evaluations based on body of work of well-known actors (i.e., availability of person-knowledge is required for evaluations). Facial attractiveness and actor's body of work were the basis for evaluations based on perceptual cues and person-knowledge respectively. Attractiveness judgments can be made based solely on perceptual cues and in the absence of person-knowledge (e.g., unfamiliar models). However, even if person-knowledge is available, one can presumably assess attractiveness based on perceptual cues without being influenced by person-knowledge (e.g., familiar actors). On the other hand, body-of-work judgments rely on person-knowledge and should not depend on attractiveness.

The results demonstrated that the VMPFC is sensitive to the use of available person-knowledge but also, to a lesser extent, to the availability of person-knowledge when performing attractiveness judgments. The VMPFC was further recruited by increasingly positive evaluations when person-knowledge was required compared to when person-knowledge was unavailable. These effects were observed in the VMPFC but not the DMPFC, reinforcing again the important divergence in their involvement during explicit social evaluations. The VMPFC, but not the DMPFC, appears to be involved in *positive* evaluations based on person-knowledge.

1.7.2 Precuneus

Viewing perceptually familiar faces has been associated with increases in precuneus activity (Gobbini & Haxby, 2006; Kosaka et al., 2003; Lee, Leung, Lee, Raine, & Chan, 2013). For example, in one study Gobbini and Haxby (2006) found greater precuneus activity to visually familiar faces compared to novel faces. In a study where participants viewed faces that were novel, just perceptually familiar, or experimentally associated with person-knowledge, there was greater precuneus activity to perceptually familiar compared to novel faces and faces associated with person-knowledge compared to just perceptually familiar (Cloutier, Kelley, et al., 2011). In multivariate network analyses, a network of regions including the precuneus has been found to preferentially respond to familiar versus novel faces (Cloutier, Li, & Correll, 2014).

1.7.3 Amygdala

The amygdala is sensitive to socially salient stimuli such as emotional expressions (Adolphs et al., 1999; Berntson, Bechara, Damasio, Tranel, & Cacioppo, 2007; Phelps, 2006), untrustworthy face evaluations (Engell, Haxby, & Todorov, 2007; Rule, Krendl, Ivcevic, & Ambady, 2013; Todorov, 2008), and novel stimuli (Blackford, Buckholtz, Avery, & Zald, 2010; Cunningham & Brosch, 2012). Indeed, one study found that the amygdala was sensitive to salient face stimuli and did not distinguish between threatening or emotional salient faces (Santos et al., 2011). The amygdala may also be essential for the convergence of valence and salience signals to direct future behavior.

Particularly relevant to the current study, the amygdala is sensitive to race, usually displaying greater activity to Black compared to White faces (Kubota, Banaji, & Phelps, 2012; Mattan, Wei, Cloutier, & Kubota, 2018; Phelps et al., 2000). This increase in amygdala activity to Black faces may be due to cultural associations between Black people and threat (Correll et al., 2007; Eberhardt et al., 2004) and it is most pronounced in perceivers with greater anti-Black attitudes (Brosch, Bar-David, & Phelps, 2013; Cunningham & Brosch, 2012; Phelps et al., 2000).

Another individual difference that may impact amygdala activity is interracial contact. In one study where White participants viewed novel and familiar Black and White faces, perceivers with greater childhood interracial contact displayed greater relative reduction in amygdala response to familiar Black faces (Cloutier et al., 2014). Therefore, we expect greater amygdala activity to novel vs familiar faces and to Black vs White faces, especially for perceivers with greater anti-Black attitudes, but this effect should be attenuated for those with greater interracial contact.

1.7.4 Additional Brain Regions

In addition to these main confirmatory ROIs, we will examine several exploratory ROIs. Specifically, we were interested in the role of the NAcc, FFA, and hippocampus in these processes.

1.7.4.1 NAcc

The NAcc has been shown to be sensitive to positive stimuli, such as perceptual cues conveying attractiveness (Aharon et al., 2001; Cloutier, Heatherton, Whalen, & Kelley, 2008; Hahn & Perrett, 2014; Kampe, Frith, Dolan, & Frith, 2001; Liang, Zebrowitz, & Zhang, 2010) or trustworthiness (Bellucci, Chernyak, Goodyear, Eickhoff, & Krueger, 2017; Fairley, Vyrastekova, Weitzel, & Sanfey, 2019). Beyond these more perceptual-based judgments, the NAcc has also been shown to be sensitive to positive person-knowledge. For example, in the same study where our lab found greater VMPFC activity to increasingly positive evaluations based on person-knowledge, we also found greater NAcc activity to increasingly positive evaluations based on person-knowledge (Dang et al., 2019). In other studies, the NAcc also displayed greater activity to high-status social network position (Parkinson et al., 2017; Zerubavel et al., 2015) and knowledge about cooperative others (Pfeiffer et al., 2014; Sun et al., 2016). We predict greater NAcc activity to faces associated with positive person-knowledge compared to faces associated with negative person-knowledge.

1.7.4.2 FFA

The fusiform face area (FFA) is proposed to be part of the core system that processes visual appearance of faces (Haxby & Gobbini, 2012; Haxby, Hoffman, & Gobbini, 2000; Ramon & Gobbini, 2017; Visconti Di Oleggio Castello, Halchenko, Guntupalli, Gors, & Gobbini, 2017). For example, when performing a perceptual task on pictures of personally familiar (i.e., friends) or novel targets, whole brain analyses revealed greater STS, precuneus, VMPFC, IFG, and FFA activity to familiar compared to unfamiliar faces (Visconti Di Oleggio Castello et al., 2017). In a different perceptual task, right FFA activity, but not left FFA, pSTS, or ATL activity, could be used to decode the identity of famous, familiar others (i.e., politicians and actors; Axelrod & Yovel, 2015). Some fMRI studies observe increased FFA activity in response to viewing famous versus unfamiliar faces (Elfgren et al., 2006; Gobbini et al., 2004), personally familiar versus novel faces (Gobbini et al., 2004; Pierce, Haist, Sedaghat, & Courchesne, 2004; Visconti Di Oleggio Castello et al., 2017), and visually familiar versus novel faces (Katanoda, Yoshikawa, & Sugishita, 2000). For example, in a study where participants viewed blocks of all perceptually familiar faces or a block with both unfamiliar and familiar faces, there was greater bilateral FG activity for the all familiar block compared to the mixed block (Katanoda et al., 2000).

In contrast, some research has found decreases in FFA activity with increased exposure to faces. For example, in a multi-session learning paradigm, results indicated decreasing left medial FG activity as sessions proceeded, possibly due to adaptation as previously unfamiliar faces become familiar (Kosaka et al., 2003). However, a study examining viewpoint variation found similar FFA activity when the same identity is presented at different angles regardless of familiarity, possibly because the FFA is involved in view-dependent processing of faces in general (Pourtois, Schwartz, Seghier, Lazeyras, & Vuilleumier, 2005). But, when there are minute changes in view, there is

FFA adaptation to both familiar and unfamiliar faces (Ewbank & Andrews, 2008; see also Henson, Shallice, & Dolan, 2000). Therefore, it is possible that familiar faces may increase FFA activity relative to novel faces; but over time the FFA may show decreased or similar activity over the course of face learning, responding with adaptation.

1.7.4.3 Hippocampus

The hippocampus has been consistently implicated in learning and memory (Eichenbaum & Cohen, 2014; Knierim, 2015). For example, one study found that knowledge about famous people is represented within the anterior temporal network, including the ATL, amygdala, and OFC, while knowledge of famous places is represented in a separate posterior medial network, including the precuneus and parahippocampal cortex (Morton, Zippi, Noh, & Preston, 2021). However, results indicated that the hippocampus represented semantic knowledge of both people and places, perhaps because the hippocampus supports domain general processing via connections with anterior temporal and posterior medial areas (Morton et al., 2021).

The hippocampus may have a central role in social cognition by integrating past experiences to guide flexible future actions (Eichenbaum & Cohen, 2014; Montagrin, Saiote, & Schiller, 2018; Rubin, Watson, Duff, & Cohen, 2014). In one fMRI study examining ongoing changes in social relationships, participants learned about targets through playing a decision-making role-playing game (Tavares et al., 2015). After scanning, participants rated each target on power and affiliation. Results indicated that the two dimensions of power and affiliation modulated hippocampus activity when making social decisions, possibly indicating that the hippocampus encodes a cognitive map of social relationships (Tavares et al., 2015). In one study, participants with damage to either the VMPFC or hippocampus made morality ratings of targets before and after being presented with person-knowledge conveying good, bad, or neutral morals (Croft et al., 2010). Results indicated that for both targets paired with good and bad person-knowledge, patients with VMPFC damage had reduced moral updating (i.e., less change in pre to post ratings of target morality) while patients with hippocampus damage had exaggerated moral updating (i.e., greater change in pre to post ratings of target morality; Croft et al., 2010). The researchers posit that damage to the VMPFC disrupts the generation of affective meaning to guide future interactions (e.g., Roy et al., 2012), leading to less updating compared to a control (Croft et al., 2010). Furthermore, they posit that damage to the hippocampus disrupts the ability to integrate contextual information and instead rely more on emotional signals, leading to exaggerated updating compared to a control (Croft et al., 2010). In all, the VMPFC and hippocampus may work in concert to update judgments of others. This view of the hippocampus in decision-making and social behavior is consistent with the functional connectivity between the hippocampus and regions implicated in social cognition, including the VMPFC and amygdala (Buckner & Carroll, 2007; Rubin et al., 2014).

The hippocampus has also been shown to differentially respond to stimuli based on race (Golby, Gabrieli, Chiao, & Eberhardt, 2001). For example, in a study where Black and White participants passively viewed Black and White faces while in an fMRI, results indicated that the right hippocampal gyri and left fusiform gyrus displayed greater activity when there was greater memory for same-race versus other-race faces, perhaps working together to encode faces into long-term memory (Golby et al., 2001). We predict greater hippocampus activity for faces associated with person-knowledge compared to those that are only perceptually familiar and for White faces associated with person-knowledge compared to Black faces associated with person-knowledge.

1.8 Current Studies

The main aim of the current studies is to examine the learning rates of faces varying in race (Black, White) that are paired with individuating information varying in valence (positive, negative) or just perceptually familiar. Specifically, we sought to investigate how perceptual familiarity, paired person-knowledge valence, and recall of individuating statements are influenced by target race (Black, White) and person-knowledge availability or valence (Positive, Negative). Once a day for five days, White participants completed an encoding session where they learned sentences conveying either positive or negative information that were paired with Black or White faces followed by a test session. Additionally, we examine how this training on separate faces affects subsequent evaluative priming and face recognition and the neural correlates of forming impressions of these now familiar faces.

Study 1 was designed to examine the differences in learning rates of individuating information of Black and White targets after being trained to be perceptually familiar only or perceptually familiar and paired with either positive or negative person-knowledge. Study 1 is a within subjects, longitudinal behavioral study where participants were asked to learn individuating information about previously novel faces. Over five days, participants learned about faces and were tested on their memory. Additionally, on the first and last day, they completed a face recognition task and an evaluative priming task (EPT) to examine the influence of learning about faces varying in race on separate tasks.

Study 2 is a partial replication of study 1 with an additional fMRI study. After completing five learning and test sessions as in study 1, these participants additionally completed an impression formation task during scanning. Here we examine the neural correlates of impression formation of faces varying in race that are either novel, perceptually familiar only, paired with positive person-knowledge, or paired with negative person-knowledge.

Chapter 2

STUDY 1: LEARNING RATES OF INDIVIDUATING INFORMATION OF FACES VARYING IN RACE

As we learn information about others, we can individuate them and learn things about them that we might not assume based solely on their looks (i.e., perceptual cues alone). However, biases may influence what and who we remember. For example, as discussed in the introduction, we tend to have better memory for people of our racial ingroup. This may occur because we have more expertise with individuating members of our ingroup (Goldstein & Chance, 1985; Kelly et al., 2009; Quinn et al., 2020), or because we are more motivated to individuate members of our ingroup (Handley et al., 2021; Hehman et al., 2010). How do the rate and accuracy of recognizing others as familiar or to recall specific information about them differ depending on their race and the type of paired information? In study 1, we seek to examine the differences in learning rates of individuating information of Black and White faces after being trained to be perceptually familiar only or perceptually familiar and paired with either positive or negative person-knowledge. Exposing participants to multiple sessions of training will allow tracking of learning rates that supplements other studies of one-shot trainings and more closely mimics real-world situations where we encounter the same people multiple times.

Study 1 is a within subjects, longitudinal behavioral study where participants were asked to learn individuating information about previously novel faces. Over five days, participants learned about faces and were tested on their memory on each day. Additionally, on the first and last day, they completed a facial recognition task and an evaluative priming task (EPT) to examine the influence of learning about faces varying in race on facial recognition and implicit evaluative associations. Study 1 is preregistered at OSF (https://osf.io/4k8ve/).

2.1 Study 1a: Learning Task

Study 1a is the main study of interest. Here we examine learning rates of faces varying in race and valence of paired person-knowledge. Specifically, participants are asked to learn about Black and White men who are either perceptually familiar or paired with person-knowledge that varies in valence (positive, negative). After learning about the faces, they are tested on their memory. In the test session, they are shown the now familiar faces and novel, distractor faces and asked to indicate whether they have seen the face before and if so, to indicate what information was paired with the face.

2.1.1 Predictions

In line with the ORE predicting better memory for same-race faces, we predicted that White participants would display increased learning for White targets compared to Black targets. In line with the negativity bias, we predict that participants will display increased learning for faces paired with negative person-knowledge. Based on previous research suggesting stronger memory for stereotype-incongruent pairs and the prevalence of negative associations with Black people and positive associations with White people, we further anticipated that participants would have more accurate memory for White faces paired with negative information and Black faces paired with positive information.

2.1.2 Methods

2.1.2.1 Participants

182 participants were recruited from the University of Delaware SONA pool. All participants self-identified as White, non-Hispanic, were between the ages of 18 and 35 years old and had lived in the U.S. for at least 5 years. Participant recruitment was not restricted by gender. 112 participants were excluded from data analysis (32 who failed to participate in subsequent days or failing to complete a portion of a session, 46 who did not pass attention check criteria, 14 due to experimenter error caused by mixing up the order of the tasks at the start of data collection, 17 who completed portions of the study multiple times, 1 from computer technical difficulties, and 2 who wished to discontinue). Data from 70 participants (M_{Age} = 18.69 years, SD_{Age} = 0.941, 53 female) who completed all five days successfully was used in final analyses. Participants were compensated with credits toward the completion of research requirements for introductory courses. Those who completed all five days were compensated with 4.5 total credits, while all others were compensated at a prorated rate of 1 credit per hour.

Sample size rationale:

To identify the sample size for the learning task, we conducted a Power Analysis using the PANGEA package (v0.2), publicly available at https://jakewestfall.shinyapps.io/pangea/ (Westfall, in preparation) with an alpha of .05. As this is the first study that explicitly examines combinations of race and valence in a learning paradigm, the variance and effect size parameters were not possible to predict a priori. Therefore, we used the default variance parameters in PANGEA (*var*[error]=0.2, *var*[Person-knowledge Valence x Race x Session x Participant]=0.04).

Analyses modeled participants as a random factor nested within contact (here, inputted as a categorical variable with 7 levels) and 8 analyzable trials per Person-knowledge Valence (Positive, Negative) x Race (Black, White) x Session (1-5) x Participant. Power analyses suggested that a sample of 70 participants would be sufficiently powered to detect a significant Info x Race x Session x Contact interaction at a relatively small effect size (d=0.20), 1–β=.80.

2.1.2.2 Stimuli

2.1.2.2.1 Faces

To equate faces used in the main series of learned memory tasks, data were collected from human subjects recruited from Amazon Mechanical Turk (AMT). Participants from AMT have at least a 70% approval rating, are at least 18 years old, and were restricted to the United States. Eligible participants provided informed consent online via a Qualtrics survey. The survey randomly generated a participant ID upon consent. After completing the pretesting task, participants were compensated at a rate of $4/hour for a total of $2 for a 30-minute task. We collected 740 pretesting participants from AMT.

We curated a set of about 750 pictures of perceived Black and White, male faces from various online face databases (Burton, White, & McNeill, 2010; DeBruine & Jones, 2017; Eberhardt, Davies, Purdie-Vaughns, & Johnson, 2006; Kennedy, Hope, & Raz, 2009; Ma, Correll, & Wittenbrink, 2015; Mende-Siedlecki, Qu-Lee, Goharzad, & Drain, 2019; Nordstrøm, Larsen, Sierakowski, & Stegmann, 2004; Strohminger et al., 2016; Thomaz, 2006; Tottenham et al., 2009) and online searches for pretesting. We then split the faces into two groups of approximately equal perceived Black and White faces. Each participant rated half of the faces (one group) on one rating dimension (Table 1). Each participant only rated about 325 faces instead of all 750 to attenuate fatigue and boredom. The stimuli displayed directed eye gaze. Stimuli were cropped around the hair and from the neck up, placed on white backgrounds, and greyscaled using Adobe Photoshop or Gimp. Images were processed using the SHINE toolbox (Willenbockel et al., 2010) to remove low-level visual variation.

For pretesting the faces, we collected 18 groups (*n* = approximately 30 each group) of AMT participants. They rated half of the faces on one of the following dimensions using a 7-point scale: distinctiveness ("How distinctive is this person's face?", from 1 (*not distinctive*) to 7 (*very distinctive*)), likability ("How likable does this person look?", from 1 (*not likable*) to 7 (*very likable*)), attractiveness ("How attractive is this person?" from 1 (*not attractive*) to 7 (*very attractive*)), trustworthiness ("How trustworthy does this person look?", from 1 (*not trustworthy*) to 7 (*very trustworthy*)), dominance ("How dominant does this person look?", from 1 (*not dominant*) to 7 (*very dominant*)), picture quality ("Rate the picture quality" from 1 (*poor quality*) to 7 (*high quality*)), age ("How old does this person appear?", categorical, with 1 (*18-25*), 2 (*26-35*), 3 (*36-45*), 4 (*46-55*), 5 (*56-65*), 6 (*66-75*), 7 (*76+ years*)), race ("What is his race?" categorical, with 1 (*Black/African American*), 2 (*Asian/Asian American*), 3 (*White/Euro-*

American), 4 (*Latino/Hispanic American*), 5 (*Middle Eastern/Arab American*), 6 (*Native American*), 7 (*Other*)), and emotional expression ("What emotion is he expressing?", categorical with 1 (*angry*), 2 (*happy*), 3 (*neutral*), 4 (*sad*)). To ensure participants were paying attention, we included 19 (5%) catch trials composed of faces with a superimposed red number on the forehead where participants were told to enter that number as their response for all questions on that page. We only included data from participants who got at least 75% (14/19 catch trials) correct.

After collecting 30 participants with complete data per version per rating dimension and eliminating those who (1) did not pass catch criteria and (2) responded with the same key for all non-catch trials, we performed reaction time (RT) exclusions in the following order: 1) deleted trials with RT 3SD away from each participant's individual mean response time, 2) deleted trials less than 100ms, and 3) deleted trials with RT 3SD away from the group mean time. We then collected additional participants so that each face stimuli had at least 30 ratings per dimension. We collected a total of 740 AMT participants with complete data. Once we had at least 30 data points per face per rating dimension, we used the average ratings to eliminate faces before equating. For facial expression, we eliminated any faces that did not have at least 70% of raters rating the face as having either a happy or neutral expression. In the final equated faces, the distribution of happy and neutral facial expressions did not differ by race. For quality, we eliminated any faces that did not have a mean rating of at least 3. For race, we eliminated any faces that did not have at least 80% consensus as being perceived to be either Black or White. After exclusions based on ratings, we ended up with 141 faces (78 Black, 63 White) to equate.

From these 141 faces, we selected 64 faces divided into four stimuli groups (A-D) of 16 faces each (8 Black and 8 White faces in each group). We equated all 9 dimensions by stimuli group and race, meaning the faces in each stimuli group by race were not rated significantly differ from each other by any of the measured dimensions (see Table 1 below for summary statistics).

Table 1: Equating Results of Face Stimuli.

		***F*-value**	***DF***	***p*-value**
Age	**Group**	0.100	3, 56	0.960
	Race	0.306	1, 56	0.583
	Group x Race	0.238	3, 56	0.870
Attractive	**Group**	0.481	3, 56	0.697
	Race	0.787	1, 56	0.379
	Group x Race	0.904	3, 56	0.445
Distinct	**Group**	0.332	3, 56	0.802
	Race	0.079	1, 56	0.780
	Group x Race	0.457	3, 56	0.714
Dominant	**Group**	1.137	3, 56	0.342
	Race	3.464	1, 56	0.068
	Group x Race	0.116	3, 56	0.950
Expression	**Group**	0.735	3, 56	0.535
	Race	0.037	1, 56	0.847
	Group x Race	0.773	3, 56	0.514
Like	**Group**	0.299	3, 56	0.826
	Race	1.990	1, 56	0.164
	Group x Race	0.050	3, 56	0.985
Quality	**Group**	1.325	3, 56	0.275

	Race	0.526	1, 56	0.471
	Group x Race	0.446	3, 56	0.721
Race	**Group**	0.722	3, 56	0.543
	Race	2.347	1, 56	0.131
	Group x Race	0.693	3, 56	0.560
Trust	**Group**	0.491	3, 56	0.690
	Race	0.968	1, 56	0.329
	Group x Race	0.266	3, 56	0.850

Note. Faces were rated on 9 dimensions. Differences in ratings on these dimensions were not statistically significant.

The 64 faces (32 White, 32 Black) were divided into four stimuli groups (Groups A-D), with each stimuli group consisting of 16 faces (8 Black, 8 White). These four stimuli groups were equated on multiple dimensions as a function of race. Eight different orderings of random selection without replacement were created from these four groups for each of the four conditions: faces paired with positive information, faces paired with negative information, perceptually familiar faces paired with no information, and novel faces. (These novel faces are used in the EPT post-learning session and the fMRI study.) During the testing phase of the learned memory task, the novel faces were not repeated in subsequent testing sessions. While these novel faces were rated as Black or White, they were not equated due to the large number of novel faces needed across five test sessions.

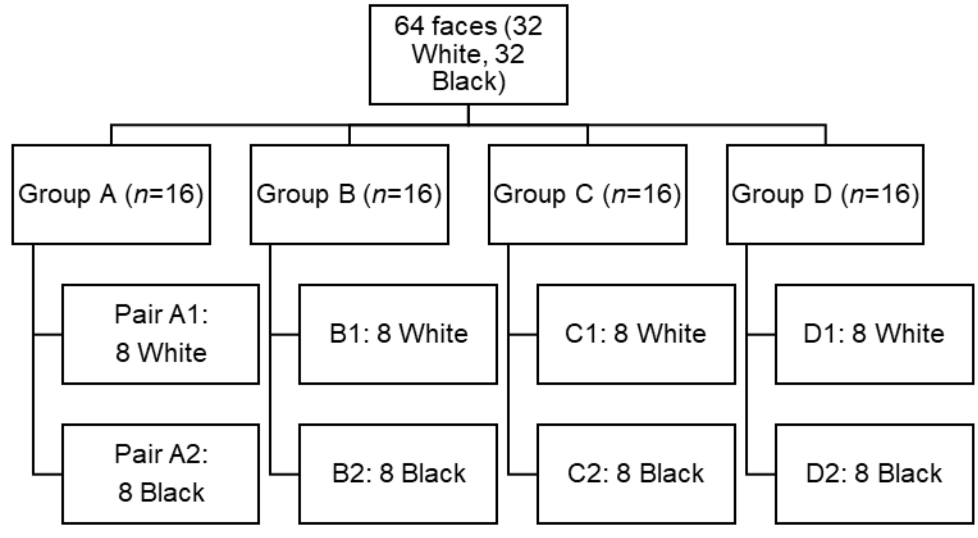

Figure 1: Grouping of Face Stimuli.

2.1.2.2.2 Statements

We used a database of sentences with available pilot data (Mende-Siedlecki & Havlicek, in prep) to curate and equate a subset of sentences to serve as person-knowledge. From this database, we discarded any sentences that (a) referred to the actor in plural/gender neutral terms, (2) described female actors, (3) used plural instead of singular (e.g., were instead of was), (4) described extreme cases (e.g., rape), and (5) described unusual situations (e.g., failed to disclose a camel illness when selling a camel). Pertinent to the current investigation, the database included ratings of gender stereotypicality [0 (*very stereotypically male*) to 8 (*very stereotypically female*)], race stereotypicality [0 (*very stereotypically Black*) to 8 (*very stereotypically White*)], valence [-4 (*very negative*) to +4 (*very positive*)], and arousal [0 (*not at all arousing*) to 8 (*extremely arousing*)] for each statement. Using these ratings, we eliminated statements that had an average rating (1) greater than 4 for gender stereotypicality, indicating that the sentence was perceived to be more stereotypically female and (2) greater than 6 or less than 2 for race, indicating that the sentence was perceived to be more stereotypical of Black or White people. To identify positive statements, we eliminated statements that had an average rating less than 1.5 for valence. To identify negative statements, we eliminated statements that had an average rating greater than -1.5 for valence.

We curated a sample of 96 statements (half negative, half positive). For each rating dimension, we ran a t-test comparing the statements across valence. Final statements did not differ on race stereotypicality by valence condition, $M_{StereotypicalityPositiveStatements} = 4.517$, $M_{StereotypicalityNegativeStatements} = 4.155$, $t(30) = -1.844$, $p = .075$, $CI_{95\%} = [-0.762, 0.039]$; absolute value of valence by valence condition, $M_{StereotypicalityPositiveStatements} = 2.121$, $M_{StereotypicalityNegativeStatements} = 2.256$, $t(29) = -1.844$, $p = .161$, $CI_{95\%} = [-0.057, 0.326]$; or arousal by valence condition $M_{StereotypicalityPositiveStatements} = 3.510$, $M_{StereotypicalityNegativeStatements} = 3.739$, $t(18) = 1.489$, $p = .153$, $CI_{95\%} = [-0.094, 0.555]$. 48 positive and 48 negative statements conveying person-knowledge were presented to each participant. Each of the statements was randomly grouped into one of 16 groups containing 3 similarly-valenced statements. This resulted in 16 unique groups of positive statements (3 statements per group) and 16 unique groups of negative statements (3 statements per group). These 32 groups in total were randomly paired with each of the 8 face orderings.

Participants were randomly assigned to one of the 8 orderings. In each ordering, each of the face groups (Groups A-D) were assigned to one of four conditions and randomly paired with the corresponding person-knowledge statements: faces paired with positive information, faces paired with negative information, perceptually familiar faces, and novel faces for the evaluative priming task. For example, if faces from Group A were assigned to the positive information condition, then each of the 16 faces in Group A were randomly paired with one of the 16 groups consisting of 3 positive statements. For example, a participant may have been assigned Group A faces paired with positive statements, Group B faces paired with negative statements, Group C faces not paired with any statements, and Group D faces for the novel faces for a different set of analyses and studies. In the series of learned memory tasks, they would have then been asked to encode Group A, Group B, and Group C faces in the encoding phases and asked to recognize them and recall the statements in the testing phases on the same day.

2.1.2.3 Procedure

This online study consisted of five separate, consecutive days of participation. Table 2 details the tasks each participant completed. On the first through fourth day, participants completed one encoding phase and one test phase from the series of learned memory tasks on each day. On the fifth and final day, participants completed one encoding phase and one test phase from the series of learned memory tasks and individual difference measures. On the first and fifth days, participants also completed an evaluative priming task (EPT) then face recognition tasks that make up study 1b and 1c, respectively.

Table 2: Outline of Study 1 Progression and Tasks.

Session	Tasks
1	1. EPT 1 2. Independent pre-learning face recognition – Encoding 1 3. Independent pre-learning face recognition – Test 1 4. Series of learned memory tasks – Encoding 1 5. Series of learned memory tasks – Test 1
2	1. Series of learned memory tasks – Encoding 2 2. Series of learned memory tasks – Test 2
3	1. Series of learned memory tasks – Encoding 3 2. Series of learned memory tasks – Test 3
4	1. Series of learned memory tasks – Encoding 4 2. Series of learned memory tasks – Test 4
5	1. Series of learned memory tasks – Encoding 5 2. Series of learned memory tasks – Test 5 3. EPT 2 4. Independent post-learning face recognition – Encoding 2 5. Independent post-learning face recognition – Test 2 6. Individual difference measures (random order except where noted) a. Likeability ratings (always 1st) b. Race IAT (always 2nd) c. Demographics (always 3rd) d. Interracial contact (sequential order) i. Childhood contact ii. Current contact e. EMS/IMS f. Modern Racism Scale (MRS) g. Symbolic Racism Scale (SRS) h. Feeling thermometer (random order) i. White people ii. Black people i. Perceived Stress Scale j. Fear of the Coronavirus

2.1.2.3.1 Encoding phase

In the encoding phase, participants were presented with three groups of equated faces for a total of 48 unique faces. One third (16) of the faces were preceded by positive statements (positive person-knowledge), one third (16) by negative statements (negative person-knowledge), and one third (16) were not paired with statements (perceptually familiar). In each of these groups, half of the faces were perceived to be White and the other half were perceived to be Black. Prior to the start of the task, participants were notified that they would subsequently be tested on their memory for the type of information (positive, negative, or no information) and the specific statements that were paired with each face. Participants were familiarized with the task with practice trials that replicated the person-knowledge paired, no person-knowledge paired, and catch conditions with faces not seen in the main experimental task.

In the main experimental encoding task, each of the 48 faces was shown six times for a total of 288 trials per encoding phase. In the two person-knowledge conditions, each face was paired with three unique statements of the same valence. For example, a White face in the negative person-knowledge condition may have been paired with the following statements: “Gave directions to a couple who was lost,” “Helped a neighbor fix their fence,” and “Picked up a child so that she could see the parade.” Each statement was shown on the screen for 2000ms. The face associated with that unique statement would then follow and be held on the screen for 2000ms. Each unique face-statement pair was presented two times in every encoding session. In the perceptually familiar condition, each face was presented six times for 2000ms without preceding statements. After each face was shown, a fixation was presented on the screen for 500ms to separate each trial. See Figure 2 for a schematic of the encoding phase.

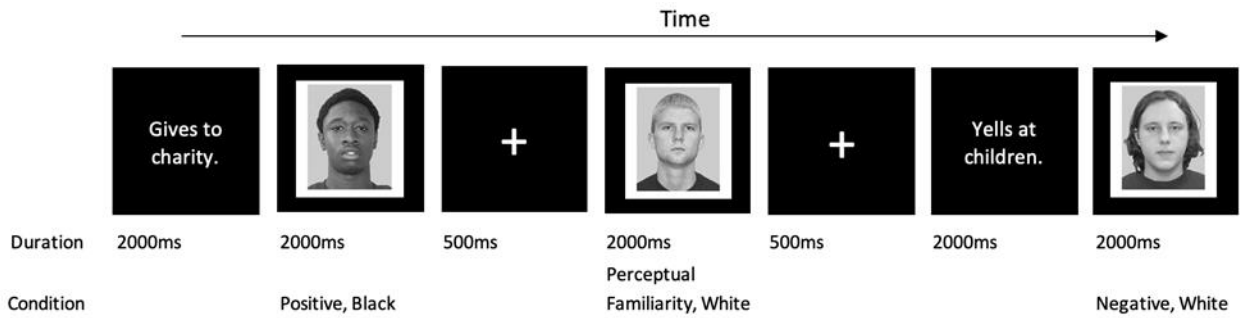

Figure 2: Schematic of Encoding Phase. Each face was presented three times per encoding phase. The first pair is positive-Black: Black target paired with positive person-knowledge. The second pair is perceptually familiar-White: White target not paired with any information. The third pair is negative-White: White target paired with negative person-knowledge.

2.1.2.3.2 Test phase

Participants completed the test phase immediately after the encoding phase ended. Each test phase began with the presentation of instructions followed by practice trials. Practice trials utilized faces that were not seen in the main experimental task to replicate each of the different categories of trials in the test phase (person-knowledge paired, no person-knowledge paired, novel, and catch) and the appropriate responses for each face. In the main experimental test phase, participants were presented with a total of 72 faces. This included all 48 of the faces that were now familiar from the encoding phase as well as 24 novel faces. The novel faces consisted of 12 Black faces and 12 White faces that had not previously been presented to participants. Each day, participants saw a new set of 24 novel faces for a total of 144 novel faces across all 5 test sessions.

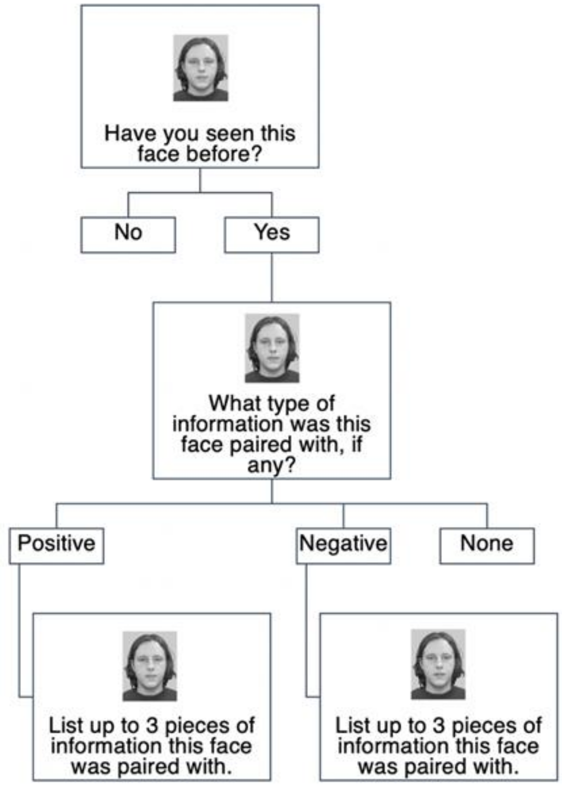

Figure 3: Schematic of the Test Phase. For each face, participants were asked whether they had seen the face before. If they selected “Yes,” they were asked what type of information the face was paired with, if any. If they selected “positive” or “negative,” they were asked to list up to three pieces of information the face was paired with during the encoding phase.

The 72 faces were presented once each and at random. All trials began with the presentation of a face in the middle of the screen with the question, “Have you seen this face before?” situated underneath each photograph. The face remained on the screen until participants indicated whether they believed the face was familiar or novel by selecting “Yes” or “No,” respectively. When participants indicated that the face was novel or incorrectly familiar, the next trial began with the presentation of a different face. When participants correctly recognized a face as familiar, the same face was presented again but this time with the question, “What type of information was this face paired with, if any?” underneath the photo. Participants were given three options to choose from: positive, negative, or none. The face remained on the screen until the participant responded. When participants selected “none” or incorrectly selected positive or negative, they were moved to the next trial. When participants correctly indicated that the face was paired with either positive or negative information, the same face appeared again in the middle of the screen with the following recall instructions: “List up to 3 pieces of information this face was paired with.” A text box appeared underneath these instructions where participants could type their responses. The face and instructions remained on the screen until participants submitted their responses.

We measured three dependent variables (DVs) in the learned memory tasks: (1) Face Recognition: proportion of faces correctly identified as either familiar or novel; (2) Attribution of Valenced Person-knowledge: proportion of perceptually familiar faces that participants correctly paired with either positive, negative, or no information; and (3) Cued Recall of Person-knowledge: proportion of correct statements recalled for perceptually familiar faces paired with either positive or negative statements.

2.1.2.4 Individual Difference Measures

Following the independent face recognition task on Day 5, all participants completed several exploratory individual difference measures as well as the confirmatory interracial contact questionnaire.

Likability task

Participants were presented with all 48 faces from the encoding phase in a randomized order, with the question “How likable is this person?” underneath each photo with a scale of 1 (*very unlikable*), 2 (*unlikable*), 3 (*somewhat unlikable*), 4 (*neutral*), 5 (*somewhat likable*), 6 (*likable*), and 7 (*very likable*).

Race IAT

Following the likability task, participants completed the race IAT (Greenwald, McGhee, & Schwartz, 1998) that measures the strength of implicit associations between race (Black, White) and valence (Positive, Negative). Participants were asked to utilize two buttons on the keyboard to categorize faces as either Black or White and words as either good or bad.

Qualtrics questionnaires

After completing the race IAT, participants were directed to Qualtrics to complete a series of questionnaires in a random order:

1. **Interracial contact questionnaires** (Cloutier, Li, & Correll, 2014; Cloutier et al., 2017; Kubota, Peiso, Marcum, & Cloutier, 2017; Li et al., 2016). Participants were asked about their quantity of contact with members of other races throughout childhood, adolescence, and adulthood.
2. **Internal and External Motivation to Respond without Prejudice Scales** (IMS/EMS; Plant & Devine, 1998). Participants were instructed to indicate the extent to which they agreed or disagreed with a series of

statements describing one's motivation to be unprejudiced on a 9-point scale ranging from 1 (*strongly disagree*) to 9 (*strongly agree*).

3. **Modern Racism Scale** (MRS; McConahay, 1983). Participants were asked to indicate the extent to which they agreed or disagreed with a series of statements on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The scale intends to measure White Americans' racial attitudes towards Black Americans.
4. **Symbolic Racism Scale** (Henry & Sears, 2002). Participants were asked to indicate the extent to which they agreed or disagreed with a series of statements on a scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). The scale's statements reflect each of the four themes of symbolic racism: work ethic and responsibility for outcomes, excessive demands, denial of continuing discrimination, and undeserved advantage (Henry & Sears, 2002).
5. **Feeling Thermometer** (Wilcox, Sigelman, & Cook, 1989). Participants completed feeling thermometers separately for Black individuals and White individuals. For each group, participants responded to the following prompt using a sliding scale from 0 to 100: "Please rate how cold or warm you feel towards the group below (0 = coldest feelings, 50 = neutral, 100 = warmest feelings)."
6. **Fear of the Coronavirus** (Mertens, in prep). Participants were asked to indicate the extent to which they agreed or disagreed with a series of

statements describing feelings and behaviors due to the coronavirus pandemic on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

7. **Perceived Stress Scale** (PSS; Cohen, 1988). Participants were asked to indicate how often they felt or thought about stress-related items during the last month on a 5-point scale with 0 (*never*), 1 (*almost never*), 2 (*sometimes*), 3 (*fairly often*), and 4 (*very often*).

2.1.2.4.1 Lifetime Interracial Contact Questionnaire

Participants completed a measure of contact with different racial group members (e.g., Pettigrew, 1997). This measure is a multi-item questionnaire that asks participants to report the racial diversity of people in their social networks at three distinct stages of their childhood and once at their current age (Cloutier et al., 2014). Items ask about the percentage of friends, acquaintances, daily contacts, and media figures that were/are Asian/White/Black/Latinx/Other. For these items, participants entered values ranging from 0 to 100, with 0 indicating that 0% of the participant's contact was with that racial group and 100 indicating that 100% of the participant's contact was with that racial group[1]. The measure also assesses the kind of environment in which participants have

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[1] Participants also reported their number of White and Black acquaintances, friends, and people dated, on a scale from 1 (*none*) to 5 (*10 or more*). This measure is an exploratory addition to the scale and was not used to calculate contact.

spent most of their lives (i.e., urban, suburban, or rural) and their awareness of their environment's racial and cultural diversity (both rated as yes/no responses).

As in previous research from our lab (Cloutier et al., 2014; Cloutier, Li, Mišic, Correll, & Berman, 2017; Handley et al., 2022, 2021; Kubota, Peiso, Marcum, & Cloutier, 2017), lifetime interracial contact was calculated by creating an average of childhood contact and current contact with Black and White people. We first averaged each participant's childhood contact questions separately for White people and Black people. We calculated each participant's childhood interracial contact scores by subtracting these two averages (Black minus White). Next, we averaged each participant's current contact questions separately for White people and Black people. Participants' current interracial contact scores were calculated by subtracting these two averages (Black minus White). Therefore, each participant had a childhood contact score and a current contact score, each of which could range from -100 (exclusively White contact) to +100 (exclusively Black contact). Lastly, these two scores representing average childhood contact and average current contact were averaged into a composite measure of lifetime interracial contact ([childhood contact score + current contact score]/2) and z-scored, which were used as a predictor in our models.

2.1.2.5 Data Exclusion

We analyzed all data of participants who completed all five encoding and test phases in the series of learned memory tasks and passed our catch trial exclusion criteria. If a participant did not complete the study, their data was not included in analyses. We eliminated any participants who responded with the same key for all trials. For example, we eliminated participants who answered that all the faces were paired with positive statements. In the test phase, all answers were force choice except for the statement recall questions. If participants left a blank write-in, it was counted as a miss. Data exclusion steps were conducted in the following order:

1. Eliminated entire participants from all analyses and participating in subsequent sessions if they did not pass both the main experiment encoding phase and main experiment test phase catch trials in the series of learned memory tasks. Participants were compensated for the sessions they had already completed but were not invited to complete subsequent sessions.
2. Eliminated entire participants from all analyses if they did not complete five encoding and five test phases of the series of learned memory tasks over six possible days.
3. Eliminated entire participants from all analyses if they did not pass the demographic questions.
4. Excluded participants from analyses requiring specific data (e.g., likability ratings) if they did not pass catch criteria for that experiment. In this case, their data was still included in analyses not requiring those data points.
5. Exclude trials based on reaction time (see “Reaction time exclusion” section below).

Catch trials

To ensure that participants were paying attention, catch trials were used in the main experiment series of learned memory tasks as well as the likability task. In each main experimental series of learned memory tasks encoding phase, 28 attention check trials (~10% of 288 trials = 28.8) were administered. In each attention check, one of 4 faces (2 Black, 2 White) was shown for two seconds with a number in red text transposed over the forehead. Participants were asked to input the number as their responses within two seconds. After each session, participants who did not correctly answer 75 percent of attention checks overall were eliminated (i.e., only encoding data from participants who correctly answered at least 21/28 attention checks was kept). Participants who did not pass the catch trial criteria for a certain encoding phase were credited for what they completed, but were not able to continue to the next session.

Figure 4: Catch Trial Example. Participants were instructed at the start of each task that included catch trials to select the number on the target's forehead as their answer.

In each main experiment series of learned memory tasks test phase, eight attention check trials (10% of 72 trials = 7.2 rounded up) were used to ensure that participants were paying attention to the task. In each attention check, one of the same 4 faces (2 Black, 2 White) from the encoding phase catch trials were shown with a number in red text transposed over the forehead. The face was presented until the participant input the number as their response. After each session, participants who did not correctly answer 75% of attention checks overall (i.e., participants who did not answer at least 6/8 attention checks correctly) were eliminated. Participants who did not pass the catch trial criteria for a certain test phase were credited for what they completed, but were not allowed to continue to the next session.

In the likability task, five attention check trials (10% of 48 trials = 4.8) were used to ensure that participants were paying attention. In each attention check, the same 4 faces (2 Black, 2 White) were shown with a number in red text transposed over the forehead. The face was presented until the participant input the number as their response. For analyses that required these likability ratings, participants who did not correctly answer 75% of attention checks overall (i.e., participants who did not answer at least 4/5 attention checks correctly) were eliminated.

Reaction time exclusion

In addition to the above catch trials, we also excluded at the trial level based on reaction time. For the independent pre and post face recognition test, series of learned memory task test for face recognition, and likability ratings, we eliminated trials in the following order: (1) 3 standard deviations away from the participant trial mean, (2) trials that are 100ms or less, and (3) 3 standard deviations away from the group mean.

2.1.2.6 Data Analysis

2.1.2.6.1 Coding

Because the participants were asked to recall and type in the statements of paired person-knowledge, we needed to determine if the recalled statements were similar to the initially presented statements in the encoding phase instead of requiring verbatim recall. For each statement group (i.e., the three statements paired with a face) two independent raters were given a list of the three recalled statements and asked to indicate if each statement matches the gist of the statements paired with that specific face in the participant's specific ordering. For example, if the participant wrote down "Donates to charity," that would have been rated as matching a paired statement "Gives to charity." When there was not consensus among the two raters, a third tie-breaker rater was used for those non-consensus items only.

2.1.2.6.2 DV Calculations

Because in the test phase we asked participants to respond up to three times for each person-knowledge face, we have three DVs: (1) face recognition, (2) attribution of valenced person-knowledge, and (3) cued recall of person-knowledge. Each DV was calculated as follows:

(1) Face Recognition = (Hits – False alarms) / total Hits possible

(2) Attribution of Valenced Person-knowledge = Hits / total Hits possible

(3) Cued Recall of Person-knowledge = Hits / total Hits possible

For the first DV of face recognition, we calculated the number of previously seen faces correctly identified as familiar minus the number of novel faces incorrectly identified as familiar divided by the total number of familiar faces they saw (48). For the second DV of attribution of valenced person-knowledge, we calculated the number of familiar faces correctly paired with the type of information (perceptually familiar only, positive person-knowledge, or negative person-knowledge) divided by the total number of familiar faces they incorrectly indicated as familiar from the first DV. The denominator varied by participant because each participant only saw the second DV for a particular face if they correctly indicated it was familiar in the first DV. For example, if they said a novel face was familiar, they would not move to the second DV for that face because it was novel and if they said a familiar face was novel, they would not move to the second DV for that face because they were wrong. For the third DV of cued recall of person-knowledge, we calculated the number of generated statements that matched the paired person-knowledge divided by the number of paired statements (3) for each person they correctly indicated was paired with person-knowledge.

2.1.2.6.3 Models

We used within-participants linear mixed effects regression models to analyze all data. We used the lme4 (Bates, Maechler, Bolker, & Walker, 2015) and lmerTest (Kuznetsova, Brockhoff, & Christensen, 2017) packages in R (R Core Team, 2018). If an omnibus test indicated a significant interaction, we decomposed the interaction by calculating simple differences and slopes. Any significant interactions were followed up with models using dummy or contrast coding of relevant factors. These follow-up models were used to decompose and ultimately plot the significant interactions from the main confirmatory analysis.

For independent variables (IVs) in the omnibus models we used the following contrast codes as applicable: target race, Black (+0.5), White (-0.5); session, day 1 (-2), day 2 (-1), day 3 (0), day 4 (+1), day 5 (+2); information type, perceptually familiar only (-2/3), positive person-knowledge (+1/3), negative person-knowledge (+1/3); and person-knowledge valence, negative (-0.5), positive (+0.5). See Appendix (A.1.1) for the omnibus models.

One important individual difference that impacts how perceivers process race is interracial contact. In a variety of contexts, greater interracial contact decreases racial bias as measured by either implicit or explicit associations (Kubota et al., 2017; Pettigrew, 1997; Pettigrew & Tropp, 2008). However, there is no research to date directly investigating the relationship between interracial contact and learning rates of valenced person-knowledge about member of different racial groups. Therefore, we present modified analyses that include a main effect of and all possible interactions with lifetime contact for each DV above.

2.1.2.6.4 Random effects determination

In the omnibus and follow-up models to the extent possible, we allowed for between-participants variance in intercepts and slopes for all within-subject factors (i.e., random effects) and the correlations among these random effects. However, sometimes, full models failed to converge or were over-fitted (Bates et al., in preparation: https://arxiv.org/pdf/1506.04967v1.pdf). If the full model failed to converge or was over-fitted, we followed the steps outlined below in the order specified. If the full model converged and was not over-fitted (as determined by the PCA procedure detailed below), then we used the full model for our final model.

In the event of convergence failure and/or an over-fitted full model, we:

1. Increased the max iterations allowed for convergence (up to 100,000)
2. Reset the optimizer used for convergence
3. Removed all correlation parameters from the random effects structure, ran this model, and conduct a PCA on the resulting model to determine how many random effects could be supported by these data, as detailed by Bates and colleagues at https://arxiv.org/pdf/1506.04967v1.pdf.
4. Based on the number of redundant dimensions in these data (determined in the previous step), removed slopes from the random effects structure, starting with random slopes corresponding to higher order interactions. When choosing between random effects for interactions on the same order (e.g., two two-way interactions), removed the random slopes that accounted for the least amount of variance in the model from the previous step.

5. Re-ran the PCA on the reduced model for step 4 to ensure that the model was not over-fitted. If the reduced model remained over-fitted (i.e., contains components that account for exactly zero variance), removed random slopes and repeated the PCA until all components accounted for some non-zero amount of variance.
6. Next, added in all possible correlation parameters, running PCA to avoid overfitting the model.
    a. If adding even one correlation parameter reduced the dimensionality of these data, then did not add any correlation parameters. Use the final model from step 5.
    b. If it was possible to include some but not all correlation parameters without reducing the dimensionality of these data, prioritized conserving the largest correlation parameters. The final resulting model from step 6 with added correlation parameters must have resulted in a significant log-likelihood ratio test when compared to the final reduced model from step 5. Otherwise, we would use the simpler model resulting from step 5.
    c. If the dimensionality of these data was conserved after including all possible correlation parameters and the model with all possible correlation parameters resulted in a significant log-likelihood ratio test when compared with the final reduced model from step 5, then pruned correlation parameters with low values. However, the pruned model must have resulted in a non-significant log-likelihood ratio test compared to the model with all possible correlation parameters (see the start of step 6). If

this was not the case, we did not prune any correlation parameters from the model.

d. If the dimensionality of these data was conserved after including all possible correlation parameters but the model with all possible correlation parameters resulted in a non-significant log-likelihood ratio test when compared with the final reduced model from step 5, then we used the simpler model resulting from step 5.

2.1.3 Results

2.1.3.1 Face Recognition

In this first model, we assessed how well participants identified novel and encoded faces depending on target race (Black, White), session (1, 2, 3, 4, 5), and information type (perceptually familiar, negative person-knowledge, positive person-knowledge). Results revealed significant main effects of target race, b = -0.116, SE = 0.013, $CI_{95\%}$ = [-0.141, -0.090], $t(69)$ = -8.998, p < .001; session, b = 0.062, SE = 0.006, $CI_{95\%}$ = [0.051, 0.072], $t(69)$ = 11.209, p < .001; and information type, b = 0.127, SE = 0.016, $CI_{95\%}$ = [0.095, 0.159], $t(69)$ = 7.793, p < .001; as well as significant interactions of Race x Session, b = 0.022, SE = 0.006, $CI_{95\%}$ = [0.011, 0.033], $t(69)$ = 3.949, p < .001; Race x Information Type, b = 0.041, SE = 0.018, $CI_{95\%}$ = [0.005, 0.077], $t(69)$ = 2.261, p = .027; and Session x Information Type, b = -0.016, SE = 0.005, $CI_{95\%}$ = [-0.026, -0.006], $t(69)$ = -3.185, p = .002. However, all effects were qualified by a 3-way Race x Session x Information Type interaction, b = 0.028, SE = 0.008, $CI_{95\%}$ = [0.012, 0.044], $t(1609)$ = 3.419, p = .001.

We analyzed simple effects for this 3-way interaction. Accuracy for White faces was greater than for Black faces for every information type for every session except faces paired with negative person-knowledge on session 5 (Table A1). Accuracy for perceptually familiar faces was less than both positive and negative person-knowledge but there was no difference between the two person-knowledge conditions regardless of target race (Table A2). Comparing sessions 1 v. 3, 3 v. 5, and 1 v. 5 accuracy for later sessions was greater for all information types within target race except for comparing person-knowledge conditions of sessions 3 and 5 (Table A3). Comparing sessions 1 v. 2 and 2 v. 3, accuracy for later sessions was greater for all information types within target race except for all information type comparisons between session 2 v. 3 for White targets (Table A4). See Figure 5. Overall, participants were more accurate for White Targets and targets associated with person-knowledge regardless of valence.

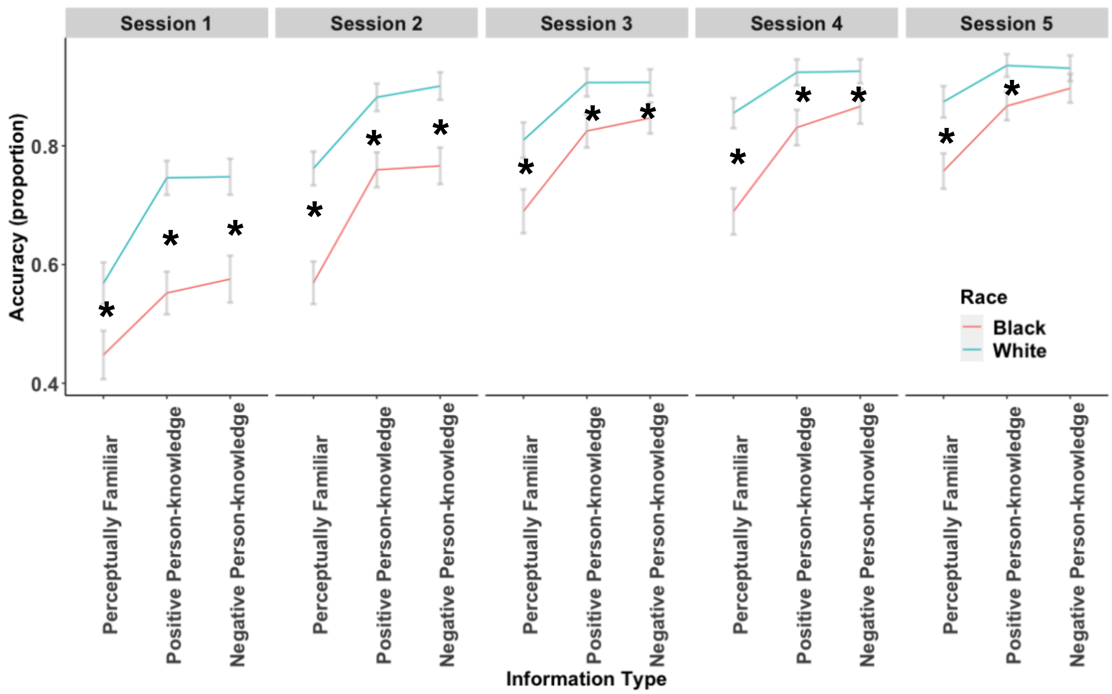


Figure 5: Greater Face Recognition Accuracy for White Targets and Person-knowledge Targets. Standard error bars are displayed.

Lastly, we examined if the magnitude of difference between accuracy for perceived Black and White targets in the same information type differed across session. The magnitude of difference between accuracy for White and Black targets decreased for all information types when comparing session 1 v. 3, session 1 v. 5, and session 2 v. 3. (Table A5).

2.1.3.2 Attribution of Valenced Person-knowledge

In this second model, we measured how well participants identified the type of paired person-knowledge, if any, for faces they correctly indicated were presented as a function of target race (Black, White), session (1, 2, 3, 4, 5), and information type (perceptually familiar, negative person-knowledge, positive person-knowledge). Results revealed significant main effects of target race, *b* = -0.036, SE = 0.008, $CI_{95\%}$ = [-0.052, -0.020], *t*(68) = -4.366, *p* < .001; session, *b* = 0.040, SE = 0.004, $CI_{95\%}$ = [0.032, 0.049], *t*(69) = 9.549, *p* < .001; and information type, *b* = -0.042, SE = 0.018, $CI_{95\%}$ = [-0.078, -0.006], *t*(69) = 2.299, *p* = .025. However, effects were qualified by 2-way interactions of Race x Information Type, *b* = -0.056, SE = 0.020, $CI_{95\%}$ = [-0.096, -0.017], *t*(69) = -2.779, *p* = .007; and Session x Information Type, *b* = -0.020, SE = 0.009, $CI_{95\%}$ = [-0.039, -0.002], *t*(69) = -2.145, *p* = .035.

First, we analyzed simple effects for the Race x Information Type 2-way interaction. Accuracy for White faces was greater than for Black faces for negative person-knowledge pairs (Table A6). Accuracy for perceptually familiar faces was greater compared to both positive and negative person-knowledge, but there was no difference between the two person-knowledge conditions for Black targets (Table A7). Accuracy for faces paired with negative person-knowledge was greater compared to positive person-knowledge, but there was no difference between any other information types for White targets (Table A7). See Figure 6. Overall, participants displayed greater accuracy for White targets associated with negative person-knowledge compared to both Black targets associated with negative person-knowledge and White targets associated with positive person-knowledge.

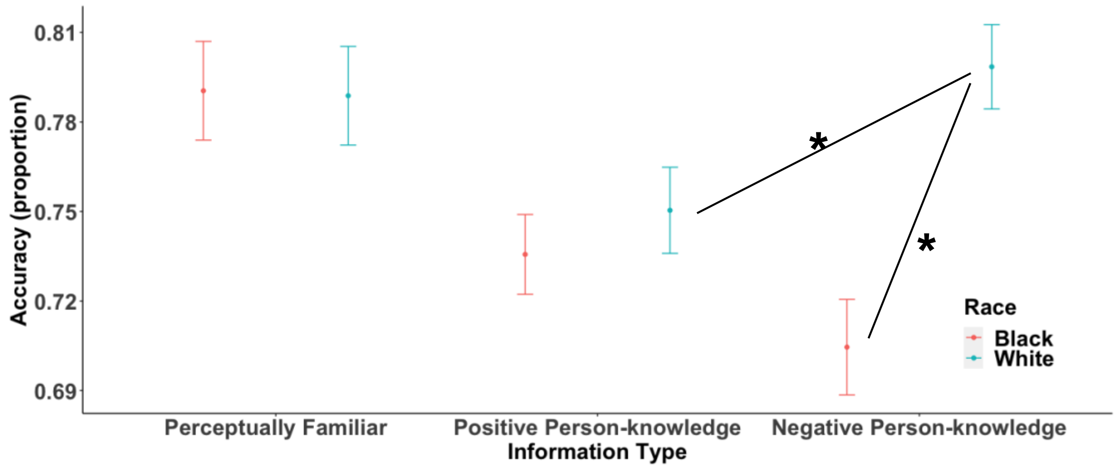


Figure 6: Greater Attribution of Valenced Person-knowledge Accuracy for Counterstereotypic White Targets. Standard error bars are displayed.

Next, we analyzed simple effects for the Session x Information Type 2-way interaction. Accuracy for perceptually familiar faces was greater than accuracy for faces paired with either positive and negative person-knowledge in sessions 3, 4, and 5, but there was no difference between the two person-knowledge conditions (Table A8). Comparing accuracy change across sessions 1 v. 3, 3 v. 5, and 1 v. 5, accuracy for sessions 3 and 5 was always greater than session 1 regardless of race or person-knowledge condition. In addition, there was no difference across sessions 3 and 5 regardless of information type (Table A9). Lastly, comparing sessions 1 v. 2 and 2 v. 3, accuracy for sessions 2 and 3, respectively, was greater for all information types except for faces paired with negative person-knowledge between session 2 v.3 (Table A10). See Figure 7. After 3 sessions there was not a recall advantage for faces paired with person knowledge as predicted, but rather participants were more accurate when identifying faces that were just perceptually familiar.

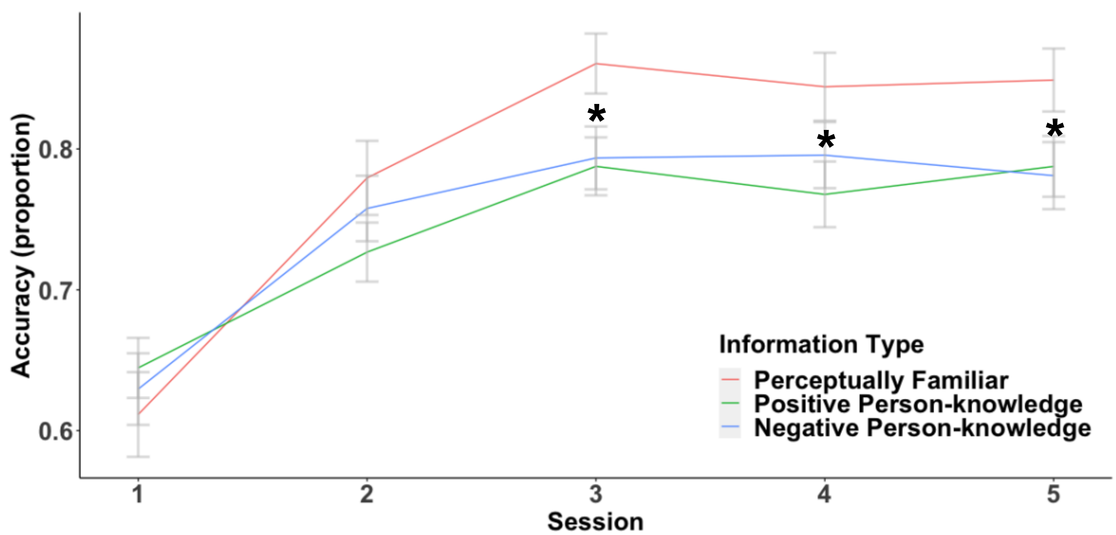


Figure 7: Greatest Attribution of Valenced Person-knowledge Accuracy for Perceptually Familiar Targets After More Learning. Standard error bars are displayed.

2.1.3.3 Cued Recall of Person-knowledge

In this third model, we assessed how well participants recalled the paired person-knowledge statements, for faces they correctly indicated were paired with person-knowledge depending on target race (Black, White), session (1, 2, 3, 4, 5), and person-knowledge valence (negative, positive). Results revealed significant main effects of target race, $b = -0.060$, SE = 0.010, $CI_{95\%} = [-0.079, -0.041]$, $t(69) = -6.165$, $p < .001$, and session, $b = 0.058$, SE = 0.007, $CI_{95\%} = [0.044, 0.073]$, $t(69) = 7.881$, $p < .001$. However, effects were qualified by a 2-way interaction of Race x Session, $b = -0.011$, SE = 0.004, $CI_{95\%} = [-0.018, -0.004]$, $t(71) = -2.953$, $p = .004$.

We analyzed simple effects for this 2-way interaction. Accuracy for recalling the specific statement content paired with White faces was greater than for Black faces for each session (Table A11). Lastly, comparing sessions 1 v. 3, 3 v. 5, and 1 v. 5 within target race, accuracy for later sessions was always greater (Table A12). See Figure 8. Recall for statements increased across sessions but was always better for statements paired with White faces relative to Black faces.

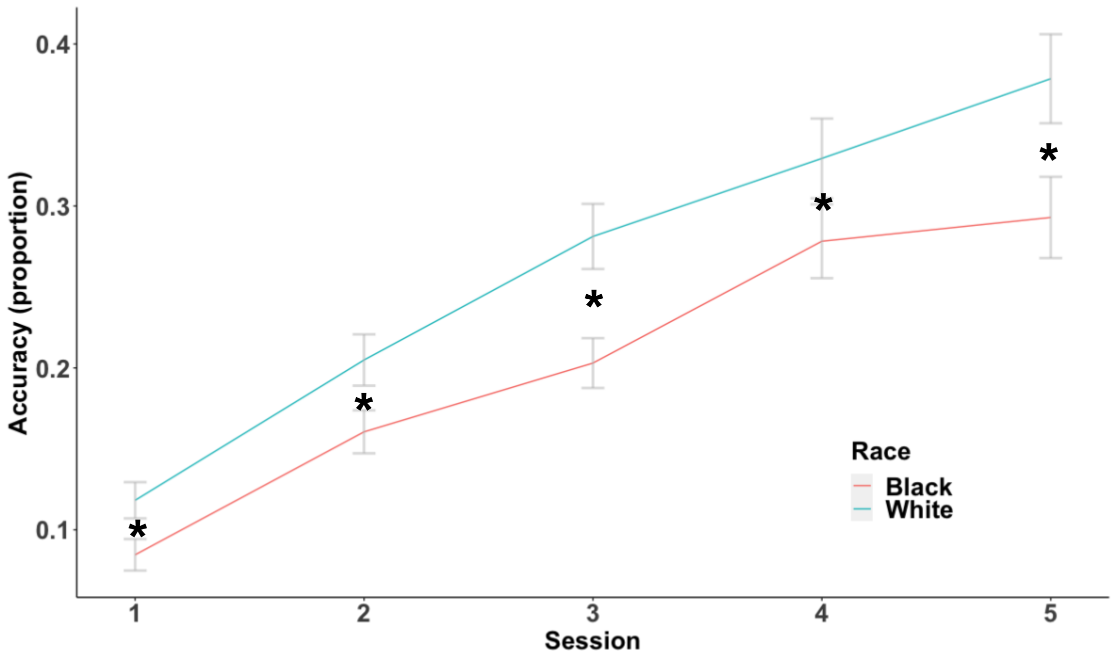


Figure 8: Greater Person-knowledge Recall Accuracy for White vs. Black Targets. Standard error bars are displayed.

2.1.3.4 Impact of Contact on Face Recognition

In this fourth model, we assessed how well participants identified novel and encoded faces depending on target race (Black, White), session (1, 2, 3, 4, 5), information type (perceptually familiar, negative person-knowledge, positive person-knowledge), and z-scored lifetime interracial contact. As in the model without contact, results revealed significant main effects of target race, b = -0.116, SE = 0.013, $CI_{95\%}$ = [-0.140, -0.091], $t(68)$ = -9.138, p < .001; session, b = 0.062, SE = 0.005, $CI_{95\%}$ = [0.051, 0.072], $t(68)$ =

11.246, $p < .001$; and information type, $b = 0.127$, SE = 0.016, $CI_{95\%}$ = [0.096, 0.158], $t(68) = 8.073$, $p < .001$; as well as significant interactions of Race x Session, $b = 0.022$, SE = 0.006, $CI_{95\%}$ = [0.011, 0.033], $t(68) = 4.018$, $p < .001$; Race x Information Type, b = 0.041, SE = 0.018, $CI_{95\%}$ = [0.006, 0.077], $t(68) = 2.265$, $p = .027$; and Session x Information Type, $b = -0.016$, SE = 0.005, $CI_{95\%}$ = [-0.026, -0.006], $t(68) = -3.208$, p = .002. However, all effects were qualified by a 3-way Race x Session x Information Type interaction, $b = 0.028$, SE = 0.008, $CI_{95\%}$ = [0.012, 0.044], $t(1608) = 3.419$, $p = .001$. Therefore, see Appendix (A.1.5) for a decomposition of the 3-way interaction that did not include contact. There was also an Information Type x Contact interaction, $b = -0.039$, SE = 0.016, $CI_{95\%}$ = [-0.070, -0.008], $t(68) = -2.459$, $p = .016$.

We analyzed simple effects for the 2-way interaction between information type and contact. There was greater accuracy for faces paired with both positive person-knowledge and negative person-knowledge compared to just perceptually familiar faces for those with low and average contact only (Table A18). See Figure 9. There was a recognition advantage for faces paired with person knowledge as predicted, but only for participants with lower contact. Participants with high contact were similarly accurate for all three information types (Table A19).

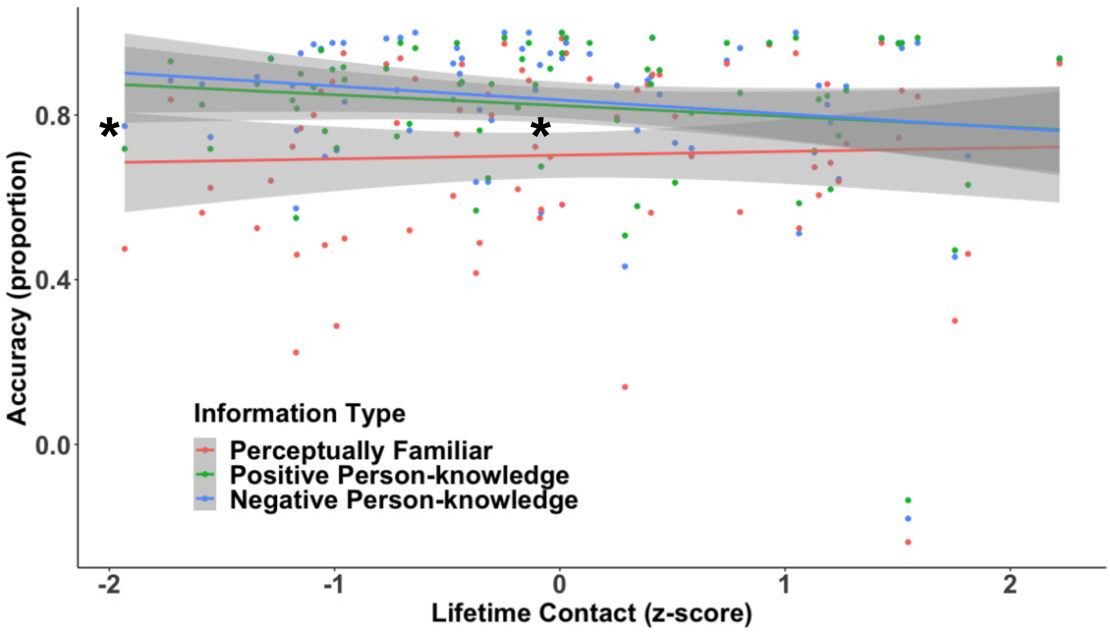


Figure 9: Lower Contact Participants were Less Accurate at Face Recognition for Perceptually Familiar Faces. This displays each individual participant's mean accuracy by information type plotted by their interracial contact score fitted with a best fit line. Standard errors are displayed.

2.1.3.5 Impact of Contact on Attribution of Valenced Person-knowledge

In this fifth model, we assessed how well participants identified the type of paired person-knowledge, if any, for faces they correctly indicated were encoded depending on target race (Black, White), session (1, 2, 3, 4, 5), information type (perceptually familiar, negative person-knowledge, positive person-knowledge), and z-scored lifetime interracial contact. As in the model without contact, results revealed significant main effects of target race, $b = -0.036$, SE = 0.008, $CI_{95\%} = [-0.052, -0.020]$, $t(67) = -4.363$, $p < .001$; session, $b = 0.040$, SE = 0.004, $CI_{95\%} = [0.032, 0.048]$, $t(68) = 9.533$, $p < .001$; and information type, $b = -0.042$, SE = 0.018, $CI_{95\%} = [-0.078, -0.006]$, $t(68) = -2.29$, $p =$ .025. Effects were similarly qualified by 2-way interactions of Race x Information Type, *b* = -0.057, SE = 0.017, $CI_{95\%}$ = [-0.089, -0.024], *t*(1808) = -3.417, *p* =.001; and Session x Information Type, *b* = -0.02, SE = 0.006, $CI_{95\%}$ = [-0.031, -0.008], *t*(1808) = -3.391, *p* =.001. There were no main effects or interactions involving contact. Attribution of valenced person-knowledge accuracy effects were unchanged when contact was included. Therefore, see Appendix (A.1.6) for a decomposition of the two 2-way interactions that did not include contact.

2.1.3.6 Impact of Contact on Cued Recall of Person-knowledge

In this sixth model, we assessed how well participants recalled the paired person-knowledge statements, for faces they correctly indicated were paired with person-knowledge depending on target race (Black, White), session (1, 2, 3, 4, 5), person-knowledge valence (negative, positive), and z-scored lifetime interracial contact. As in the model without contact, results revealed significant main effects of target race, *b* = -0.059, SE = 0.01, $CI_{95\%}$ = [-0.078, -0.040], *t*(68) = -6.041, *p* < .001, and session, *b* = 0.058, SE = 0.007, $CI_{95\%}$ = [0.043, 0.073], *t*(68) = 7.780, *p* < .001. There was also a 2-way interaction of Race x Session, *b* = -0.011, SE = 0.003, $CI_{95\%}$ = [-0.017, -0.004], *t*(1079) = -3.107, *p* = .002. However, results were qualified by 3-way interactions of Race x Session x Contact, *b* = 0.01, SE = 0.003, $CI_{95\%}$ = [0.003, 0.016], *t*(1078) = 2.843, *p* = .005; and Race x Valence x Contact, *b* = -0.033, SE = 0.01, $CI_{95\%}$ = [-0.052, -0.014], *t*(1077) = -3.420, *p* = .001.

We first analyzed simple effects for the 3-way interaction of Race x Session x Contact. Accuracy for White faces was greater than for Black faces for every session and contact level except low contact at session 1 and high contact at session 5 (Table A25). Participants with low contact become more divergent in their accuracy by session 5, while participants with high contact converge in their accuracy by session 5. Lastly, comparing accuracy across sessions 1 v. 3, 3 v. 5, and 1 v. 5 within target race and contact level, accuracy for later sessions was always greater except for low contact participants recalling statements during session 3 versus session 5 regardless of target race (Table A26). See Figure 10. Overall, lower contact participants diverged in their accuracy depending on target race as sessions increased and displayed greater accuracy for White compared to Black targets while high contact participants converged.

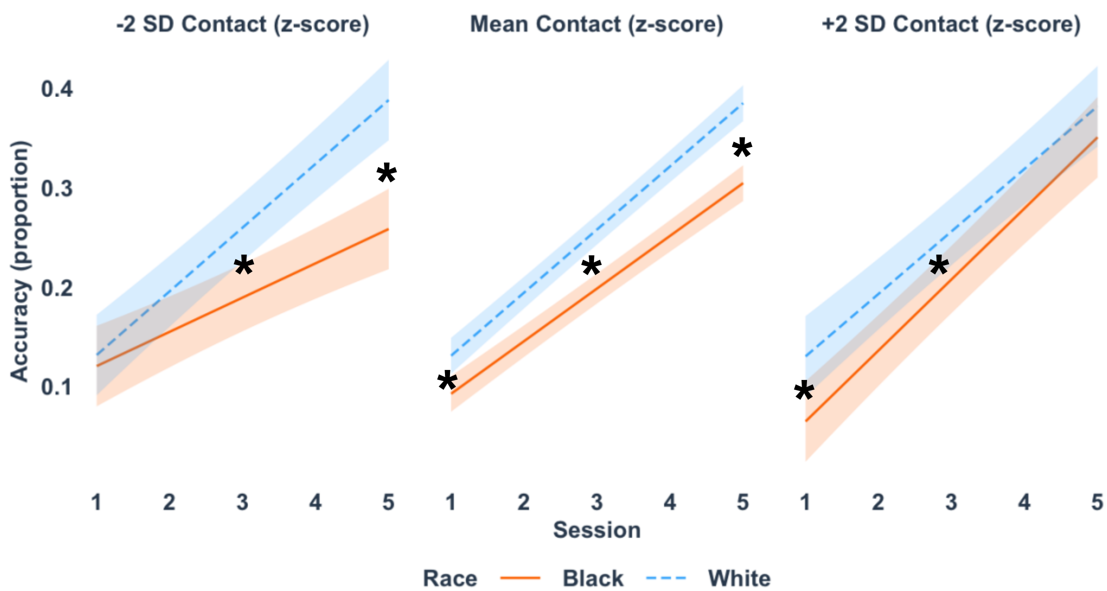
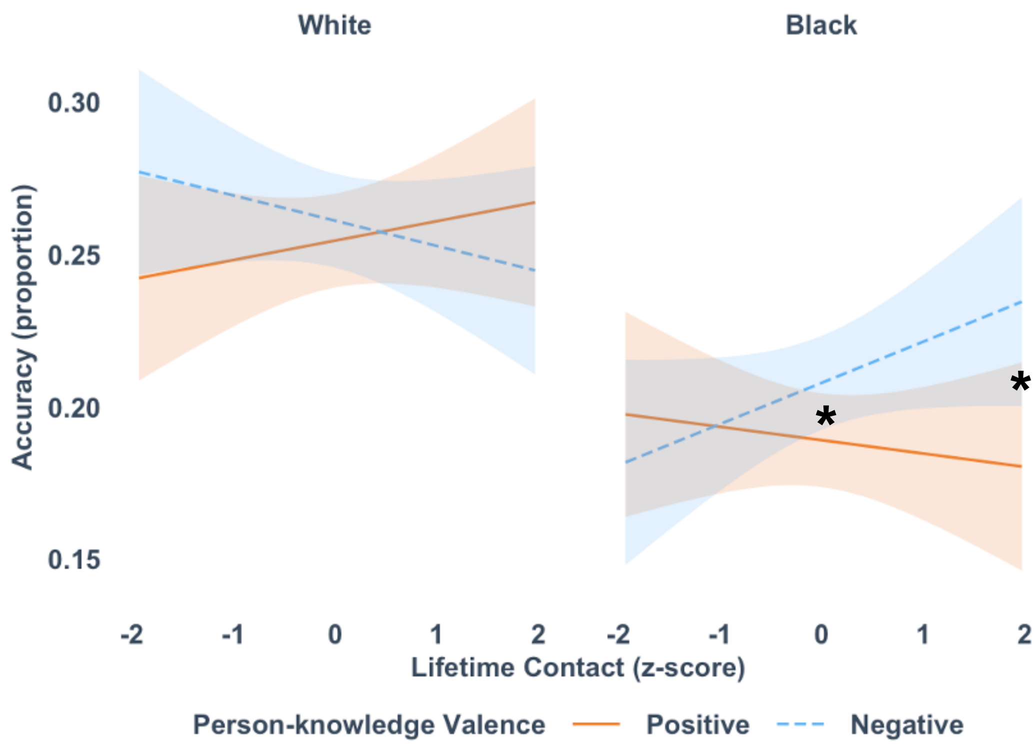


Figure 10: Lower Contact Participants Display a Person-knowledge Recall Advantage for White Targets as Learning Increase. Standard error bars are displayed.

We next analyzed simple effects for the 3-way interaction of Race x Valence x Contact. Accuracy for Black faces paired with negative person-knowledge was greater than for Black faces paired with positive person-knowledge only for those with average and high interracial contact (Table A27). There were no differences depending on valence and interracial contact for White faces (Table A27) and the slopes for interracial contact were not significant (Table A28). Lastly, accuracy for White faces compared to Black faces was greater for participants with lower contact only when paired with negative person-knowledge, for participants with average contact regardless of person-knowledge valence, and for participants with high contact only when paired with positive person-knowledge (Table A29). See Figure 11. Overall, higher contact participants displayed greater recall for Black targets paired with negative person-knowledge.


White
Black
Accuracy (proportion)
0.30
0.25
0.20
0.15
-2
-1
0
1
2
Lifetime Contact (z-score)
Person-knowledge Valence
Positive
Negative
*

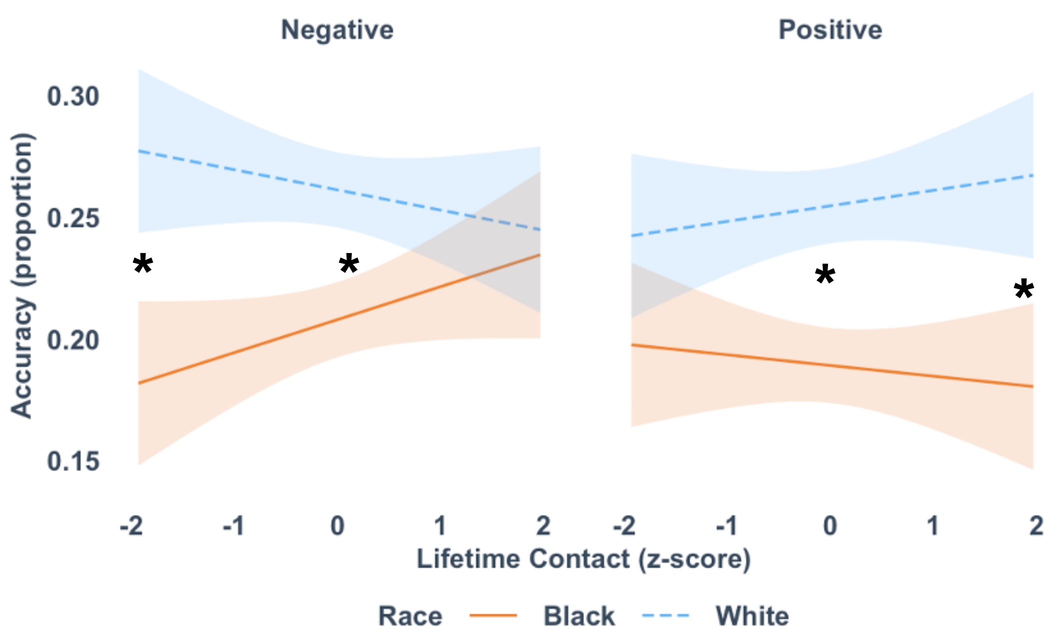

Negative
Positive
Accuracy (proportion)
0.30
0.25
0.20
0.15
-2
-1
0
1
2
Lifetime Contact (z-score)
Race
Black
White
*

Figure 11: Average and High Contact Participants Displayed Greater Recall for Negative Person-knowledge Paired with Black Targets (top panel) and for Positive Person-knowledge Paired with White Targets (bottom panel). Low and Average Contact Participants Displayed Greater Recall for Negative Person-knowledge Paired with White Targets (bottom panel). Standard errors are displayed.

2.1.4 Study 1a Discussion

When examining face recognition accuracy, our White participants displayed an other race effect, where they had better face recognition for their racial ingroup (White) faces v. Black faces when comparing within session and information type except for faces paired with negative person-knowledge on session 5. This indicates that as participants gained more exposure to the faces paired with person-knowledge, the difference between recognition accuracy for White and Black faces decreased. Additionally, participants were able to better recognize the faces that were paired with person-knowledge regardless of valence compared with faces that were just perceptually familiar. When we include the individual difference of interracial contact participants with lower contact displayed greater accuracy for targets paired with person-knowledge regardless of valence compared to targets that were just perceptually familiar. However, participants with higher contact displayed no differences in accuracy regardless of information type. This finding aligns with other research in our lab indicating that greater interracial contact increases face processing efficiency and decreases salience regardless of target race (Handley et al., 2022). These results may similarly indicate an efficiency in processing faces regardless of the availability of person-knowledge for individuals with more interracial contact.

When examining attribution of valenced person-knowledge accuracy, results indicate that participants quickly became more accurate during the first three sessions, but this leveled out during the fourth and fifth days. Furthermore, participants were more accurate at recognizing that faces were just perceptually familiar than when attributing valence to paired person-knowledge statements. We also observed that our White participants encoded information about their ingroup more deeply when there was a violation of expectation, when a White face was paired with negative information, because negative person knowledge is counterstereotypic to affective stereotypes of White people in the U.S. According to social identity theory (Tajfel & Turner, 1979, 2004), our participants may be more sensitive to negative information regarding the ingroup because ingroup members paired with negative information may be ideologically threatening. We did not observe any effect of interracial contact on accuracy of valence of the information accuracy.

When examining cued recall of person-knowledge accuracy, there was a steady increase in accuracy over the five sessions, but participants were always more accurate for White compared to Black targets. Again, this supports an other race effect. When we include interracial contact, results revealed greater accuracy for White compared to Black targets regardless of contact and session, except for low contact individuals during the first session and high contact during the last session. Accuracy between White and Black targets diverged for participants with low contact but converged for those with high contact. Results also revealed that average and high contact participants displayed greater recall for Black targets paired with negative person-knowledge and for White targets paired with positive person-knowledge. These higher contact participants had greater recall for statements consistent with affective stereotypes of White and Black people in the U.S. However, low and average contact participants displayed greater recall for White targets paired with negative person-knowledge. These lower contact participants had greater recall for statements counterstereotypic to affective stereotypes of White people in the U.S. These findings from lower contact participants converge with the previously reported attribution of valenced person-knowledge accuracy showing that White participants had greater accuracy when a White face were paired with negative information. These findings also converge with previous findings suggesting that high-prejudice individuals tend to remember more stereotype-incongruent statements compared to low-prejudice individuals, suggesting that prejudice may be related to biased processing of either consistent or inconsistent information (Sherman et al., 2005). Taken together, these findings suggest that low contact White participants may encode information about their ingroup more deeply expectations are violated.

In all, and in line with our predictions, participants demonstrated a robust other race effect as they were more accurate when recognizing, identifying, and recalling statements about White compared to Black targets despite days of learning individuating information.

Because of the diagnosticity of negative person-knowledge, we predicted a bias towards target paired with negative information. Participants were expected to be more accurate for faces paired with negative person-knowledge. However, we observed no difference between valence, but rather a difference between the presence and absence of person-knowledge. For example, when asked if they just recognized the face as familiar without needing to distinguish the valence of paired person-knowledge, if any, participants were more accurate for faces paired with person-knowledge compared to faces that were just perceptually familiar but there was no accuracy difference depending on person-knowledge valence. These findings are consistent with previous research and theoretical framework suggesting that knowledge-based individuation leads to greater person memory (Fiske & Neuberg, 1990; Macrae et al., 1999; Mattarozzi et al., 2019). Contrastingly, when asked to attribute information type previously paired with faces, participants were more accurate for faces that were just perceptually familiar compared to faces that were paired with person-knowledge. There was again no accuracy difference depending on person-knowledge valence. However, for cued recall of person-knowledge statements we did observe greater accuracy for Black targets paired with negative person-knowledge compared to positive person-knowledge, but only for high contact participants. Overall, attribution of person-knowledge results suggest that the difficulty of accurately attributing the correct valence of person-knowledge, beyond just recognizing the face as familiar, favored the correct attribution of absence of person-knowledge for the perceptually familiar faces. Furthermore, an expected negativity bias for the recall of person-knowledge was only found for Black faces among high contact participants.

Although we predicted greater accuracy for affectively incongruent person-knowledge, we only observed this effect when participants attributed negative person-knowledge to White faces. This may be because perceivers paid particular attention to ingroup members who negatively violated social expectations (Macrae et al., 1999).

However, the fact that a similar effect was not obtained when perceivers attempted to recall person-knowledge about ingroup faces, but rather instead remembered more person-knowledge for White compared to Black faces regardless of valence, suggests that the violations of expectations may have a greater impact on encoding of the valence of the paired information rather than its content.

2.2 Study 1b: Evaluative Priming Task

The use of implicit measures is important for understanding race-based prejudice because these measures may reflect the activation of valence associations that people otherwise may not explicitly divulge. In the U.S., race-based valence associations are well-known and influence impressions even when we do not explicitly endorse them (Devine & Elliot, 1995; Fazio et al., 1995; Greenwald et al., 1998; Olson & Fazio, 2004). For example, particularly for racially ambiguous faces, low-status clothing (e.g., janitor's uniform) increases the likelihood of categorizing someone as Black, while high-status clothing (e.g., suit) increases the likelihood of categorizing someone as White (Freeman et al., 2011). In addition, researcher have found briefly pairing Black faces with positive information and White faces with negative information resulted in less implicit negativity in response to Black targets (Olson & Fazio, 2006). Therefore, our impressions of others are influenced by race-based evaluative associations that can be modulated by individuating information.

Therefore, this study examines implicit evaluations of Black and White targets before and after extensive training to increase perceptual and personal familiarity with the faces. Does experimentally manipulated perceptual familiarity or valenced person-knowledge interact with race to modulate implicit evaluative racial bias? To assess this, participants completed an EPT before learning associations between person-knowledge and the faces varying in race (pre-learning) then again on after learning (post-learning) to examine the influence of trained familiarity and valence on evaluative priming.

2.2.1 Predictions

We predicted that individuating faces across days will lead to differences in evaluative priming pre-learning versus post-learning consistent with a decrease in negative biases towards Black individuals and a decrease in positive biases towards White individuals. Before the series of learned memory tasks (pre-learning), we expected typical biases consistent with greater accuracy and faster response times for evaluatively congruent pairs (i.e., White-positive and Black-negative). However, after learning pairs of valenced person-knowledge and Black and White faces (post-learning), we expected a removal of the initial negative bias for Black faces paired with positive person-knowledge and an increase in negative bias for Black faces paired with negative information. We additionally expected a removal of the initial positive bias for White (ingroup) faces, but an increase in positive bias for White faces paired with positive information.

2.2.2 Methods

2.2.2.1 Participants

The same participants from study 1a participated in study 1b. However, due to exclusion criteria, a total of 65 participants were included in the EPT analyses. Two participants were excluded from theses analyses due to their mean accuracy being 3.5 SD below the group mean accuracy and 3 participants were excluded due to their average reaction time being 3.5 SD away from the group mean reaction time.

2.2.2.2 Face Stimuli

We used a subset of the same faces seen in the training phases in study 1a. We randomly selected 5 of 8 faces from each condition (i.e., perceptually familiar, negative person-knowledge, positive person-knowledge) by race (Black, White), for a total of 30 faces. These faces were used for the EPT during the pre-learning and post-learning sessions. For the pre-learning novel faces, we additionally randomly selected 5 Black and 5 White faces from the same conditions, for a total of 3 faces from each condition. For example, we selected 2 Black faces and 1 White face from the positive person-knowledge condition, 2 Black faces and 1 White face from the negative person-knowledge condition, and 1 Black face and 2 White faces from the perceptual familiarity condition. For the post-learning novel faces, we randomly selected 5 Black and 5 White faces from the set of equated faces that was not used in the learning task (study 1a) for that participant.

2.2.2.3 Procedure

During the first and last sessions (pre-learning and post-learning, respectively), participants completed an EPT (Fazio et al., 1995; Gawronski et al., 2010) using faces repeated in the series of learned memory tasks and novel faces. Participants were first familiarized with the priming task by categorizing ten valenced words (i.e., PARADISE, POISON) as positive or negative using the “m” and “n” keys. We counterbalanced the key-mapping for categorizations. There was only one correct response per word. For the actual EPT, participants were taught to continue to categorize valenced words, one at a time, but now a face from one of the equated face groups preceded each word. The first eight trials of the evaluative priming task was practice trials using practice faces that were not seen elsewhere. The target stimuli used for practice and task familiarizing were different from those utilized in the experimental task.

The remaining 240 experimental trials followed seamlessly from the practice trials. Each possible type of trial (i.e., 16 possible combinations: Race (Black, White) x Person-knowledge (positive, negative, perceptually familiar, novel) x Word (positive, negative)) were repeated 15 times. Each face prime was shown six times throughout the task. The trials were randomly presented without replacement according to the trial type—they only repeated once so that all 40 distinct face primes appeared once. Each face prime was presented for 300 ms, and then replaced by a target word for 1500 ms or until response. Failures to respond after 1500 ms resulted in termination of the trial and a recorded incorrect response. Before each new trial, there was a pretrial pause of 150 ms, followed by a fixation for 500 ms.

2.2.2.4 Individual Difference Measures

The individual difference measures were the same as in study 1a.

2.2.2.5 Data Exclusion

Only participants who fully completed the study and received compensation were included in analyses. If a participant had complete evaluative priming task data for both pre-learning and post-learning sessions, we included their data in the EPT analyses given that they had complete and usable encoding and test data from the main series of learned memory tasks. If they were missing data from the individual difference measures or the face recognition task, we still used their data in EPT analyses. We excluded participants from analysis upon finding evidence that they did not attempt to complete the task correctly (e.g., response accuracy rates statistically indistinguishable from chance), or did not follow directions (e.g., responded the same values for the duration of the survey). We then excluded participants whose mean accuracy was beyond 3.5 standard deviations from the mean group accuracy. We excluded participant-specific trials that deviated more than 3.5 standard deviations from the participant's mean latency. Finally, we excluded any participants whose average latency was beyond 3.5 standard deviations from the group mean latency. We implemented data exclusion in the following order: 1) Deleted people who did not finish the study. 2) Deleted people with incomplete data sets. 3) Deleted data from participants whose response accuracy was statistically indistinguishable from chance (or lower than chance). 4) Deleted people with mean accuracy below 3.5 standard deviations from the mean group accuracy. 5) Excluded participant-specific trials that deviated more than 3.5 standard deviations from the mean latency of the participant. 6) Excluded participant-specific trials that were shorter than 75 milliseconds. 7) Excluded any participants whose average RT was beyond 3.5 standard deviations from the group mean RT.

2.2.2.6 Data Analysis

We used within-participants linear mixed effects regression models to analyze all data. We used the lme4 (Bates et al., 2015) and lmerTest (Kuznetsova et al., 2017) packages in R (R Core Team, 2018). If an omnibus test indicated a significant interaction, we decomposed the interaction by calculating simple differences and slopes. Any significant interactions were followed up with models using dummy or contrast coding of relevant factors. These follow-up models were used to decompose and ultimately plot the significant interactions from the main confirmatory analysis.

For independent variables (IVs) in the omnibus models were used with the following contrast codes as applicable: target race, Black (+0.5), White (-0.5); information type, novel (-3/4), perceptually familiar only (+1/4), positive person-knowledge (+1/4), negative person-knowledge (+1/4); and word valence, negative (-0.5), positive (+0.5). See Appendix (A.2.1) for the omnibus models.

In the omnibus model for session 1, latency data was analyzed using a 2 (Prime Face Race: Black, White) × 2 (Word Valence: positive, negative) linear mixed effects model, with prime race and word valence varying within subjects. In the omnibus model for session 5, latency data was analyzed using a 2 (Prime Face Race: Black, White) × 2 (Familiarity: novel, familiar) × 2 (Word Valence: positive, negative) linear mixed effects model, with information type and word valence varying within subjects. Response time data were log-transformed to minimize positive skew of RT data prior to analysis.

As in study 1a, we present modified analyses that include a main effect of and all possible interactions with lifetime contact for each DV above. For all omnibus models that indicated a significant interaction, we decomposed the interaction by calculating simple differences and slopes using dummy or contrast coding of relevant factors. In these follow-up models, we modeled random slopes as much as possible following the procedures outlined in the models for main task learning faces.

2.2.2.6.1 Random effects determination

The random effects determination was the same as study 1a.

2.2.3 Results

2.2.3.1 Pre-learning Session

We analyzed evaluative priming logged reaction time depending on prime face race (Black, White) and word valence (negative, positive) during the pre-learning session. Results revealed a significant main effect of word valence, b = -0.008, SE = 0.002, $CI_{95\%}$ = [-0.013, -0.003], $t(64)$ = -3.415, p = .001. Participants were faster to classify positive compared to negative words regardless of prime face race.

2.2.3.2 Post-learning Session

We analyzed evaluative priming logged reaction time depending on prime face race (Black, White), prime face information type (novel, perceptually familiar, paired with negative person-knowledge, paired with positive person-knowledge), and word valence (negative, positive) during the post-learning session. Results revealed a significant main effect of prime face information type, *b* = -0.005, SE = 0.002, $CI_{95\%}$ = [-0.008, -0.001], $t(65) = -2.412$, $p = .019$. However, this effect was qualified by a 2-way interaction of Prime Face Information Type x Valence, *b* = -0.012, SE = 0.003, $CI_{95\%}$ = [-0.019, -0.005], $t(14100) = -3.409$, $p < .001$.

We analyzed simple effects for this 2-way interaction. While there were no differences by prime face information type when classifying negative words, when classifying positive words participants were slower when primed with a novel face than all other information types (Table A30). Lastly, comparing classification of positive and negative words by face prime information type there was only a difference when primed with positive person-knowledge faces where positive faces words were classified faster than negative words (Table A31). See Figure 12. Participants were slower when there was a valence mismatch between the prime word and positive person-knowledge targets.

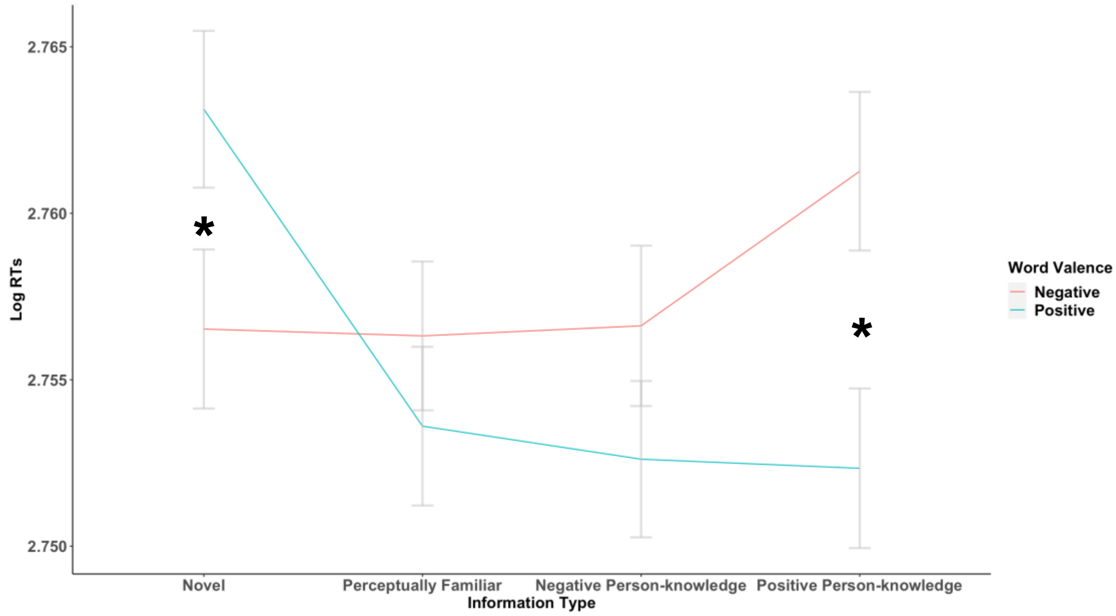


Figure 12: Slower Classification of Negative Words when Primed with a Positive Person-knowledge Target. Standard error bars are displayed.

2.2.3.3 Influence of Contact on Pre-learning Session

In this third model, we analyzed evaluative priming reaction time depending on prime face race (Black, White), word valence (negative, positive), and z-scored lifetime interracial contact at the pre-learning session before extensive learning. As in the model without contact, results revealed a significant main effect of word valence, b = -0.008, SE = 0.002, $CI_{95\%}$ = [-0.013, -0.003], t(63) = -3.441, p = .001. Participants were faster to classify positive compared to negative words regardless of prime face race. Results also revealed a 2-way interaction of Race x Contact, b = -0.004, SE = 0.002, $CI_{95\%}$ = [-0.007, 0.000], t(14150) = -2.099, p = .036.

We analyzed simple effects for this 2-way interaction. While there were no differences in logged reaction time by race for participants with average or high contact, participants with low contact were slower after being primed with a White compared to Black face (Table A32, Figure 13).

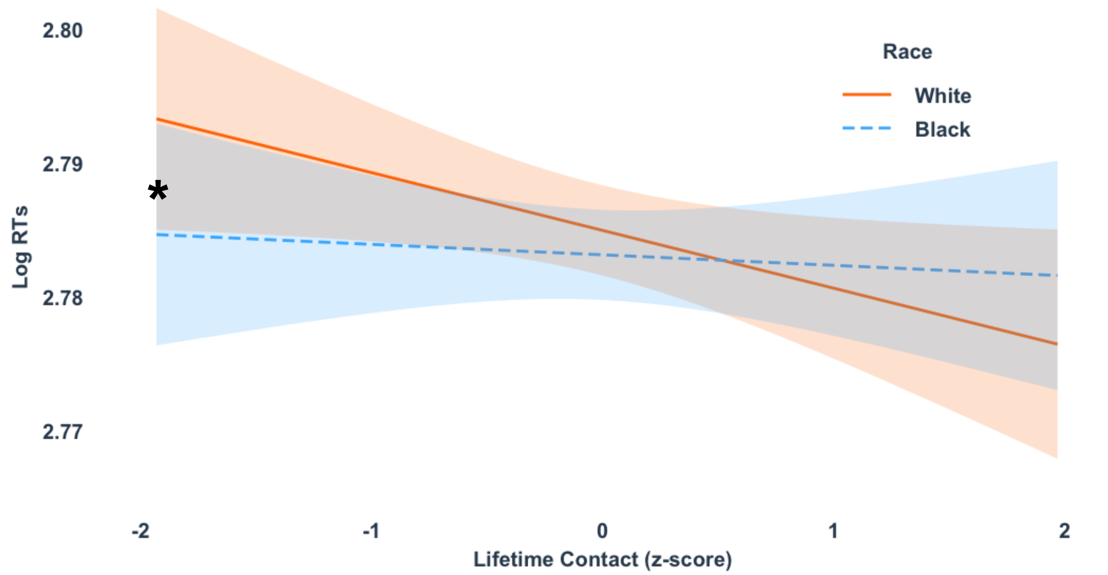


Figure 13: Low Contact Participants were Slower After Primed with a White Face During the Pre-learning Session. Standard errors are displayed.

2.2.3.4 Influence of Contact on Post-learning Session

In this fourth model, we analyzed evaluative priming logged reaction time depending on prime face race (Black, White), prime face information type (novel, perceptually familiar, paired with negative person-knowledge, paired with positive person-knowledge), word valence (negative, positive), and z-scored lifetime interracial contact during the post-learning session after extensive training. As in the model without contact, results revealed a significant main effect of prime face information type, *b* = -0.005, SE = 0.002, $CI_{95\%}$ = [-0.008, -0.001], *t*(64) = -2.398, *p* = .019. Similarly, this effect was qualified by a 2-way interactions of Prime Face Information Type x Valence, *b* = -0.012, SE = 0.003, $CI_{95\%}$ = [-0.019, -0.005], *t*(14090) = -3.401, *p* < .001. Evaluative priming reaction time effects were unchanged when contact was included. Therefore, see

Appendix (A.2.4) for a decomposition of the 2-way interaction that did not include contact.

2.2.4 Study 1b Discussion

We predicted that at in the pre-learning session before the series of learned memory tasks (study 1a), participants would have greater accuracy and faster response times for evaluatively congruent pairs (i.e., White prime-positive word and Black prime-negative word). The results from the pre-learning session revealed only a main effect of word valence, such that participants were faster to classify positive compared to negative words. When we include interracial contact, participants with low contact were faster to categorize the valence of the words after being primed by a Black face compared to a White face. In contrast to our predictions, we did not observe an interaction between prime race and word valence. When all prime faces were novel, there was not facilitation nor inhibition due to the congruence between prime face race and word valence.

We predicted that during the post-learning session after the series of learned memory tasks, the culturally learned race-based biases would disappear and performance would be influenced instead by the valence of the learned person-knowledge. In models including and not including interracial contact, the results from the post-learning session revealed an interaction between prime face information type and word valence, such that participants were slower to classify positive words when primed with novel faces compared to all other information types and faster to classify positive words compared to negative words when primed by a face associated with positive person-knowledge. There was only facilitation when classifying positive words after being primed with a face associated with positive person-knowledge. This partially supported our hypothesis as we observed facilitation for positive word classification after positive person-knowledge prime but did not observe faster reaction times when classifying negative words after being primed with a face associated with negative person-knowledge. The absence of race-based affective priming previously found in the literature (Fazio et al., 1995; Mattan, Kubota, Li, Venezia, & Cloutier, 2019) (Cites) may be a result of the current study being underpowered to detect these effect in a design with eight experimental conditions.

2.3 Study 1c: Independent Face Recognition Task

One explanation for the other race effect is that we have less experience with encoding faces of other races. Therefore, deficits in individuating other race faces are due to a lack of expertise. In this study, we examined how training to individuate other faces generalizes to face recognition of different faces. Participants completed a face recognition task during session 1 before learning associations between person-knowledge and the faces varying in race (pre-learning) then again on session 5 after learning (post-learning).

2.3.1 Predictions

We predicted that participants who had better learning rates for Black faces in the series of learned memory tasks would have a reduction in the other race effect from pre-learning to post-learning. In other words, as participants' learning rates of Black targets in the series of main learned memory tasks increased, the other race effect would attenuate.

2.3.2 Methods

2.3.2.1 Participants

The same participants from study 1a participated in study 1c. No participants were excluded and a total of 70 participants were included in the generalization of face recognition analyses.

2.3.2.2 Face stimuli

We used face stimuli not used in any other part of the series of studies. We selected 76 Black and 76 White faces from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015). The faces in each race group were then randomly divided into four categories each with 19 Black and 19 White faces: encoding faces for the pre-learning session, distractor faces for the pre-learning session test, encoding faces for the post-learning session, and distractor faces for the post-learning session 5. The stimuli display directed eye gaze. Stimuli were cropped around the hair and from the neck up, placed on white backgrounds, and greyscaled using Adobe Photoshop or Gimp. Images were processed using the SHINE toolbox (Willenbockel et al., 2010) to remove low-level visual variation.

2.3.2.3 Procedure

On the first and last day, participants completed an independent face recognition task designed to measure the other race effect using novel faces that were not included elsewhere in the study, including in the series of learned memory tasks encoding and test phases. In the independent face recognition task, participants were instructed to remember a series of faces for later recognition (Young & Hugenberg, 2012). Participants were shown the novel, unequated groups of 38 faces (19 White, 19 Black). In this independent face recognition task, they were first randomly presented with each of the 38 faces for 2s each with an ITI of 250 ms. Then in the second part of the face recognition task, they were randomly presented with 76 faces. These 76 faces consisted of 38 faces previously seen in the first part of the face recognition task and 38 novel faces (19 White, 19 Black). Participants were instructed to distinguish between faces seen during the first part and novel faces by pressing the “m” and “n” keys. They were assigned to 1 of 2 counterbalanced key orderings. Each face was held on the screen until the participant responded, followed by an ITI of 250 ms, then the participant moves to the next face recognition trial.

2.3.2.4 Data Exclusion

Only participants who fully completed the entire study and received compensation were included in analyses. If they are missing data from other tasks, we still used their data in FR analyses. We immediately excluded participants from analysis upon finding evidence that they did not complete the task correctly (e.g., response accuracy rates statistically indistinguishable from chance), or did not follow directions (e.g., responded the same values for the duration of the survey). We excluded participant-specific trials that deviated more than 3.5 standard deviations from the participant's mean latency. Finally, we excluded participants whose average latency was beyond 3.5 standard deviations from the group mean latency. We implemented data exclusion in the following order: 1) Deleted people with incomplete data sets. 2) Deleted data from participants whose response accuracy was statistically indistinguishable from chance (or lower than chance). 3) Excluded participant-specific trials that deviated more than 3.5 standard deviations from the mean latency of the participant. 4) Excluded participant-specific trials that were shorter than 75 milliseconds. 5) Excluded any participants whose average RT was beyond 3.5 standard deviations from the group mean RT.

2.3.2.5 Data Analysis

We used within-participants linear mixed effects regression models to analyze all data. We used the lme4 (Bates et al., 2015) and lmerTest (Kuznetsova et al., 2017) packages in R (R Core Team, 2018). If an omnibus test indicated a significant interaction, we decomposed the interaction by calculating simple differences and slopes. Any significant interactions were followed up with models using dummy or contrast coding of relevant factors. These follow-up models were used to decompose and ultimately plot the significant interactions from the main confirmatory analysis.

For independent variables (IVs) in the omnibus models we used the following contrast codes: target race, Black (+0.5), White (-0.5); familiarity, novel (-0.5), familiar

(+0.5); and session, pre-learning (-0.5), post-learning (+0.5). To address our main hypothesis, we calculated a model identical to the omnibus learning rates models (study 1a) for each of the 3 DVs except dummy coded the race factor with Black = 0 and White = +1. From these models, we extracted each participants' session beta as their learning rate of Black targets for each of the three DVs in the series of learned memory tasks (i.e., face recognition, attribution of valenced person-knowledge, and cued recall of person-knowledge). We also averaged across all three session betas from the three DVs for each participant to obtain an average learning rate of Black targets. See Appendix A.3.1 for the omnibus models.

Because all omnibus models indicated significant interactions, we decomposed the interactions by calculating simple differences and slopes using dummy or contrast coding of relevant factors. In these follow-up models, we modeled random slopes as much as possible following the procedures outlined in the models for main task learning faces.

2.3.3 Results

2.3.3.1 Independent Face Recognition Accuracy as a Function of Face Recognition Learning Rate

We analyzed accuracy in recognizing faces that they did not extensively learn about to see if the training generalized to better memory for other faces depending on target face race (Black, White), session (pre-learning, post-learning), target face familiarity (novel, familiar), and their face recognition learning rate of Black targets in the series of learned memory tasks. Results revealed significant main effects of race, *b* = -0.041, SE = 0.009, $CI_{95\%}$ = [-0.058, -0.023], t(68) = -4.526, *p* < .001; session, *b* = -0.043, SE = 0.017, $CI_{95\%}$ = [-0.077, -0.01], t(68) = -2.532, *p* = 0.014; and familiarity, *b* = -0.067, SE = 0.02, $CI_{95\%}$ = [-0.105, -0.028], t(68) = -3.372, *p* =.001. Results also revealed a 2-way interaction of Session x Familiarity, *b* = -0.06, SE = 0.03, $CI_{95\%}$ = [-0.118, -0.002], *t*(68) = -2.017, *p* = .048. However, these effects were qualified by a 2-way interaction of Familiarity x Face Recognition Learning Rate, *b* = 0.800, SE = 0.373, $CI_{95\%}$ = [0.069, 1.531], *t*(68) = 2.146, *p* = .035; and a 3-way interaction of Race x Session x Familiarity, *b* = -0.157, SE = 0.049, $CI_{95\%}$ = [-0.252, -0.061], *t*(68) = -3.215, *p* = .002.

We analyzed simple effects for the 2-way interaction. Participants with low and average face recognition learning rates from the series of learned memory tasks were more accurate when classifying novel faces while those with greater face recognition learning rates did not display accuracy differences depending on familiarity (Table A35). Accuracy within familiarity did not differ by learning fate (Table A36). See Figure 14. Participants with lower face recognition learning rates were more accurate for novel faces.

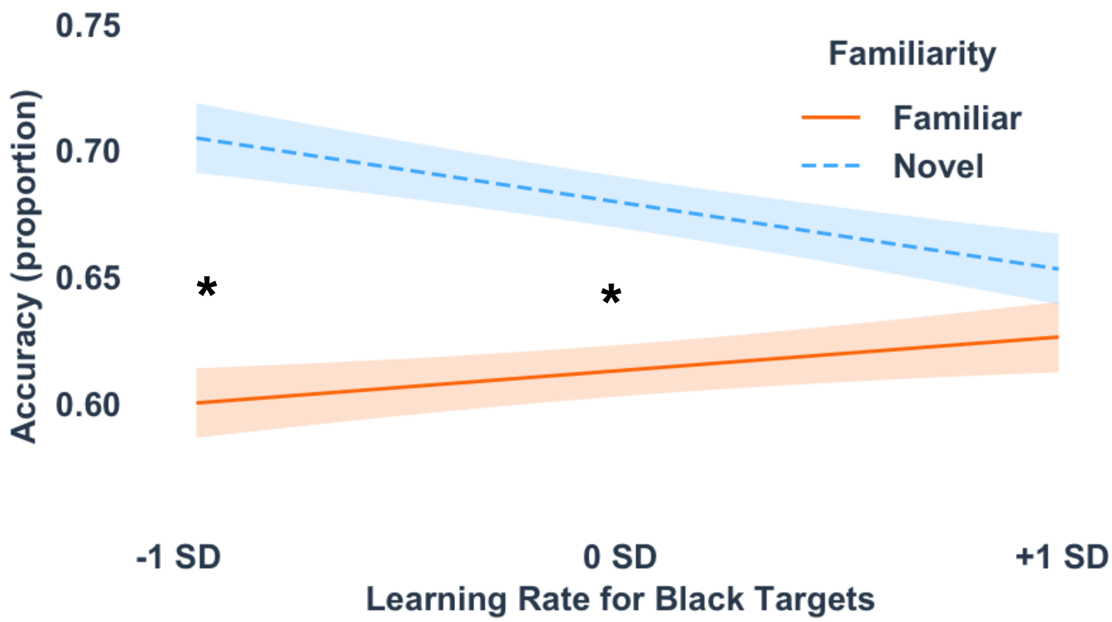


Figure 14: Participants with Lower Learning Rates Displayed Greater Independent Face Recognition Accuracy for Novel Faces. Standard error bars are displayed.

We also analyzed simple effects for the 3-way interaction. Participants were only more accurate when classifying White faces as novel pre-learning compared to Black faces (Table A37). Participants were also more accurate when classifying White faces as novel pre-learning compared to post-learning and Black faces as familiar on pre-learning compared to post-learning (Table A38). Lastly, participants were more accurate at classifying Black faces as familiar compared to novel on pre-learning and White faces as novel compared to familiar on pre-learning and post-learning (Table A39). See Figure 15. Before the learning sessions, participants were better at identifying White compared to Black faces as novel. Participants were also better at recognizing familiar Black faces pre-learning compared to post-learning.

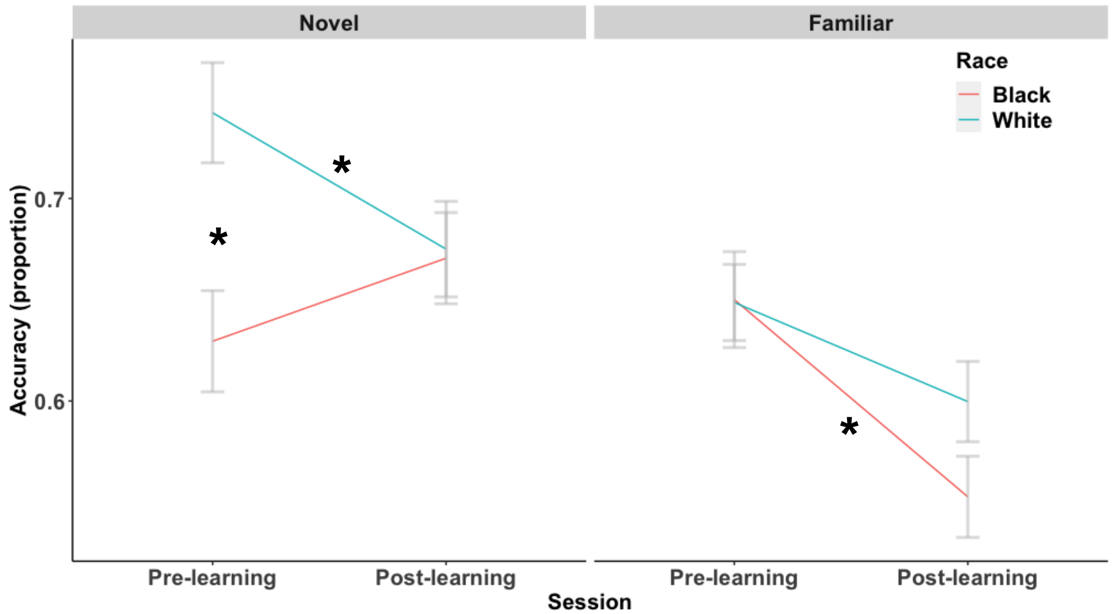


Figure 15: Greater Independent Face Recognition Accuracy for Novel White Targets Pre-learning. Standard error bars are displayed.

2.3.3.2 Independent Face Recognition Accuracy as a Function of Attribution of Valenced Person-knowledge Learning Rate

We analyzed accuracy in recognizing faces that they did not extensively learn about to see if the training generalized to better memory for other faces depending on target face race (Black, White), session (pre, post), target face familiarity (novel, familiar), and their attribution of valenced person-knowledge learning rate of Black targets in the series of learned memory tasks. Results revealed significant main effects of race, b = -0.041, SE = 0.014, $CI_{95\%}$ = [-0.068, -0.013], t(476) = -2.894, p = .004; session, b = -0.043, SE = 0.014, $CI_{95\%}$ = [-0.071, -0.016], t(476) = -3.067, p = .002; and familiarity, b = -0.067, SE = 0.014, $CI_{95\%}$ = [-0.094, -0.039], t(476) = -4.73, p < .001. Results also revealed a 2-way interaction of Session x Familiarity, b = -0.06, SE = 0.028,

$CI_{95\%}$ = [-0.115, -0.005], $t(476) = -2.132$, $p = .034$. However, these effects were qualified by a 3-way interaction of Race x Session x Familiarity, $b = -0.157$, SE = 0.056, $CI_{95\%}$ = [-0.267, -0.046], $t(476) = -2.785$, $p = .006$.

We analyzed simple effects for this 3-way interaction. As with the results from independent face recognition accuracy as a function of face recognition learning rate, participants were only more accurate when classifying White faces as novel pre-learning compared to Black faces (Table A40). Participants were also more accurate when classifying White faces as novel pre-learning compared to post-learning and Black faces as familiar pre-learning compared to post-learning (Table A41). Lastly, participants were more accurate at classifying Black faces as familiar compared to novel pre-learning and White faces as novel compared to familiar pre-learning and post-learning (Table A42). See Figure 15. Before the learning sessions, participants were better at identifying White compared to Black faces as novel. Participants were also better at recognizing familiar Black faces pre-learning compared to post-learning.

2.3.3.3 Independent Face Recognition Accuracy as a function of Cued Recall of Person-knowledge Learning Rate

We analyzed accuracy in recognizing faces that they did not extensively learn to see if the training generalized to better memory for other faces depending on target face race (Black, White), session (pre, post), target face familiarity (novel, familiar), and their cued recall of person-knowledge learning rate of Black targets in the series of learned memory tasks. Results revealed significant main effects of race, $b = -0.041$, SE = 0.014,

$CI_{95\%}$ = [-0.069, -0.013], $t(476) = -2.868$, $p = .004$; session, $b = -0.043$, SE = 0.014, $CI_{95\%}$ = [-0.071, -0.015], $t(476) = -3.04$, $p = .002$; familiarity, b = -0.067, SE = 0.014, $CI_{95\%}$ = [-0.094, -0.039], $t(476) = -4.688$, $p < .001$; and face recognition learning rate (Figure 16), b = 0.5, SE = 0.204, CI95% = [0.101, 0.9], $t(68) = 2.457$, $p = .017$. Participants with greater cued recall learning rates were more accurate. Results also revealed a 2-way interaction of Session x Familiarity, $b = -0.06$, SE = 0.028, $CI_{95\%}$ = [-0.116, -0.004], $t(476) = -2.113$, $p = .035$. Most of these effects were qualified by a 3-way interaction of Race x Session x Familiarity, $b = -0.157$, SE = 0.057, $CI_{95\%}$ = [-0.268, -0.045], $t(476) = -2.76$, $p = .006$.

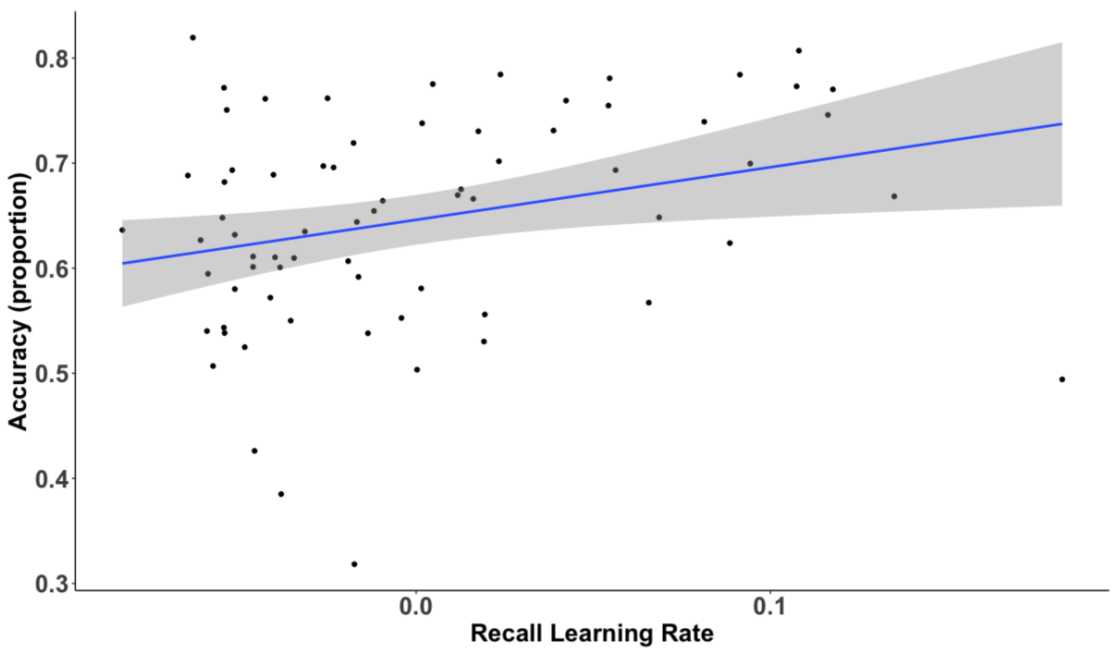


Figure 16: Participants with Greater Person-knowledge Recall Learning Rates were More Accurate at Independent Face Recognition. Standard error bars are displayed.

We analyzed simple effects for this 3-way interaction. As with the results from independent face recognition accuracy as a function of face recognition learning rate, participants were only more accurate when classifying White faces as novel pre-learning compared to Black faces (Table A43). Participants were also more accurate when classifying White faces as novel pre-learning compared to post-learning and Black faces as familiar pre-learning compared to post-learning (Table A44). Lastly, participants were more accurate at classifying Black faces as familiar compared to novel pre-learning and White faces as novel compared to familiar pre-learning and post-learning (Table A45). See Figure 15. Before the learning sessions, participants were better at identifying White compared to Black faces as novel. Participants were also better at recognizing familiar Black faces pre-learning compared to post-learning.

2.3.3.4 Independent Face Recognition Accuracy as a Function of Average Learning Rate

We analyzed accuracy in recognizing faces that they did not extensively learn to see if the training generalized to better memory for other faces depending on target face race (Black, White), session (pre, post), target face familiarity (novel, familiar), and their average learning rate of Black targets in the series of learned memory tasks (learning rate for Black targets averaged across all three DVs of face recognition, attribution of valenced person-knowledge, and cued recall of person-knowledge). Results revealed significant main effects of race, b = -0.041, SE = 0.014, $CI_{95\%}$ = [-0.068, -0.013], $t(476)$ = -2.887, p = .004; session, b = -0.043, SE = 0.014, $CI_{95\%}$ = [-0.071, -0.016], $t(476)$ = -3.06,

p = .002; and familiarity, b = -0.067, SE = 0.014, $CI_{95\%}$ = [-0.094, -0.039], $t(476)$ = -4.719, p < .001. Results also revealed a 2-way interaction of Session x Familiarity, b = -0.06, SE = 0.028, $CI_{95\%}$ = [-0.115, -0.005], $t(476)$ = -2.127, p = .034. However, these effects were qualified by a 2-way interaction of Session x Average Learning Rate, b = 1.327, SE = 0.508, $CI_{95\%}$ = [0.332, 2.322], $t(476)$ = 2.613, p = .009; and a 3-way interaction of Race x Session x Familiarity, b = -0.157, SE = 0.056, $CI_{95\%}$ = [-0.267, -0.046], $t(476)$ = -2.778, p = .006.

We analyzed simple effects for this 2-way interaction. Participants with a greater learning rate were more accurate than those with lower learning rates post-learning (Table 46). Participants with low and average learning rates were more accurate pre-learning compared to post-learning while those with greater learning rates did not differ (Table A47). See Figure 17. Participants with lower average face recognition learning rates were more accurate pre-learning compared to post-learning, possibly due to interference from all the faces they encountered during the training sessions.

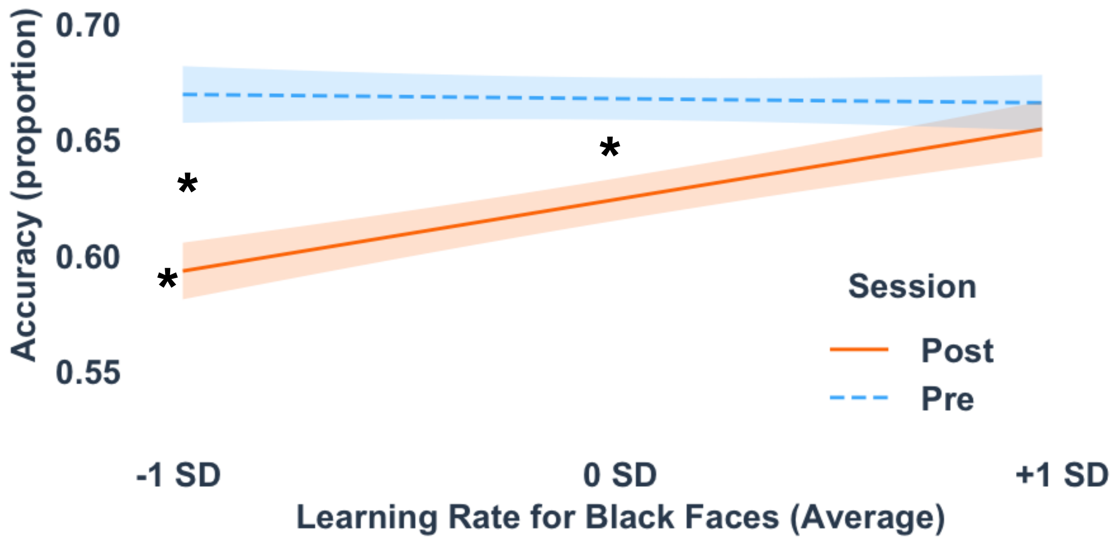


Figure 17: Those with Lower Average Learning Rates Were More Accurate at Independent Face Recognition Pre-learning. Standard error bars are displayed.

We analyzed simple effects for this 3-way interaction. As with the results from independent face recognition accuracy as a function of face recognition learning rate, participants were only more accurate when classifying White faces as novel pre-learning compared to Black faces (Table A48). Participants were also more accurate when classifying White faces as novel pre-learning compared to post-learning and Black faces as familiar pre-learning compared to post-learning (Table A49). Lastly, participants were more accurate at classifying Black faces as familiar compared to novel pre-learning and White faces as novel compared to familiar pre-learning and post-learning (Table A50). See Figure 15. Before the learning sessions, participants were better at identifying White compared to Black faces as novel. Participants were also better at recognizing familiar Black faces pre-learning compared to post-learning.

2.3.3.5 Independent Face Recognition Accuracy without Learning Rates

We analyzed accuracy in recognizing faces that they did not extensively learn about to see if the training generalized to better memory for other faces depending on target face race (Black, White), target face familiarity (novel, familiar), and session (pre, post). Results revealed significant main effects of race, b = -0.041, SE = 0.012, $CI_{95\%}$ = [-0.064, -0.018], $t(345) = -3.455$, $p < .001$; session, b = -0.043, SE = 0.017, $CI_{95\%}$ = [-0.077, -0.009], $t(69) = -2.152$, $p = .014$; and familiarity, b = -0.067, SE = 0.020, $CI_{95\%}$ = [-0.106, -0.027], $t(69) = -3.287$, $p = .002$. Results also revealed a 2-way interaction of Session x Familiarity, b = -0.060, SE = 0.024, $CI_{95\%}$ = [-0.106, -0.014], $t(345) = -2.545$, $p = .011$. However, these effects were qualified by a 3-way interaction of Race x Session x Familiarity, b = -0.157, SE = 0.047, $CI_{95\%}$ = [-0.249, -0.064], $t(345) = -3.325$, $p < .001$.

We analyzed simple effects for this 3-way interaction. As with the results from independent face recognition accuracy as a function of face recognition learning rate, participants were more accurate when classifying White faces as novel pre-learning compared to Black faces and when classifying White faces as familiar on post-learning compared to Black faces (Table A51). Participants were also more accurate when classifying White faces as novel pre-learning compared to post-learning and Black faces as familiar pre-learning compared to post-learning (Table A52). Lastly, participants were more accurate at classifying Black faces as familiar compared to novel pre-learning and

White faces as novel compared to familiar pre-learning and post-learning (Table A53). See Figure 15. Results were similar to those from independent face recognition accuracy as a function of face recognition learning rate with the exception that when learning rates are not included, participants were additionally better at recognizing White familiar targets post-learning.

2.3.3.6 Impact of Contact on Independent Face Recognition Accuracy

In the second model, we analyzed accuracy in recognizing faces that they did not extensively learn about to see if the training generalized to better memory for other faces depending on target face race (Black, White), target face familiarity (novel, familiar), session (1, 5), and z-scored lifetime interracial contact. As in the model without contact, results revealed significant main effects of race, b = -0.041, SE = 0.012, $CI_{95\%}$ = [-0.064, -0.018], $t(340)$ = -3.464, p < .001; session, b = -0.043, SE = 0.017, $CI_{95\%}$ = [-0.076, -0.011], $t(68)$ = -2.598, p = .012; and familiarity, b = -0.067, SE = 0.020, $CI_{95\%}$ = [-0.106, -0.027], $t(68)$ = -3.302, p = .002. Results also revealed a 2-way interaction of Session x Familiarity, b = -0.060, SE = 0.024, $CI_{95\%}$ = [-0.106, -0.014], $t(340)$ = -2.552, p = .011. However, these effects were qualified by a 3-way interactions of Race x Session x Familiarity, b = -0.157, SE = 0.047, $CI_{95\%}$ = [-0.249, -0.065], $t(340)$ = -3.334, p < .001. See Appendix (A.3.6) for a decomposition of the 3-way interaction that did not include contact. There was also a 2-way interaction of Session x Contact, b = 0.040, SE = 0.017, $CI_{95\%}$ = [0.007, 0.073], $t(68)$ = 2.399, p = .019.

We analyzed simple effects for the 2-way interaction of Session x Contact. Participants with low and average contact were more accurate pre-learning compared to post-learning but accuracy for participants with high contact did not differ depending on session (Table A54, Figure 18). Overall, lower contact participants displayed greater accuracy pre-learning, while high contact participants did not differ in accuracy depending on session, suggesting that the learning sessions did not interfere with their subsequent independent face recognition performance.

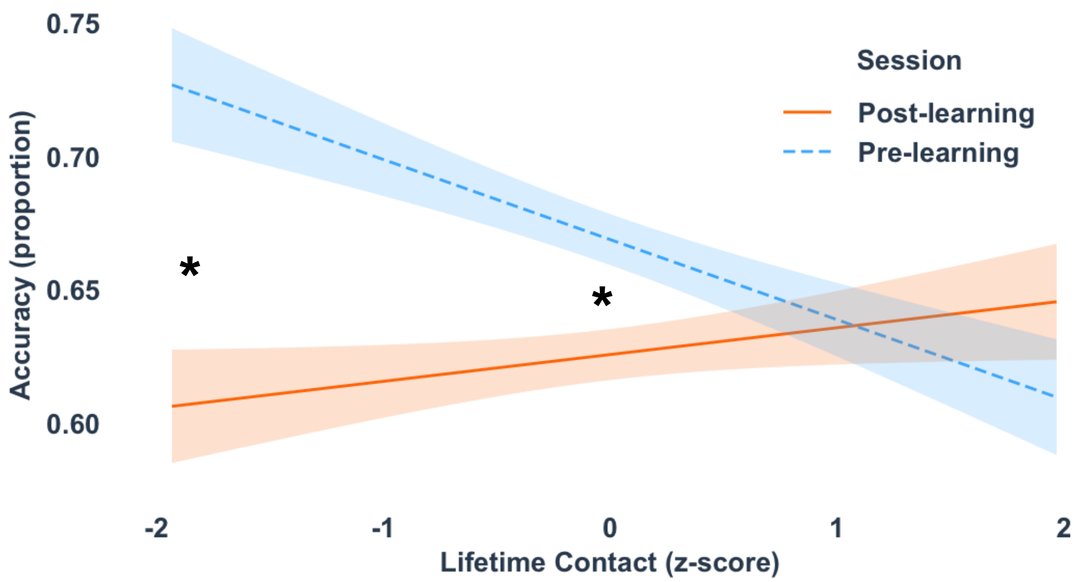


Figure 18: Lower Contact Participants Displayed Greater Independent Face Recognition Accuracy Pre-learning. Standard error bars are displayed.

2.3.4 Study 1c Discussion

Our main prediction was that participants with better learning rates for Black targets in the series of learned memory tasks would have a reduction in the other race effect from pre-learning to post-learning. However, our results indicated that learning rates for Black targets in the series of learned memory tasks did not influence race-related independent face recognition. We obtained the same result that participants were generally more accurate at recognizing new novel vs. familiar faces regardless of which of the 3 DVs or learning rate we used from the series of learned memory tasks. In analyses without including learning rates, at the pre-learning session participants were more accurate at identifying novel White faces as novel compared to all other information types. However, at the post-learning session participants were less accurate when identifying Black compared to White while there was no difference between accuracy for novel faces post-learning regardless of race. Overall, regardless of learning rate in the individuation training, participants were more accurate when identifying novel White targets pre-learning, perhaps due to interference from all the faces they encountered during the training sessions and a general benefit for White targets.

However, participants with lower face recognition learning rates were more accurate at identifying novel compared to familiar targets. Participants with greater cued recall learning rates were more accurate at independent face recognition overall than those with lower cued recall learning rates. However, participants with low and average learning rates of Black targets averaged over all three DVs were more accurate post-learning compared to pre-learning while those with high averaged learning rates did not differ pre- to post-learning. This might be because participants with greater learning rates are better able to discriminate between people they have seen before and novel faces overall. This partially supports our hypothesis, because while those with greater learning rates do not have a reduction in the ORE from pre-learning to post-learning, they have a decreased ORE compared to those with lower learning rates.

In analyses including interracial contact, results additionally indicated that participants with less contact were more accurate pre-learning compared to post-learning while participants with greater contact did not differ in accuracy from pre- to post-learning. This difference may be due to those with less interracial contact encountering interference from all the faces they learned about during the training sessions while those with greater contact were not as affected because they may generally be better at processing a variety of faces.

2.3.5 Study 1 General Discussion

Study 1 consists of three studies examining learning rates of individuating information and how individuation training affects evaluative priming and generalizes to face recognition of novel faces. In the main study of interest (study 1a), participants completed five sessions of encoding where they learned about Black and White targets who were paired with positive person-knowledge, negative person-knowledge, or no person-knowledge. After each encoding session, participants were shown these learned as well as novel faces and asked to indicate whether they had seen the face before (face recognition), what type of information the face was paired with (information attribution), and to generate the statements the face was paired with (recall). Overall, results indicate a robust other race effect where our White participants had better accuracy for White compared to Black targets. Interestingly, when asked about information attribution, participants displayed a memory advantage for White targets paired with negative person-knowledge, possibly due to a mismatch between the presented negative information about these ingroup members and expectations our participants had about their ingroup in general. Accuracy depending on person-knowledge differs depending on the specificity of information participants must access. When participants only need to recognize *the face* as familiar or novel, they were more accurate when the face was associated with person-knowledge, but accuracy did not differ between person-knowledge valence. However, when we examine the influence of interracial contact, this effect only emerged for those with low and average contact, as those with high contact did not differ in accuracy depending on information type. Conversely, when participants needed to *identify the valence of paired information*, they were more accurate when the face was perceptually familiar and did not differ between person-knowledge valence. This might be because it is relatively easy to recognize a face as familiar if it was paired with person-knowledge, but harder to distinguish between valence of the person-knowledge. In addition, when participants were able to correctly identify the valence of paired information, *recall for statements* increased across sessions, but was always better for statements paired with White faces relative to Black faces. This seems to be driven by participants with low and average contact because they display greater accuracy for White compared to Black faces on the last session while participants with high contact converge in their accuracy. These contact results align with other research in our lab indicating that greater interracial contact increases face processing efficiency and decreases the social salience of faces regardless of target race (Handley et al., 2022). Participants with high contact may be processing Black and White faces more similarly than those with lower contact.

In the evaluative priming study (study 1b), participants were asked to classify positively and negatively valenced words after being primed with a face before and after individuating training. Before individuation training, participants were slower to classify negative compared to positive words regardless of prime face race. When we examine the influence of interracial contact, results indicate that only low contact participants were slower after a White prime compared to a Black prime regardless of word valence. However, after individuation training, for both models including and not including contact, participants were slower to classify negative compared to positive words after being primed with faces associated with positive person-knowledge. Therefore, their performance was hindered by an affective incongruence between the positive person-knowledge prime and the negative word to be classified. Even when irrelevant to the task, classification performance is impacted by the learned associations of prime faces. However, we only observed differences based on prime face race when examining contact on pre-learning performance, where low contact participants had slower RTs for White prime faces. This lack of race-based priming effects may be a result of participants being able to ignore the prime faces pre-learning while being influenced by the paired person-knowledge post-learning. However, it is possible that the current study was underpowered to detect this effect across all experimental conditions.

In the independent face recognition study (study 1c), learning rates for Black targets in the series of learned memory tasks did not influence race-related independent face recognition. Before the learning sessions, participants were better at identifying White compared to Black faces as novel. Participants were also better at recognizing familiar Black faces pre-learning compared to post-learning. Participants with greater learning rates did not display differences between novel and familiar targets. However, participants with greater cued recall of person-knowledge learning rates were more accurate overall at this independent face recognition task. Additionally, participants with greater average learning rates did not differ in accuracy from pre- to post-learning while those with lower learning rates performed worse post-learning. When we examine the influence of interracial contact, results indicate that lower contact participants displayed greater accuracy pre-learning, while high contact participants did not differ in accuracy depending on session. Participants with higher contact and higher learning rates may not display accuracy differences depending on session because they are better able to discriminate between targets while those with lower contact and lower learning rates experienced interference from extensive individuation training.

In summary, participants generally had greater memory for White compared to Black targets after extensive individuation training and had difficulty recalling the exact valence of paired information. This individuation training impacted performance on a separate study examining affective priming such that performance was hindered by an affective incongruence between the positive person-knowledge prime and the negative word to be classified. This individuation training also impacted performance on a separate study examining generalization of face training such that those with lower learning rates diverged in their accuracy depending on familiarity of the faces across learning sessions. We also found that participants with high interracial contact were equally accurate at recognizing familiarity regardless of information type, equally accurate at recalling person-knowledge regardless of target race after extensive training, equally fast at classifying words regardless of prime race, and equally accurate at recognizing faces after independent individuation training. While participants with lower contact displayed race-related differences and interference from individuation training, those with high contact did not. This provides support for the hypothesis that greater interracial contact increases face processing efficiency and decreases the social salience of faces regardless of target race (Handley et al., 2022). In study 2, we seek to replicate these findings and examine the neural correlates of forming impressions of these individuated targets.

Chapter 3

STUDY 2: THE INFLUENCE OF PERCEPTUAL AND KNOWLEDGE-BASED FAMILIARITY OF FACES VARYING IN RACE ON THE NEURAL SUBSTRATES OF FACE PERCEPTION

When studying impression formation based on social dimensions that may be sensitive to some perceivers (e.g., race, gender, trust), brain imaging methodologies provide a unique means of assessing ongoing and spontaneous social cognitive engagement while minimizing social desirability and incomplete information concerns associated with explicit self-reports (Berkman, Cunningham, & Lieberman, 2014; Cacioppo, 2002). Indeed, many studies ask participants to evaluate targets that vary in physical attributes (e.g., attractiveness) or social category (e.g., race) and participants may want to obscure their initial evaluations for fear of appearing prejudiced (Devine, Plant, Amodio, Harmon-Jones, & Vance, 2002; Pearson, Dovidio, & Gaertner, 2009). Therefore, neuroimaging can be a useful tool that relies on decoding brain activity instead of on participant self-report. Additionally, these techniques also allow for testing of neural mechanisms underlying social behavior and may inform hypotheses about social psychological constructs or behaviors (Cacioppo, 2002; Cacioppo & Decety, 2011). In addition to behavioral examinations of impression formation, researchers also study the neural mechanisms supporting individuation and impression formation based on perceptual cues and person-knowledge.

Although a network of brain region supports impression formation based on person-knowledge, the MPFC is believed to be central in learning and retrieving knowledge about the self and others (Amodio & Frith, 2006; Cloutier, Kelley, et al., 2011; Mitchell, 2009; Wagner et al., 2012). The DMPFC appears to be involved in retrieving person-knowledge during impression formation more generally (Baron et al., 2011; Mitchell, Macrae, & Banaji, 2005). In a study where participants were exposed to previously novel faces to create conditions of faces that are novel, only perceptually familiar, and paired with person-knowledge, results indicate that novel and perceptually familiar faces paired with person-knowledge elicited more DMPFC activity than novel and perceptually familiar faces not paired with person-knowledge, respectively (Cloutier, Kelley, et al., 2011). On the other hand, the VMPFC appears to be preferentially active when forming *positive* evaluations based on person-knowledge (Bartra, McGuire, & Kable, 2013; Wagner, Chavez, & Broom, 2019). In a study where participants provided explicit ratings based on perceptual cues or person-knowledge, the VMPFC, but not the DMPFC, was recruited by increasingly positive evaluations when person-knowledge was required compared to when person-knowledge was unavailable (Dang et al., 2019).

After examining the behavioral learning rates in study 1, we additionally wanted to replicate our findings and examine the neural correlates and possible neural mechanisms associated with forming impressions of these trained targets. To do so, we asked these trained participants to simply form impressions of these learned targets as well as novel targets. Familiarity with others can be broadly divided into three categories: novel, perceptually familiar only, and perceptually familiar with available person-knowledge. Research on the neural correlates of impression formation using fMRI have implicated social cognitive brain regions in processing faces. Of particular interest are the DMPFC, VMPFC, precuneus, and amygdala. As discussed in the introduction, in the context of impression formation the DMPFC is sensitive to the presence of person-knowledge regardless of valence (Baron et al., 2011; Mitchell, Macrae, et al., 2005), the VMPFC is sensitive to the presence of positive person-knowledge (Bartra et al., 2013; Dang et al., 2019; Wagner et al., 2019), the precuneus is sensitive to viewing familiar others (Gobbini & Haxby, 2006; Kosaka et al., 2003; Lee, Leung, Lee, Raine, & Chan, 2013), and the amygdala is sensitive to salient or unexpected stimuli (Blackford et al., 2010; Cunningham & Brosch, 2012).

Study 2 is a partial replication of study 1 with an additional fMRI study. After completing five learning and test sessions as in study 1, these participants additionally completed an impression formation task while being scanned. Here we examine the neural correlates of impression formation of faces varying in race that are either novel, perceptually familiar only, paired with positive person-knowledge, or paired with negative person-knowledge.

3.1 Study 2a: Learning Task

Study 2a is a partial replication of study 1a, both assessing the learning rates of faces varying in race and valence of paired person-knowledge. Therefore, we only highlight differences between the methods and results of the two studies below.

3.1.1 Methods

3.1.1.1 Participants

29 and 21 participants were recruited from the University of Delaware SONA pool and University of Delaware community, respectively (total $n = 50$). In order to participate in the study, participants were required to meet the following criteria: (1) self-identify as White; (2) between 18 and 35 years old; (3) right-handed; (4) lived in the U.S. for at least 5 years; (5) good command of the English language; (6) no history of drug abuse; (7) no history of serious head injury; (8) no color vision problems; (9) no current acute illness; (10) not currently taking psychotropic medication; (11) no diagnosis of developmental disorders; (12) no diagnosis of a chronic disease that compromises mental, neural, or autonomic function; and (13) pass a standard MRI safety screen. Participant recruitment was not restricted by gender. 24 participants were excluded from data analysis (8 who failed to participate in subsequent days or failing to complete a portion of a session, 10 who did not pass attention check criteria, 3 who were not actually MRI safe, and 3 who wished to discontinue). Data from 26 participants ($M_{Age} = 19.154$ years, $SD_{Age} = 1.489$, 23 female, 3 male) who successfully completed all five days of training and the fMRI session were used in final analyses for all portions of study 2.

For their online training sessions, participants were compensated according to one of the following three schedules:

1. SONA Option A - Those who completed all five days of training were compensated with 4.5 total credits toward the completion of research

requirements for introductory courses, while all others were compensated at a prorated rate of 1 credit per hour. In completing the 5th day of training, they were additionally compensated with $10.

2. SONA Option B - Those who completed the first day of training were compensated with 1 total credit toward the completion of research requirements for introductory courses. For training days 2-4 and 5, they received $10 and $15, respectively, either via cash or an Amazon gift card.
3. Community Option - For training days 1-4 and 5, they received $10 and $15, respectively, either via cash or an Amazon gift card.

Due to illness, last minute scheduling conflicts, or issues with the scanner, 3 participants were rescheduled and completed an additional encoding session the day before their rescheduled scan in exchange for $5.

For their in-person fMRI scan, all participants received $25 for the hour spent inside of the scanner and $10 for the hour spent at the facility, but not in the scanner completing other tasks and preparing for the scan.

This research was approved by the University of Delaware Institutional Review Board (IRB 1396663). All research was conducted in line with the University of Delaware's ethical guidelines. All participants provided informed consent prior to participation.

3.1.1.1.1 Sample size rationale:

We planned to collect a final sample size of 60 participants. However, due to difficulties with recruitment and time constraints, the current series of results in study 2 only include 26 participants. Therefore, the behavioral and brain-imaging results should be interpreted with caution as we await the final results from ongoing data collection efforts. Additionally, at this time we did not conduct analyses including individual differences (i.e., interracial contact) as the study is not powered to detect these effects.

3.1.1.2 Procedure

As in study 1a, this online study consisted of five separate, consecutive days of participation. Table 3 details the tasks each participant completed. On the first through fourth day, participants completed one encoding phase and one test phase from the series of learned memory tasks on each day. On the fifth and final day, participants completed one encoding phase and one test phase from the series of learned memory tasks and individual difference measures. However, diverging from study 1a, participants completed the face recognition task on the first day before the learning task and after the MRI scan and did not complete the EPT.

Table 3: Outline of Study 2 Progression and Tasks

Session	Tasks
1	1. Independent pre-learning face recognition – Encoding 1 2. Independent pre-learning face recognition – Test 1 3. Series of learned memory tasks – Encoding 1 4. Series of learned memory tasks – Test 1

2	1. Series of learned memory tasks – Encoding 2 2. Series of learned memory tasks – Test 2
3	1. Series of learned memory tasks – Encoding 3 2. Series of learned memory tasks – Test 3
4	1. Series of learned memory tasks – Encoding 4 2. Series of learned memory tasks – Test 4
5	1. Series of learned memory tasks – Encoding 5 2. Series of learned memory tasks – Test 5 3. Individual difference measures (random order except where noted) a. Likeability ratings (always 1st) b. Race IAT (always 2nd) c. Demographics (always 3rd) d. Interracial contact (sequential order) i. Childhood contact ii. Current contact e. EMS/IMS f. Modern Racism Scale (MRS) g. Symbolic Racism Scale (SRS) h. Feeling thermometer (random order) i. White people ii. Black people i. Perceived Stress Scale j. Fear of the Coronavirus
6	1. MRI study a. Race-familiarity run1 b. Race-familiarity run 2 c. 6 runs of unrelated threat-status study 2. Independent post-learning face recognition – Encoding 2 3. Independent post-learning face recognition – Test 2 4. Task for unrelated threat-status study

3.1.1.2.1 Encoding Phase

The encoding phase was similar to what was completed in study 1a except we increased the number of encoding trials because we wanted participants to be extremely familiar with the faces before getting scanned. We increased the number of encoding trials from 288 in study 1a (6 repeats of each of the 48 faces) to 432 encoding trials in study 2a (9 repeats of each of the 48 faces).

3.1.1.2.2 Test Phase

The test phase was similar to what was completed in study 1a except we provided feedback after the completion of each test trial (i.e., when participants finished indicating their familiarity and recall with each face) because we wanted participants to be extremely familiar with the faces before getting scanned. For the faces paired with person-knowledge, we provided the three paired sentences at the end of each trial. For the perceptually familiar only faces, we gave feedback at the end of each trial ("This is a face you've seen before. It is not paired with any sentences.").

3.1.2 Results

See Appendix (B.1.1) for the omnibus models.

3.1.2.1 Face Recognition

In this first model, we assessed how well participants identified novel and encoded faces depending on target race (Black, White), session (1, 2, 3, 4, 5), and information type (perceptually familiar, negative person-knowledge, positive person-knowledge). Results revealed a significant main effect of target race, $b = -0.068$, SE = 0.013, $CI_{95\%} = [-0.094, -0.043]$, $t(25) = -5.266$, $p < .001$; session, $b = 0.057$, SE = 0.005, $CI_{95\%} = [0.046, 0.067]$, $t(25) = 10.819$, $p < .001$; and information type, $b = 0.092$, SE = 0.018, $CI_{95\%} = [0.057, 0.128]$, $t(25) = 5.081$, $p < .001$. However, all effects were qualified by 2-way interactions of Race x Session, $b = 0.036$, SE = 0.009, $CI_{95\%} = [0.02, 0.053]$,

$t(25) = 4.28$, $p < .001$; and Session x Information Type , $b = -0.021$, SE = 0.007, $CI_{95\%}$ = [-0.034, -0.008], $t(25) = -3.123$, $p = .005$.

We analyzed simple effects for the 2-way interaction of Race x Session. Accuracy for White faces was greater than for Black faces for all days except on session 5 (Table B1). The greatest increase in accuracy occurred from session 1 to session 2, but accuracy leveled out after session 2 (Table B2). See Figure 19. Overall, while participants' accuracy rapidly increased during the first couple encoding sessions, they had greater accuracy for White compared to Black faces until the final session.

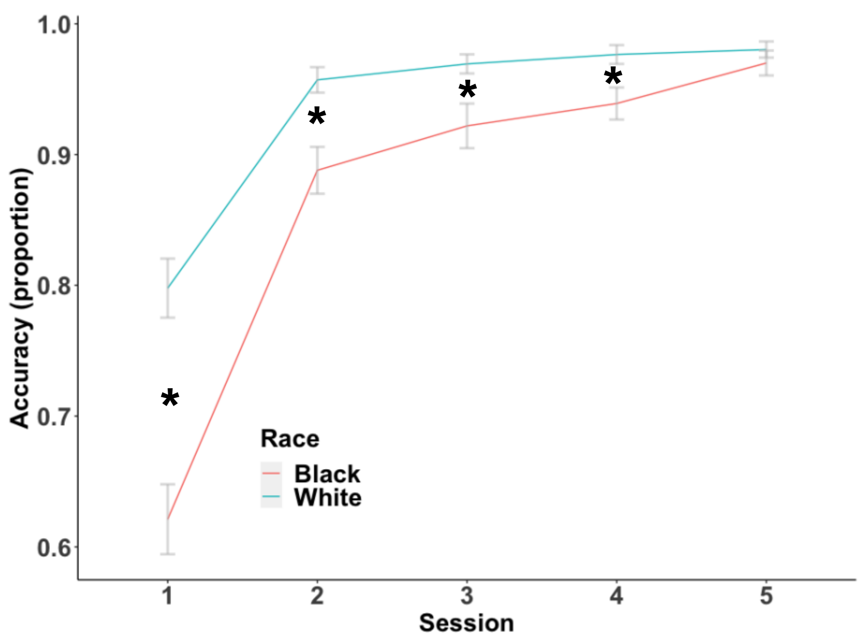


Figure 19: Greater Face Recognition Accuracy for White Targets. Standard error bars are displayed.

We then analyzed simple effects for the 2-way interaction of Information Type x Session. Accuracy for faces associated with person-knowledge was always greater than faces that were just perceptually familiar but there was no difference between person-knowledge valence (Table B3). The greatest increase in accuracy occurred from session 1 to session 2, but the accuracy leveled out after session 2 (Table B4). See Figure 20. Overall, while participants' accuracy rapidly increased during the first couple encoding sessions, they had greater accuracy for faces associated with person-knowledge regardless of the valence compared to faces that were just perceptually familiar.

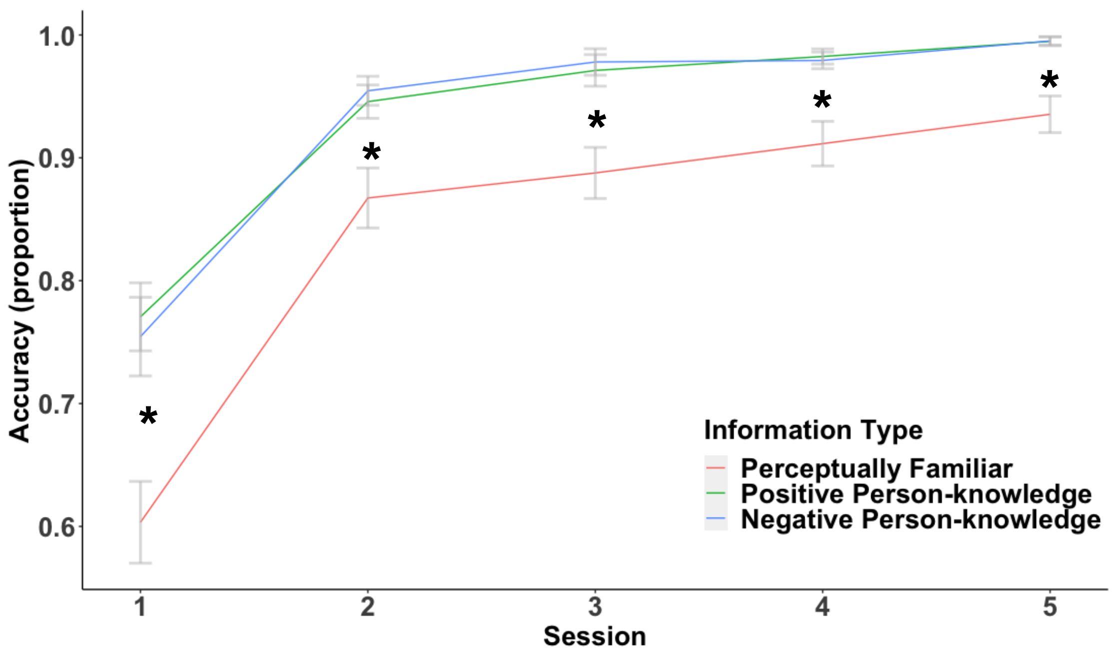


Figure 20: Greater Face Recognition Accuracy for Targets with Person-knowledge. Standard error bars are displayed.

While these interactions are consistent with the results from the fully powered study 1a, we do not observe the 3-way interaction of Race x Session x Information Type in these analyses. In both studies, we do observe that participants are more accurate as they gain more training and for targets associated with person-knowledge regardless of valence.

3.1.2.2 Attribution of Valenced Person-knowledge

In this second model, we assessed how well participants identified the type of paired person-knowledge, if any, for faces they correctly indicated were presented as a function of target race (Black, White), session (1, 2, 3, 4, 5), and information type (perceptually familiar, negative person-knowledge, positive person-knowledge). Results revealed significant main effects of target race, b = -0.049, SE = 0.011, $CI_{95\%}$ = [-0.07, -0.028], $t(25)$ = -4.551, $p < .001$; session, b = 0.062, SE = 0.01, $CI_{95\%}$ = [0.043, 0.081], $t(25)$ = 6.476, $p < .001$; and information type, b = -0.041, SE = 0.016, $CI_{95\%}$ = [-0.074, -0.009], $t(25)$ = -2.521, p = .018.

For the target race main effect, accuracy for White targets was greater than for Black targets (Figure 21). For the session main effect, accuracy increased rapidly from session 1 to 2 and session 2 to 3 but leveled out after session 3 (Figure 22; Table B5). For the information type main effect, accuracy for both person-knowledge conditions were less than the perceptually familiar only condition, but the valenced person-knowledge conditions did not differ from each other (Figure 23; Table B6). Although participants were more accurate at recognizing faces paired with person-knowledge (i.e., face recognition DV), they were less accurate at attributing the valence of person-knowledge previously paired with faces compared to identifying faces perceptually familiar (i.e., not previously paired with person-knowledge). Overall, participants were more accurate for

White compared to Black targets, became more accurate with increased training, and were more accurate at identifying faces as perceptually familiar than attributing the correct valence of previously paired person-knowledge.

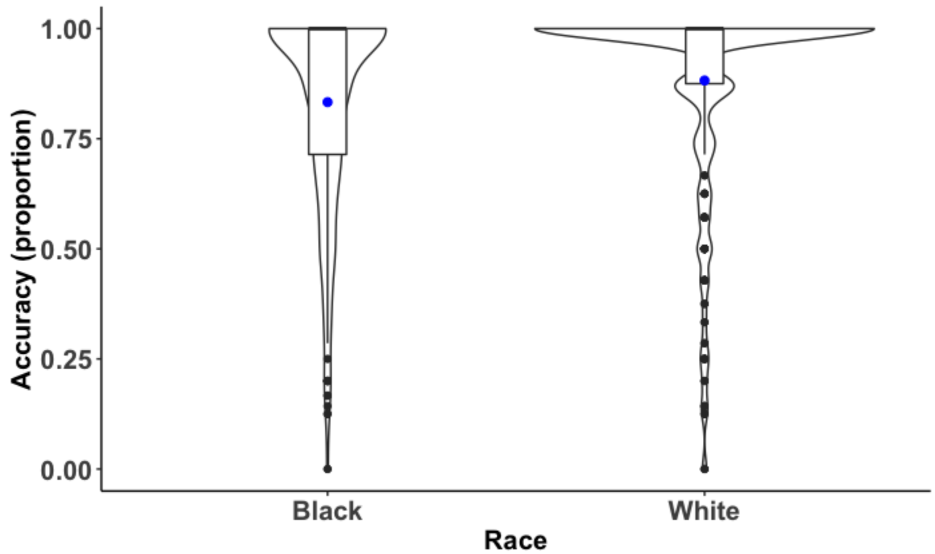


Figure 21: Greater Attribution of Valenced Person-knowledge for White targets. The rectangle represents the interquartile range, the blue dot represents the mean, and the thick line at the top of the rectangle represents the median.

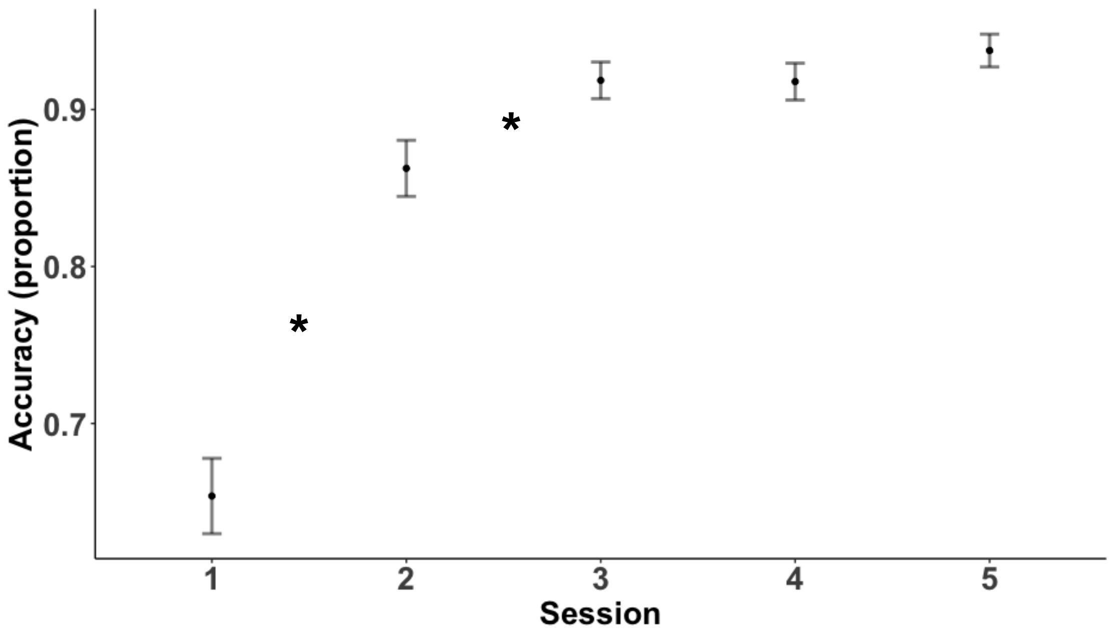


Figure 22: Greatest Attribution of Valenced Person-knowledge Accuracy Increases During Sessions 1-3. Standard error bars are displayed.

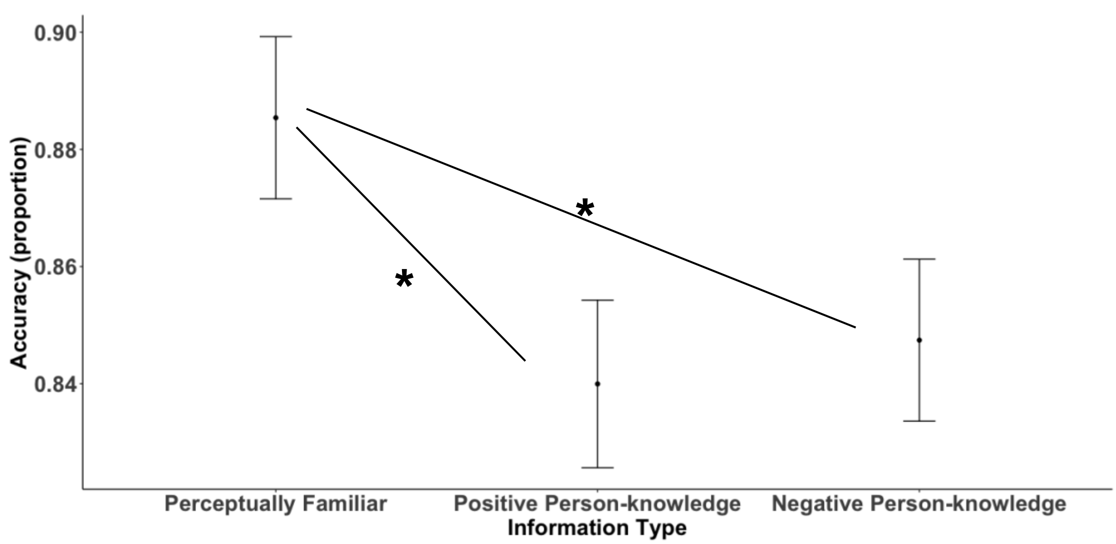


Figure 23: Greater Attribution of Valenced Person-knowledge Accuracy for Perceptually Familiar Faces. Standard error bars are displayed.

While these main effects are consistent with the results from the fully powered study 1a, we do not observe the two 2-way interactions of Race x Information Type and Session x Information Type. In both studies, we do observe that participants are more accurate attributing person-knowledge type to faces as they gain more training and to identify faces as not previously associated with person-knowledge (i.e., perceptual familiar).

3.1.2.3 Cued Recall of Person-knowledge

In this third model, we assessed how well participants recalled the paired person-knowledge statements, for faces they correctly indicated were paired with person-knowledge depending on target race (Black, White), session (1, 2, 3, 4, 5), and person-knowledge valence (negative, positive). Results revealed significant main effects of target race, b = -0.081, SE = 0.015, $CI_{95\%}$ = [-0.11, -0.052], $t(25) = -5.439$, $p < .001$; and session, b = 0.120, SE = 0.011, $CI_{95\%}$ = [0.099, 0.141], $t(25) = 11.245$, $p < .001$. However, effects were qualified by a 3-way interaction of Race x Session x Valence, b = 0.03, SE = 0.013, $CI_{95\%}$ = [0.005, 0.056], $t(358) = 2.329$, $p = 0.020$.

We analyzed simple effects for this 3-way interaction. For faces paired with positive person-knowledge, accuracy for White faces was always greater than for Black faces. However, for faces paired with negative person-knowledge, accuracy for White faces was less than for Black faces for session 1 (Table B7). Accuracy for both Black and White targets increased significantly as participants completed more learning sessions (Table B8). See Figure 24. Overall, accuracy for White targets was greater than for Black targets regardless of session or person-knowledge valence and accuracy increased after more learning sessions regardless of target race or person-knowledge valence.

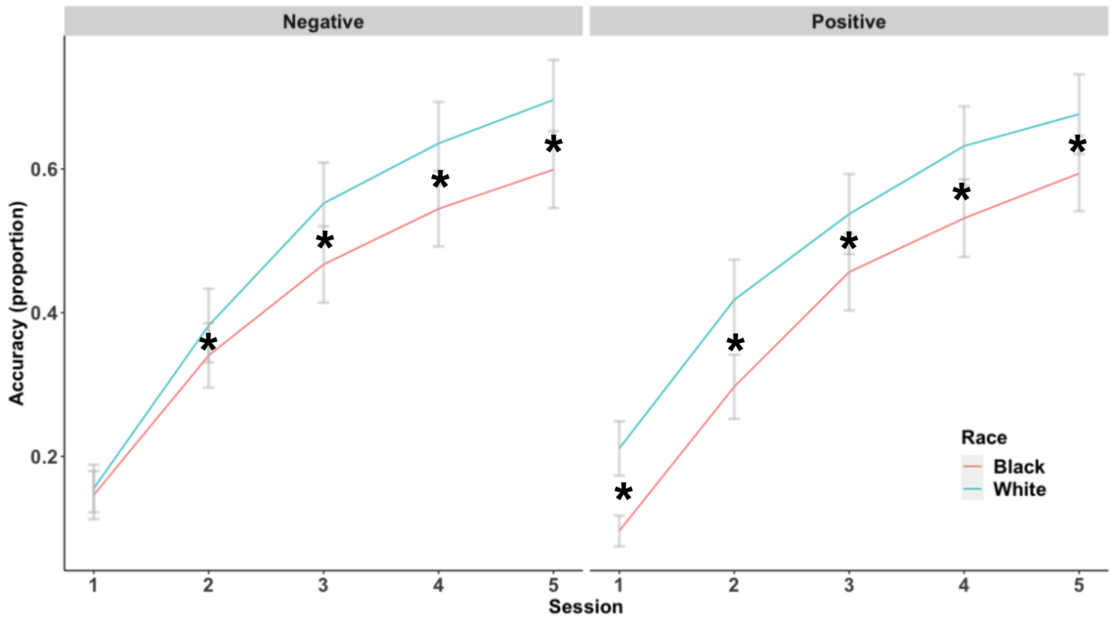


Figure 24: Greater Person-knowledge Recall Accuracy for White Targets and Over Time. Standard error bars are displayed.

While this 3-way interaction is consistent with the results from the fully powered study 1a, in study 1a we only observe a 2-way interaction of Race x Session. However, in both studies we do observe that participants are more accurate at recalling person-knowledge following greater learning sessions and for White compared to Black targets.

3.1.3 Study 2a Discussion

When examining face recognition accuracy, participants initially displayed an other race effect, where they had better face recognition for their racial ingroup (White) faces versus Black faces. However, this effect decreased as participants encountered and encoded the faces across the sessions and the difference in recognition between Black and White faces disappeared by the fourth session. Additionally, participants displayed a robust learning bias for faces paired with person-knowledge, regardless of valence, compared to faces that were just perceptually familiar. This is perhaps because available person-knowledge facilitated individuation. Across both findings, participants had the greatest increase in accuracy from session 1 to session 2 and the learning benefit from subsequent sessions decreased. Particularly for the White faces and faces paired with person-knowledge, we observed a ceiling effect. This may be due to expertise in encoding own-race faces and to increased individuation when provided with person-knowledge.

When examining attribution of valenced person-knowledge accuracy, as with the first DV of face recognition, participants displayed an other race effect, where they had better information type recognition for their racial ingroup (White) faces versus Black faces. As with face recognition, participants had the greatest increase in accuracy from session 1 to 2 and from session 2 to 3 and the learning benefit from subsequent sessions decreased. Lastly, participants were better able to identify perceptually familiar faces as perceptually familiar compared to being able to attribute the correct person-knowledge valence. This contrasts with face recognition where they were able to better recognize familiar faces if they were paired with person-knowledge. However, this may have occurred because participants were able to recognize the individuated faces, but were not able to recall the specific paired valence.

When examining cued recall accuracy, participants were generally more accurate for White compared to Black targets. However, during the first two sessions, there was no accuracy difference for targets paired with negative person-knowledge regardless of race, but as sessions progressed, accuracy diverged, and participants were more accurate for White than Black faces paired with negative person-knowledge. Additionally, accuracy for White targets continued to increase while accuracy for Black targets leveled out. This indicates an ORE where participants were better able to individuate and subsequently recall paired person-knowledge statements for racial ingroup members regardless of valence. Replicating our findings in study 1a, participants demonstrated a robust other race effect as they were more accurate when recognizing, identifying, and recalling statements about White compared to Black faces despite days of learning individuating information.

Because of the diagnosticity of negative person-knowledge, we predicted a negativity bias. Participants were expected to be more accurate for faces paired with negative person-knowledge. However, the findings did not support our hypothesis. Participants were more accurate in recognizing targets associated with person-knowledge compared to targets that were just perceptually familiar but did not differentiate between person-knowledge valence. Conversely, participants were more accurate at identifying the paired information for targets that were just perceptually familiar compared to targets associated with person-knowledge, but again did not differentiate between person-knowledge valence. This may be because participants were able to recall that the face was paired with person-knowledge, but unable to remember whether the information was positive or negative.

Lastly, we predicted greater accuracy for stereotype incongruent pairs, but instead observed a general memory bias for White targets. As in the fully powered study 1a, participants displayed a learning advantage for their racial ingroup compared to their racial outgroup, perhaps from increased perceptual expertise or motivational differences with their ingroup (Brewer, 1988; Fiske & Neuberg, 1990; Hughes, Zaki, & Ambady, 2017; Li et al., 2016).

3.2 Study 2b: Independent Face Recognition Task

Study 2b is a partial replication of study 1c, both examining how training to individuate other faces generalizes to improve face recognition of different faces. Therefore, we only highlight differences between the methods and results of the two studies below.

3.2.1 Procedure

Procedures are identical to study 1c except participants completed the second face recognition task right after being scanned rather than after the fifth training session.

3.2.1.1 Data Analysis

Because we are not powered to examine individual differences, we do not present analyses including learning rates as a predictor. Instead, we only present the face recognition accuracy model as predicted by target race (Black, White), session (pre-learning, post-learning), and familiarity (familiar, novel).

3.2.2 Results

See Appendix (B.2.1) for the omnibus models.

3.2.2.1 Independent Face Recognition Accuracy

We analyzed accuracy in recognizing faces that they did not extensively learn about to see if the training generalized to better memory for other faces depending on target race (Black, White), target familiarity (novel, familiar), and session (pre-learning, post-learning). Results revealed main effects of session, *b* = -0.088, SE = 0.025, $CI_{95\%}$ = [-0.136, -0.04], *t*(25) = -3.585, *p* = 0.001; and familiarity, *b* = -0.082, SE = 0.026, $CI_{95\%}$ = [-0.134, -0.03], *t*(25) = -3.108, *p* = 0.005. However, these main effects were qualified by a two-way interaction of Session x Familiarity, *b* = -0.158, SE = 0.037, $CI_{95\%}$ = [-0.23, -0.085], *t*(125) = -4.279, *p* < .001.

We analyzed simple effects for the 2-way interaction of Session x Familiarity. Accuracy for familiar faces on the post-learning session was lower than for both familiar faces on the pre-learning session (Table B9) and novel faces on the post-learning session (Table B10). See Figure 25. Participants were least accurate at recognizing familiar targets after completing all training sessions, perhaps due to interference with the extensively newly learned faces during the learning sessions.

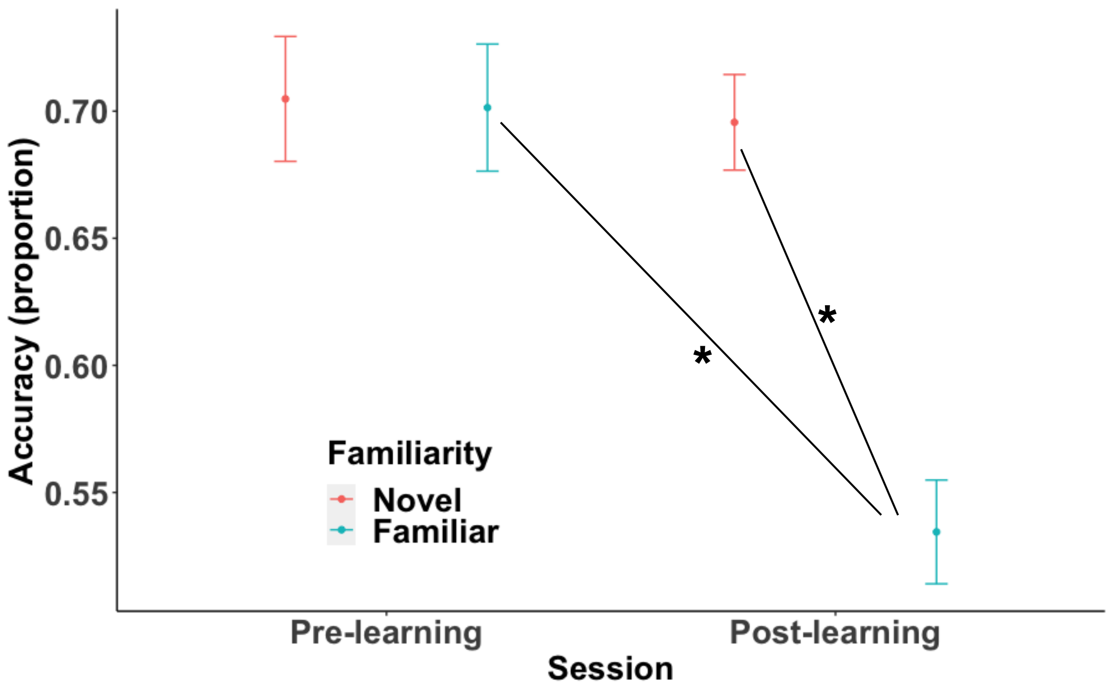


Figure 25: Least Independent Face Recognition Accuracy for Familiar Targets Post-learning. Standard error bars are displayed.

3.2.3 Study 2b Discussion

Here we were interested in whether extensively learning about other faces would generalize to participants' accuracy in recognizing novel faces. Results indicate that accuracy for familiar faces post-learning was less than both familiar faces pre-learning and novel faces post-learning. Perhaps the extensive training interfered with their ability to accurately recognize other faces as familiar and had the opposite effect than predicted of generalizing face recognition to faces that they were not extensively trained on. While we additionally observed an influence of race in study 1c, the results here are consistent in that both results indicate interference after training for the familiar targets in this independent face recognition task, perhaps because they are confusing the targets in this task with the faces that were recently extensively encoded.

3.3 Study 2c: Neural Correlates of Impression Formation of Targets Varying in Race, Familiarity, and Person-knowledge Availability

Participants who successfully completed five days of training were invited to participate in an fMRI study where they were asked to form impressions of the previously learned as well as novel faces while being scanned. The aim of this study is to examine the neural regions that are preferentially active when forming impressions of targets varying in race and experimentally manipulated type and level of familiarity after extensive individuation.

3.3.1 Confirmatory ROI Predictions

We anticipate that the DMPFC will be particularly involved in impression formation when person-knowledge is available. Therefore, we expect greater DMPFC activity to faces for which person-knowledge is available regardless of valence compared to just perceptually familiar faces. Previous research has shown increased DMPFC activity when forming impressions of Black and White targets paired with trait words that violate race-based affective stereotypes, such as Black faces paired with positive traits and White faces paired with negative traits (Li et al., 2016). However, we predict that because participants in the current study will be extensively trained and exposed to the targets, they will not display this greater DMPFC to faces that violate expectations because they will resolve any expectancy violations after extensive training. Therefore, we predict an ingroup bias of greater DMPFC activity to White targets compared to Black targets regardless of valence.

We anticipate that the VMPFC will be particularly involved in impression formation when positive person-knowledge is available. Therefore, we expect greater VMPFC activity to faces for which positive person-knowledge is available compared to all other information types. We additionally predict greater VMPFC activity to White targets paired with positive person-knowledge compared to Black targets paired with positive person-knowledge.

We anticipate that the precuneus will be particularly involved in impression formation when the face is familiar and well-known. Therefore, we expect greater precuneus activity to perceptually familiar faces compared to novel faces.

We anticipate that the amygdala will be particularly sensitive to novel faces and faces associated with negative person-knowledge. Therefore, we expect greater amygdala activity to novel compared to perceptually familiar faces and, because the Black faces may be more salient, we additionally expect greater amygdala activity to novel Black faces compared to novel White faces. Based on previous studies suggesting that preferential amygdala activity to novel black faces may be driven by negative evaluative responses to outgroup members (Phelps et al., 2000), we expect greater amygdala activity to faces paired with negative compared to positive person-knowledge (but see Li et al., 2016).

3.3.2 Exploratory ROI Predictions

We predict greater NAcc activity to faces associated with positive person-knowledge compared to faces associated with negative person-knowledge.

Because we are interested in the contrast between faces that are familiar with person-knowledge, just visually familiar, and visually novel, we therefore predict increased FFA activity in response to familiar versus novel faces. In contrast to these adaptation paradigms that find decreased FFA activity in response to multiple repetitions of familiar faces, we predict increases in FFA activity for familiar versus novel faces because the faces are not shown back-to-back.

We predict greater hippocampus activity for faces associated with person-knowledge compared to those that are only perceptually familiar and for White faces associated with person-knowledge compared to Black faces associated with person-knowledge.

3.3.3 Methods

3.3.3.1 Participants

3.3.3.1.1 Sample Size Rationale

Although the goal of including 60 participants is more than twice the size of an average fMRI study, it still is less than the recommended sample sizes for confirmatory whole-brain analyses (Vul & Pashler, 2017) ($n > 80$). Therefore, readers should note that our whole-brain analyses are exploratory. Because previous analyses indicate that adequately powered sample sizes can be reduced by three to four times by adopting an

ROI-based approach (Vul & Pashler, 2017; Zandbelt et al., 2008), we focus our interpretation on results from the a priori ROIs. Furthermore, our current sample size of 26 is less than our goal of 60 participants, therefore the current results are underpowered and should be interpreted with caution.

3.3.3.2 Face Stimuli

The 64 faces for the fMRI study were the same as the equated faces used in the learning task of study 1. However, participants saw all four groups of equated faces because we used the group that was not used during learning as novel faces. For example, in one ordering, participants would have encoded Group A faces as perceptually familiar, Group B faces as paired with negative person-knowledge, and Group C faces as paired with positive person-knowledge (see Figure 1). Therefore, in the fMRI impression information task the participants with this ordering would see face groups A through C again as well as Group D faces which would be novel faces.

3.3.3.3 fMRI Trial Sequence Generation

Trial sequences for the impression-formation task were generated using optseq2 (Greve, 2002). The following parameters were entered: TR (repetition time) = 0.8, ntp (total time points) = 228, psdwin (post-stimulus delay window) = 0–20 seconds, eight conditions (entered as events each with 8 occurrences of 1.6 seconds in duration), tnullmin (minimum null event duration) = 0.8 seconds, tnullmax (maximum null event duration) = 3.2 seconds. After 10,000 iterations, optseq returned several optimal trial sequences. This was run four independent times to generate two sequences that all participants would see.

We selected trial sequences following a set of constraints: (1) one run must start with a White target and end with a Black target and the other run must start with a Black target and end with a White target, (2) there must be no more than three photos of the same race in a row, and (3) there must be no more than three photos of the same condition in a row. The first sequence started with a Black face and ended with a White face and the second sequence started with a White face and ended with a Black face and represent the two main functional runs from the first two independent optseq generated sequences. Then to ensure that there are no more than three photos of the same race or condition in row, we minimally edited the sequence. We then tested for collinearity using a SPM12 (https://www.fil.ion.ucl.ac.uk/spm/software/spm12/) facilitated by a custom suite of scripts (https://github.com/ddwagner/SPM12w).

This resulted in two runs, each of which depicted all 64 faces. We added TRs of jitter to the end of each run so that there would be at least 10 s of padding before each run ended. After this one main run and both additional runs lasted 228 TRs and we added 2 TRs to one main run to make that run also last 228 TRs. The two runs were counterbalanced so that about half of the participants saw the run with the Black target first and the other half saw the run with the White target first.

3.3.3.4 Procedure

Upon successful completion of session 3 of the learning task, participants were contacted via phone for the researchers to provide more details about the fMRI impression formation task as well as to double check that participants were MRI safe. If the participants were eligible and consented to participating in the fMRI portion, they were scheduled for a two-hour timeslot at the University of Delaware Center for Biomedical and Brain Imaging. At this time, they were also scheduled for their session four and session 5 learning rates sessions to be two days and one day before their fMRI session, respectively. Participants who completed their last day of online training but were unable to get scanned the following day (n = 2 due to illness; n = 1 due to scanner issues), completed one additional training session the day before their rescheduled in person scanning session.

Upon arriving for the scanning session, participants gave informed consent and received task instructions. Once inside of the scanner they completed two runs of the race-familiarity impression formation task. Each run lasted approximately 4 minutes. After this, participants completed six runs of an unrelated task. Then they completed post-scan tasks outside of the scanner, including the second session of the face recognition task.

3.3.3.4.1 Impression-formation Task

After getting situated in the scanner, participants were verbally informed that they would be forming quick overall impressions of some faces then pressing both their thumbs simultaneously after they have formed their impression while the face was on the screen to indicate that they had formed their impression. Before each run the instructions were presented in written format and they completed two practice trials of forming their impression then pressing both their thumbs simultaneously.

Trials began with a face presented on a black background. After 1000ms, the face was replaced by a white fixation of a jittered duration (i.e., inter-trial interval of 1400, 2200, 3000, or 3800 ms). Participants formed a quick impression of each individual by the time the face disappeared or shortly thereafter. To signal they formed an impression, participants simultaneously pressed two keys, one per thumb. Participants were informed that their responses were not meant to indicate of the content of their impressions, but merely to indicate that they had formed an impression. In each run of the impression formation task, participants viewed 64 male faces (half Black, half White) divided evenly into each of the four familiarity categories (i.e., novel, perceptually familiar only, paired with negative person-knowledge, or paired with positive person-knowledge).

3.3.3.4.2 fMRI Acquisition, Pre-processing, and GLM

Anatomical and functional whole-brain imaging were performed using a Siemens 3.0 T scanner and a 64-channel head coil at the University of Delaware Center for Biomedical and Brain Imaging. We acquired BOLD, T2* contrast-weighted images using a multi-band echo-planar imaging sequence. With an 800-ms TR and a 20-ms echo time (TE), we acquired 32 oblique, interleaved slices to minimize signal dropout from the OFC. Following conventional standards, we wanted to interpolate BOLD responses according to the acquisition time for a slice in the middle of the brain. Slices were 3.60-mm thick and acquired with a resolution of 2.6 mm x 2.6 mm x 3.6 mm, multiband acceleration factor of 4, 40° flip angle, and a 230×230 mm field of view. Slices were aligned to the anterior commissure–posterior commissure axis of each participant.

Echo-planar images (EPIs) from each participant's two runs were pre-processed and analyzed using SPM12 (www.fil.ion.ucl.ac.uk/spm), facilitated by a custom suite of scripts for fMRI analysis (https://github.com/ddwagner/SPM12w). The resulting images from each participant were then unwarped and realigned to the participant's mean EPI to correct for motion and motion-by-distortion interactions. Images were subsequently normalized to the Montreal Neurological Institute (MNI) template and smoothed with an 8-mm full-width at half-maximum (FWHM) kernel (Ashburner & Friston, 1999).

To estimate the BOLD responses for each condition, each trial was considered as an event, and the stimulus time series was convolved with the canonical hemodynamic response function. A GLM modeled both scan sequences concatenated as a single session with regressors for each of the eight conditions (ordered as follows: positive person-knowledge Black targets, positive person-knowledge White targets, negative person-knowledge Black targets, negative person-knowledge White targets, perceptually familiar Black targets, perceptually familiar White targets, novel Black targets, novel White targets). Contrast images reflecting the first-level effects of interest were used in second-level analyses.

3.3.3.5 Data Analysis

The present analyses focused on potential effects of availability of person-knowledge and target race during impression formation. Our primary analyses focused on key regions of interest (ROI) identified above: VMPFC, DMPFC, precuneus, and amygdala. We also conducted exploratory whole-brain analyses to determine whether (1) any other regions would show a similar pattern of activity to that observed in our a priori ROIs and (2) the activity observed in our a priori ROI analysis would be robust to multiple comparison correction at the whole-brain level.

3.3.3.5.1 ROI analyses

As mentioned, we are focusing on the VMPFC, DMPFC, precuneus, and amygdala as confirmatory ROIs. The 8-mm a priori VMPFC spherical ROI was taken from previous research examining moral appraisals during social evaluations (Moll et al., 2002) [MNI: 0, 52, -6]. The 8-mm a priori DMPFC spherical ROI was taken from previous research examining person-knowledge and mentalizing (Spreng, Mar, & Kim, 2009) [MNI: -3, 55, 23]. The 8-mm a priori precuneus spherical ROI was taken from previous research examining perceptual familiarity (Spreng et al., 2009) [precuneus; MNI: -5, -55, 32]. The 4-mm a priori amygdala spherical ROIs were taken from previous research examining processing of evaluative relevant stimuli (Cloutier et al., 2014) [left amygdala, MNI: -24, -6, -24; right amygdala, MNI: 18, -6, -21].

We are also interested in the NAcc, FFA, and hippocampus as exploratory ROIs. The 4-mm a priori NAcc spherical ROIs were taken from previous research examining reward processing of attractive faces (Cloutier, Heatherton, et al., 2008) [left NAcc, MNI: -9, 11, -13; right NAcc, MNI: 10, 18,-10]. The 8-mm a priori FFA spherical ROIs were taken from previous research examining processing of faces varying in familiarity (Visconti Di Oleggio Castello et al., 2017) [left FFA, MNI: -34, -44, -18; right FFA, MNI: 38, -38, -24]. The 4-mm a priori hippocampus spherical ROIs were taken from a meta-analysis of autobiographic memory (Spreng et al., 2009) [left hippocampus, MNI: -24, -11, -22; right hippocampus, MNI: 24, -11, -22].

Average parameter estimates (vs. average signal response) were extracted for each condition. We used the lme4 (Bates et al., 2015) and lmerTest (Kuznetsova et al., 2017) packages in R (R Core Team, 2018). Degrees of freedom were estimated using Satterthwaite's approximation, provided by the package lmerTest, version 2.0–3655.

We ran two types of models examining whether target race, information type, and the interaction predicted neural activity. The general omnibus model is below. For all models, race was coded as Black (+0.5) and White (-0.5). The contrast coding for the IV of information type was varied according to the contrast of interest.

```
lmer(ROI Activity ~ Race * Information Type + (1 | subject), data =
data)
```

In the first types of models, we contrast coded all the different information types (i.e., novel, perceptually familiar, positive person-knowledge, and negative person-knowledge) according to the four contrasts of interest to examine the omnibus models. For independent variables (IVs) in the first types of omnibus models we used the following contrast codes for information type as applicable: (1) novel v. other faces, novel (+0.75), perceptually familiar only (-0.25), positive person-knowledge (-0.25), negative person-knowledge (-0.25); (2) perceptually familiar v. other faces, novel (-0.25), perceptually familiar only (+0.75), positive person-knowledge (-0.25), negative person-knowledge (-0.25); (3) negative person-knowledge v. other faces, novel (-0.25), perceptually familiar only (-0.25), positive person-knowledge (-0.25), negative person-knowledge (+0.75); and (4) positive person-knowledge v. other faces, novel (-0.25), perceptually familiar only (-0.25), positive person-knowledge (+0.75), negative person-knowledge (-0.25).

Because of our limited power, we created a second type of contrast model to more directly examine differences between conditions. In the second types of models, we contrast coded the different information types (i.e., novel, perceptually familiar, positive person-knowledge, and negative person-knowledge) according to three contrasts of interest. For independent variables (IVs) in the first types of omnibus models we used the following contrast codes for information type as applicable: (5) person-knowledge v. novel faces, novel (-0.5), perceptually familiar only (0), positive person-knowledge (+0.5), negative person-knowledge (+0.5); (6) perceptually familiar v. novel faces, novel (-0.5), perceptually familiar only (+0.5), positive person-knowledge (0), negative person-knowledge (0); and (7) positive person-knowledge v. negative person-knowledge faces, novel (0), perceptually familiar only (0), positive person-knowledge (+0.5), negative person-knowledge (-0.5).

To follow up on significant interactions, we tested the simple effects between conditions using a combination of dummy and contrast coding. Because we are underpowered, we maintained a .05 alpha level for ROI analyses.

3.3.3.5.2 Whole-brain Analyses

Complementing our ROI analyses, we conducted exploratory whole-brain analyses to determine whether any other regions would show differential activity as a function of the availability and type of person-knowledge. Using the GLMs created for the ROI analyses, whole brain cluster analysis was conducted on contrasts of areas that display greater activity to (1) faces associated with person-knowledge v. novel faces, (2) novel faces v. faces associated with person-knowledge, (3) faces associated with positive person-knowledge v. novel faces, (4) novel faces v. faces associated with positive person-knowledge, (5) faces associated with negative person-knowledge v. novel faces, (6) novel faces v. faces associated with negative person-knowledge, (7) perceptually familiar only v. novel faces, (8) novel v. perceptually familiar only faces, (9) faces associated with positive v. negative person-knowledge, (10) faces associated with negative v. positive person-knowledge, (11) faces associated with person-knowledge v. perceptual familiar only, and (12) perceptual familiar only faces v. faces associated with person-knowledge.

To correct for multiple comparisons at voxel level across the whole brain, these results were thresholded at $p < .001$ with a minimum cluster size of 5 contiguous voxels. The clusters were visualized using xjView toolbox (http://www.alivelearn.net/xjview).

3.3.4 ROI Results

3.3.4.1 Novel vs. Other Faces

In this first model, we assessed how well brain activity was predicted by target race (Black, White) and information type (novel v. perceptually familiar, negative person-knowledge, and positive person-knowledge). Results revealed a significant main effect of information type in our confirmatory right amygdala, $b = 0.103$, SE = 0.047, $CI_{95\%} = [0.01, 0.196]$, $t(179) = 2.162$, $p = .032$. Right amygdala activity was greater for novel targets compared to perceptually familiar targets (Figure 26, Table B11). Results also revealed a significant main effect of information type in our exploratory right hippocampus, $b = 0.079$, SE = 0.036, $CI_{95\%} = [0.009, 0.149]$, $t(179) = 2.198$, $p = .029$. Right hippocampus activity was greater for novel targets compared to perceptually familiar only targets (Figure 27, Table B12). Overall, both the right amygdala and right hippocampus were found to be more sensitive to novel faces compared to perceptually familiar only faces.

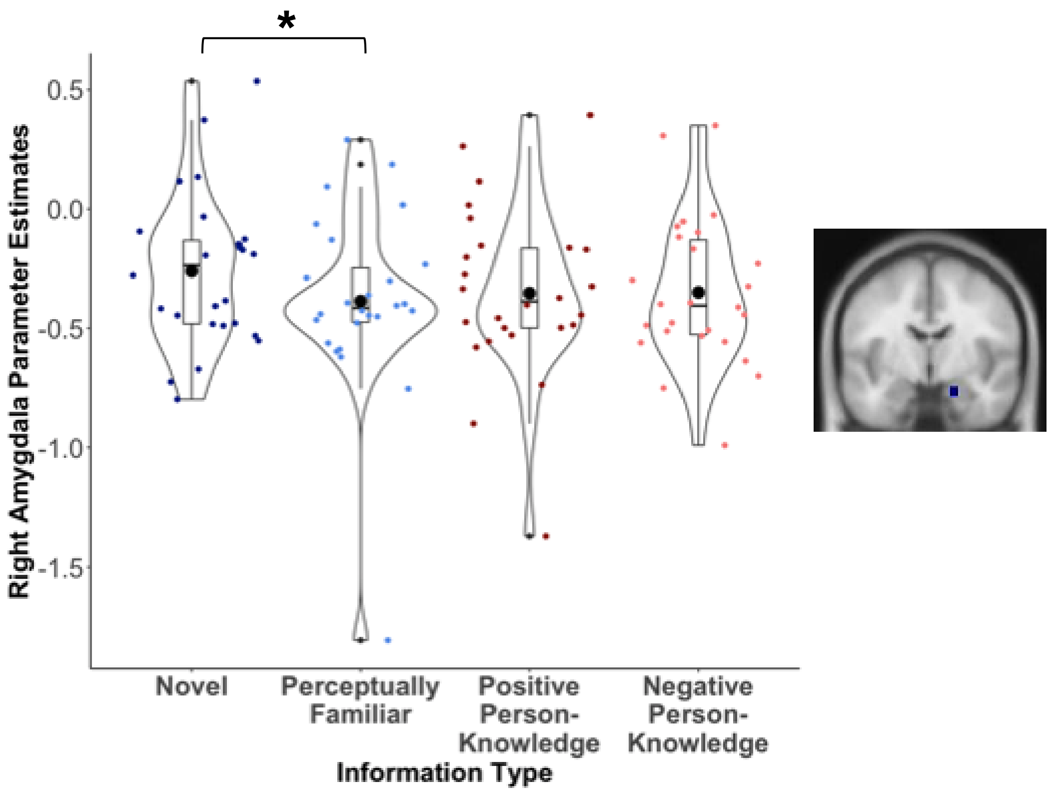


Figure 26: Greater Right Amygdala Activity for Novel v. Perceptually Familiar Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

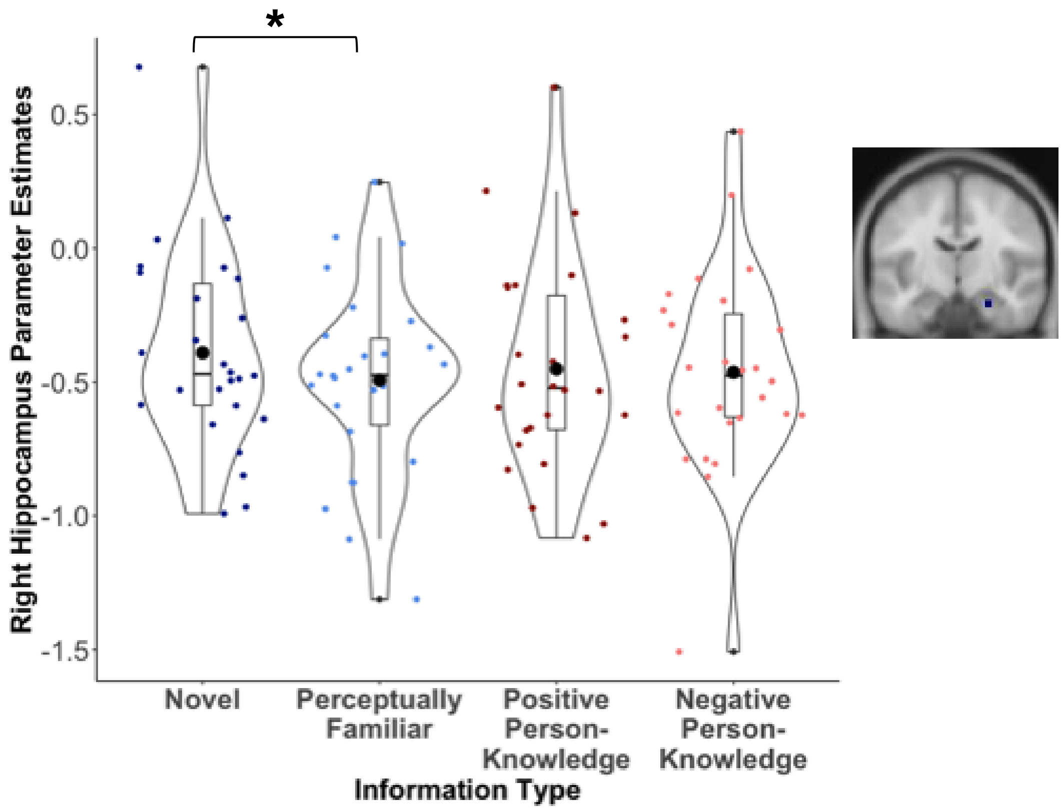


Figure 27: Greater Right Hippocampus Activity for Novel v. Perceptually Familiar Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

3.3.4.2 Perceptually Familiar vs. Other Faces

In this second model, we assessed how well brain activity was predicted by target race (Black, White) and information type (perceptually familiar v. novel, negative person-knowledge, and positive person-knowledge). Results revealed a significant main effect of information type in our confirmatory left amygdala, b = -0.079, SE = 0.033, $CI_{95\%}$ = [-0.143, -0.015], t(179) = -2.424, p = .016. Left amygdala activity was greater for novel targets compared to perceptually familiar only targets (Figure 28, Table B13).

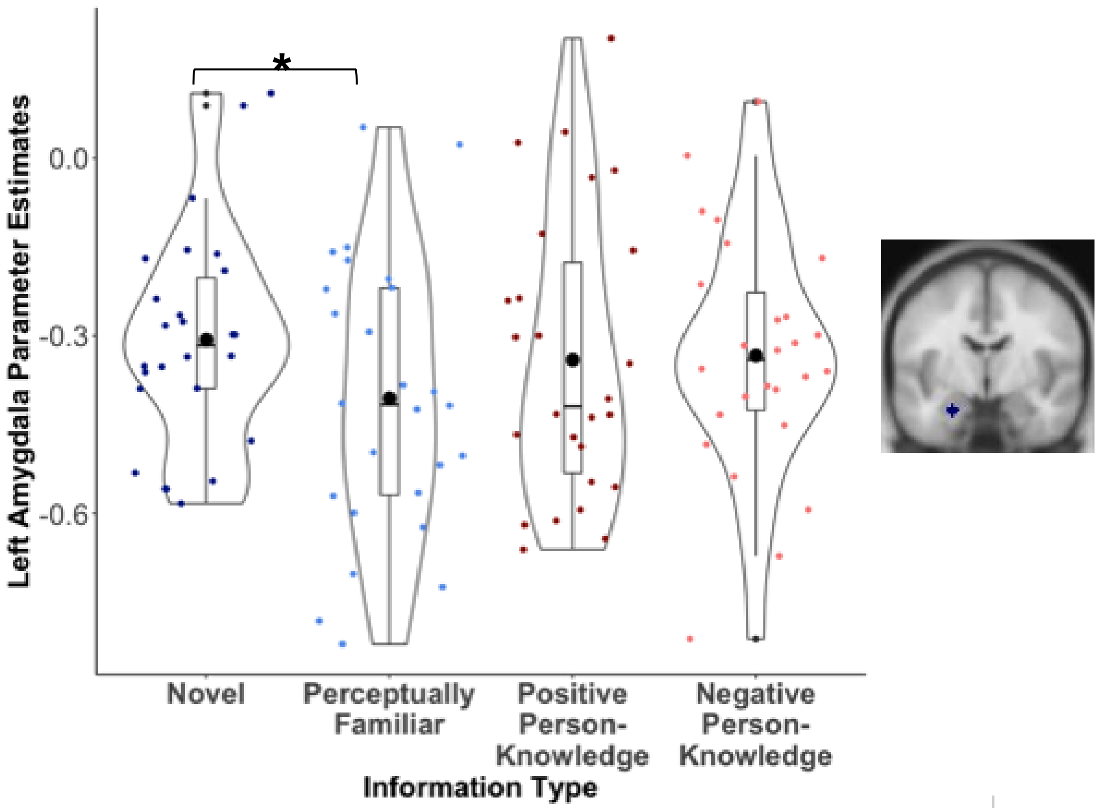


Figure 28: Greater Left Amygdala Activity for Novel v. Perceptually Familiar Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

3.3.4.3 Negative Person-knowledge vs. Other Faces

In this third model, we assessed how well brain activity was predicted by target race (Black, White) and information type (negative person-knowledge v. novel, perceptually familiar, and positive person-knowledge). Results revealed a significant main effect of information type in our confirmatory precuneus, $b = 0.124$, SE = 0.059, $CI_{95\%} = [0.008, 0.241]$, $t(179) = 2.09$, $p = .038$. Precuneus activity was greater for targets associated with negative person-knowledge compared to novel targets (Figure 29, Table B14).

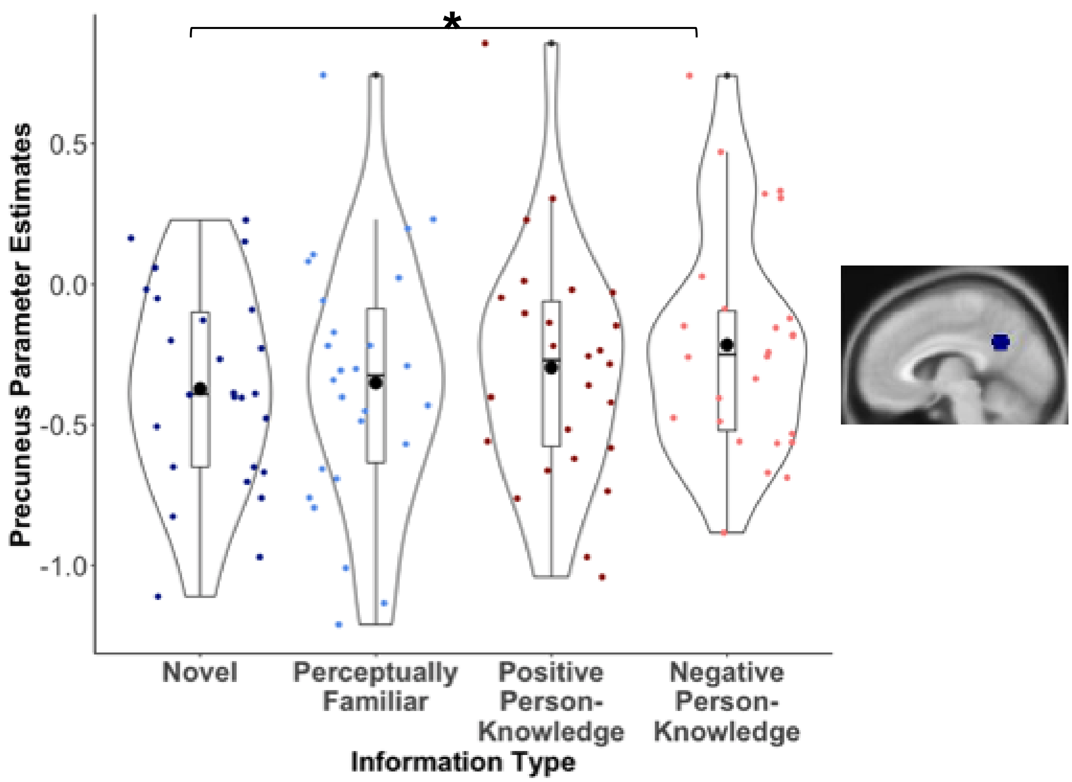


Figure 29: Greater Precuneus Activity for Negative Person-knowledge v. Novel Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

3.3.4.4 Positive Person-knowledge vs. Other Faces

In this fourth model, we assessed how well brain activity was predicted by target race (Black, White) and information type (positive person-knowledge v. novel, perceptually familiar, and negative person-knowledge). Results revealed no significant effects in any ROIs.

3.3.4.5 Person-knowledge vs. Novel Faces

In this fifth model, we assessed how well brain activity was predicted by target race (Black, White) and information type (person-knowledge, novel). Results revealed a significant main effect of information type in our confirmatory right amygdala, *b* = -0.091, SE = 0.044, $CI_{95\%}$ = [-0.178, -0.004], *t*(127) = -2.046, *p* = .043. Right amygdala activity was greater for novel targets compared to targets associated with person-knowledge (Figure 30). Results also revealed a significant main effect of information type in our confirmatory precuneus, *b* = 0.116, SE = 0.057, $CI_{95\%}$ = [0.005, 0.227], *t*(127) = 2.053, *p* = .042. Precuneus activity was greater for targets associated with person-knowledge compared to novel targets (Figure 31). Overall, while the right amygdala was more sensitive to novel faces, the precuneus was more sensitive to person-knowledge.

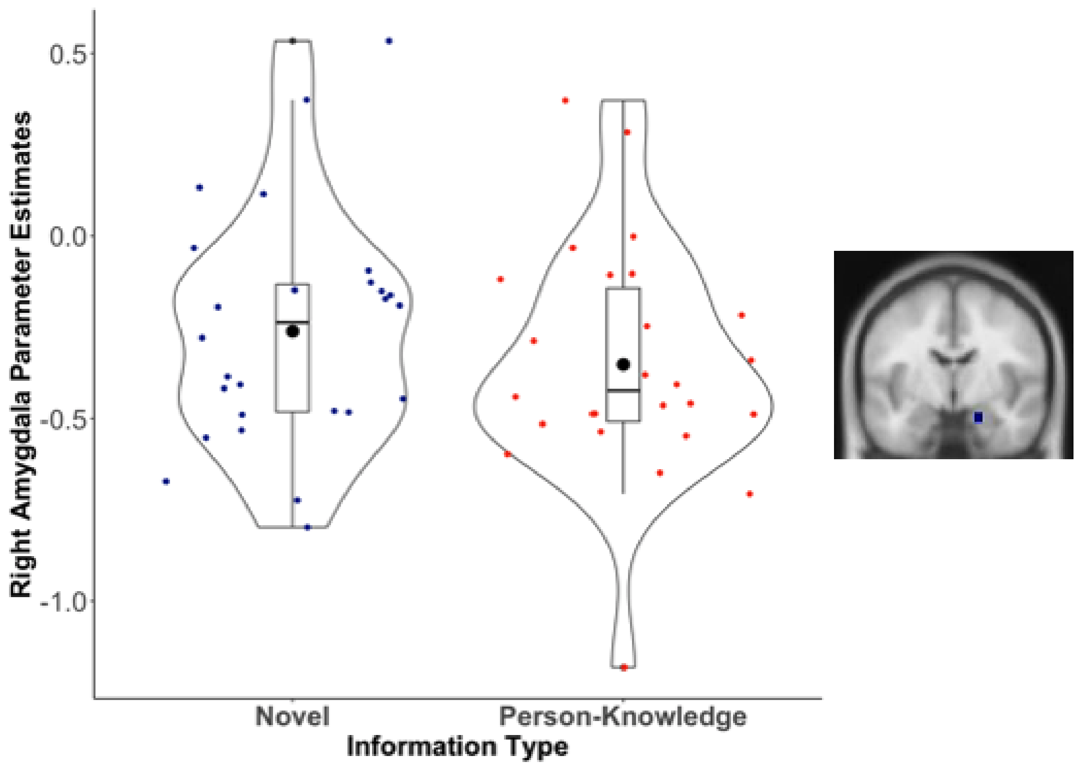


Figure 30: Greater Right Amygdala Activity for Novel v. Person-knowledge Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

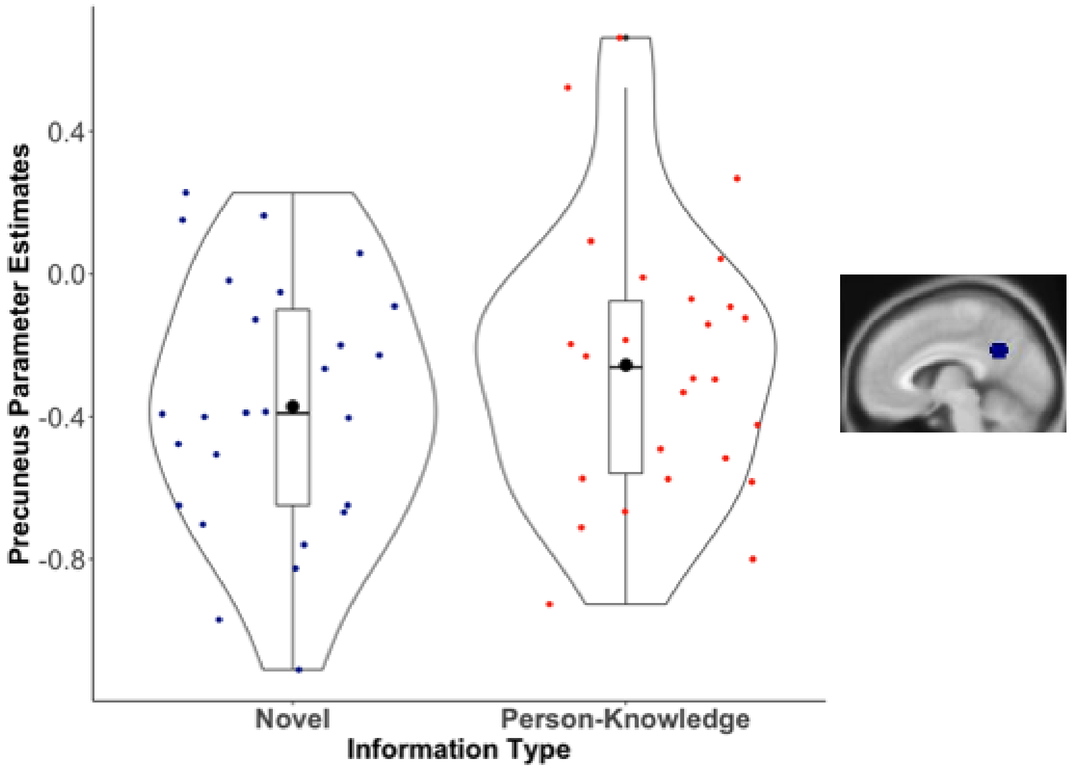


Figure 31: Greater Precuneus Activity for Person-knowledge v. Novel Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

3.3.4.6 Perceptually Familiar vs. Novel Faces

In this sixth model, we assessed how well brain activity was predicted by target race (Black, White) and information type (perceptually familiar, novel). Results revealed a significant main effect of information type in our confirmatory left amygdala, b = -0.099, SE = 0.042, $CI_{95\%}$ = [-0.182, -0.016], $t(75) = -2.345$, $p = .022$. Left amygdala activity was greater for novel targets compared to perceptually familiar only targets (Figure 32). Results also revealed a significant main effect of information type in our exploratory right hippocampus, b = -0.103, SE = 0.045, $CI_{95\%}$ = [-0.19, -0.015], $t(75) = -2.301$, $p = .024$. Right hippocampus activity was greater for novel targets compared to perceptually familiar only targets (Figure 33). Overall, both the left amygdala and right hippocampus were more sensitive to novel faces compared to perceptually familiar faces.

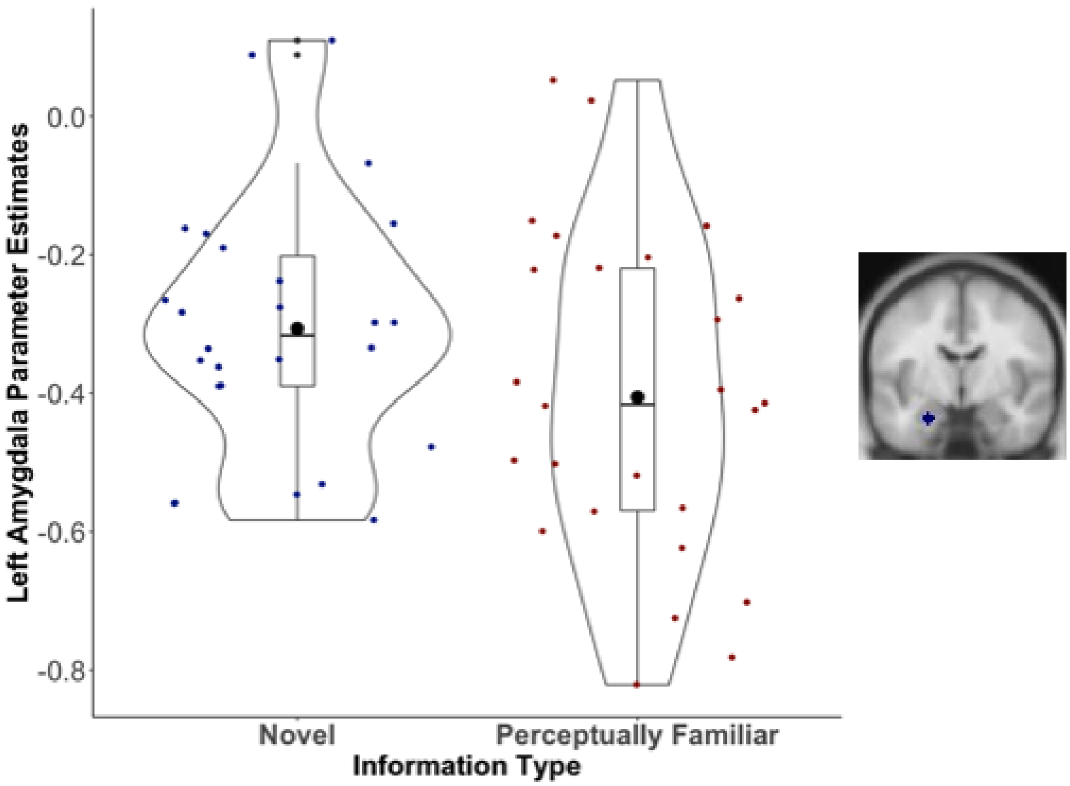


Figure 32: Greater Left Amygdala Activity for Novel v. Perceptually Familiar Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

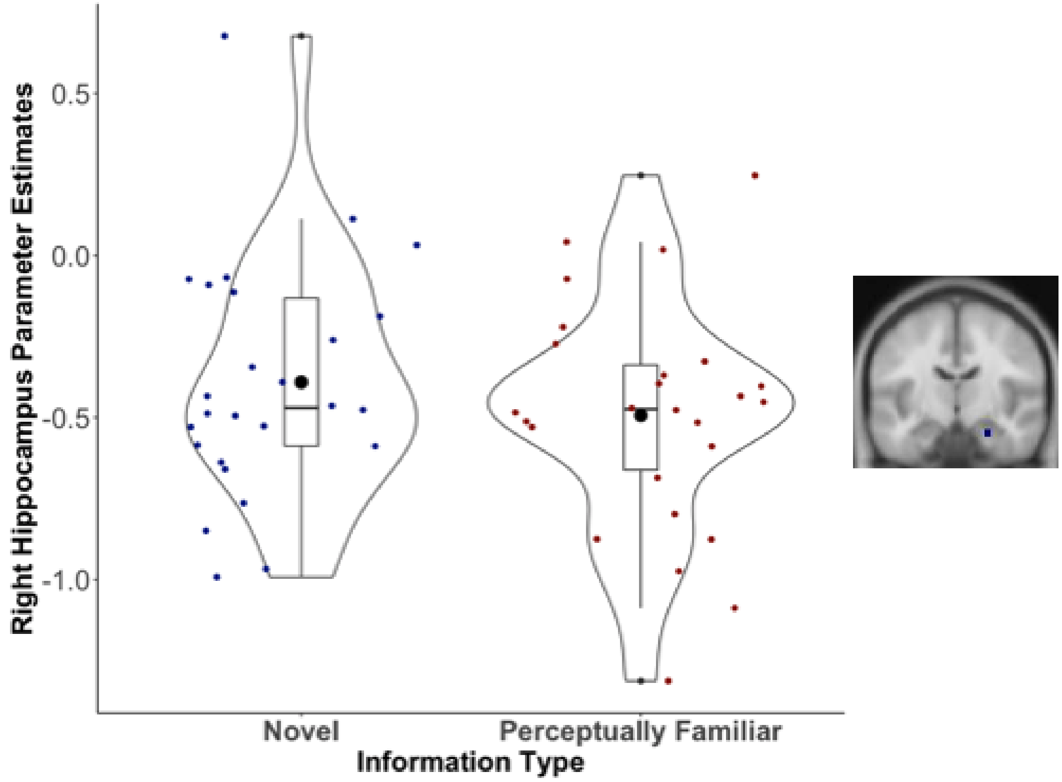


Figure 33: Greater Right Hippocampus Activity for Novel v. Perceptually Familiar Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

3.3.4.7 Positive Person-knowledge vs. Negative Person-knowledge

In this seventh model, we assessed how well brain activity was predicted by target race (Black, White) and information type (positive person-knowledge, negative person-knowledge). Results revealed a significant main effect of race in our confirmatory precuneus, $b = -0.127$, SE = 0.06, $CI_{95\%} = [-0.244, -0.01]$, $t(75) = -2.123$, $p = .037$. Precuneus activity was greater for White targets compared to Black targets (Figure 34) when focusing just on faces paired with person-knowledge.

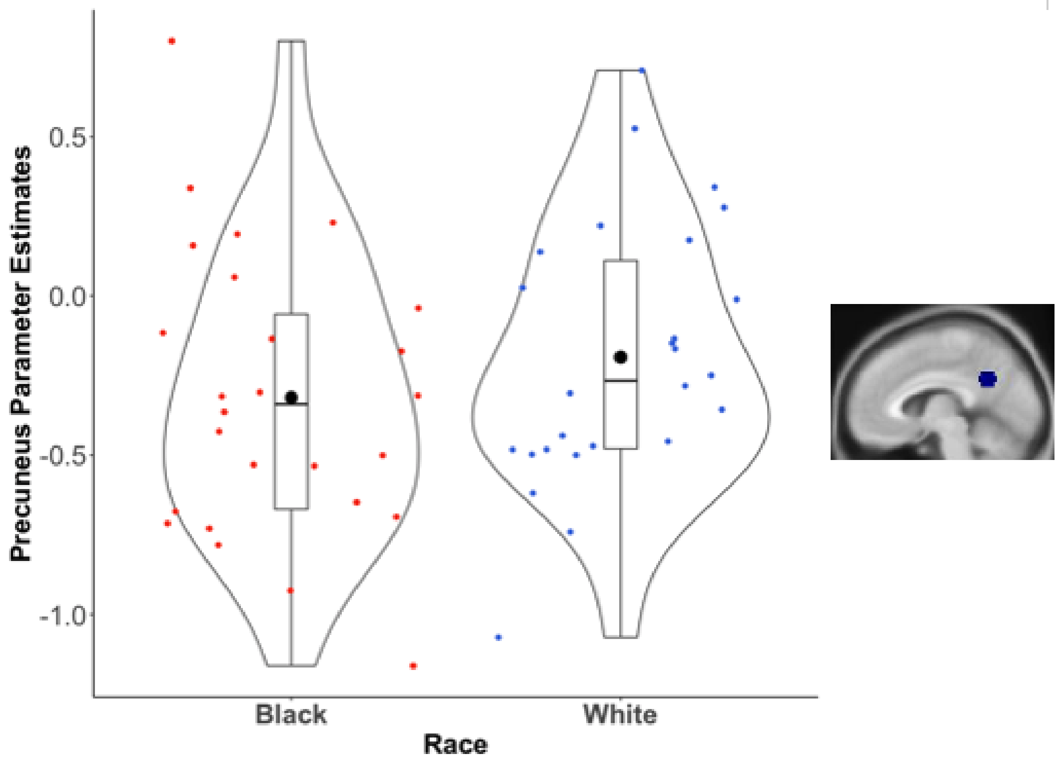


Figure 34: Greater Precuneus Activity for White v. Black Faces. Each dot represents a participants' data point. The rectangle represents the interquartile range, the black dot represents the mean, and the thick line in the middle of the rectangle represents the median.

3.3.5 Exploratory Whole-brain Results

3.3.5.1 Impact of Perceptual Familiarity and Person-knowledge

We did not observe any increases in activity for faces associated with person-knowledge compared to novel faces. However, we did observe greater activity in the right posterior superior temporal sulcus (pSTS) for novel faces compared to faces associated with person-knowledge (Figure 35, Table B15).

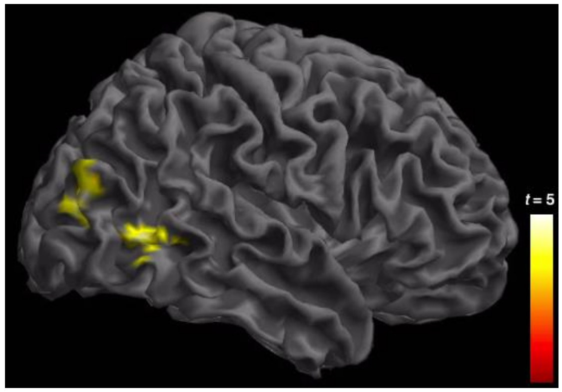


Figure 35: Greater Right pSTS Activity to Novel Faces v. Person-knowledge Faces. The results of this exploratory whole-brain analysis are displayed on a the right hemisphere.

3.3.5.2 Impact of Perceptual Familiarity and Positive Person-knowledge

We did not observe any increases in activity for faces associated with positive person-knowledge compared to novel faces. However, we did observe greater activity in the right pSTS for novel faces compared to faces associated with positive person-knowledge (Figure 36, Table B16).

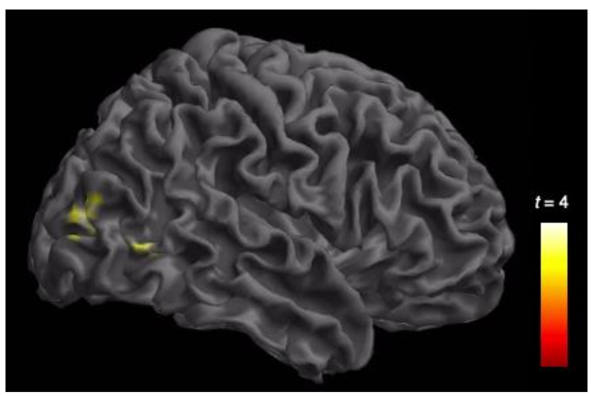


Figure 36: Greater Right pSTS Activity to Novel Faces v. Positive Person-knowledge Faces. The results of this exploratory whole-brain analysis are displayed on the right hemisphere.

3.3.5.3 Impact of Perceptual Familiarity and Negative Person-knowledge

We did not observe any increases in activity for faces associated with negative person-knowledge compared to novel faces. However, we did observe greater activity in the right pSTS for novel faces compared to faces associated with negative person-knowledge (Figure 37, Table B17).

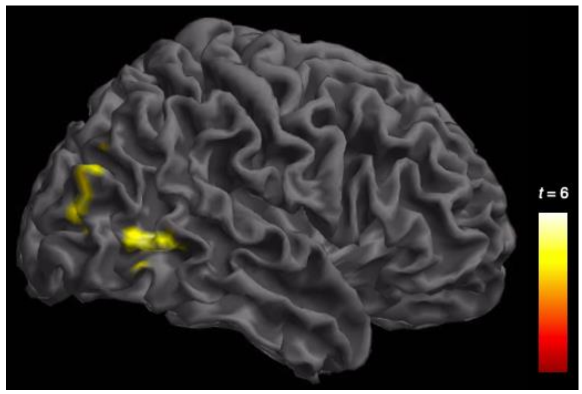


Figure 37: Greater Right pSTS Activity to Novel Faces v. Negative Person-knowledge Faces. The results of this exploratory whole-brain analysis are displayed on the right hemisphere.

3.3.5.4 Impact of Perceptual Familiarity

We did not observe any increases in activity for perceptually familiar only faces compared to novel faces. However, we did observe greater activity in the inferior frontal gyrus and right supramarginal gyrus for novel faces compared to perceptually familiar only faces (Figure 38, Table B18).

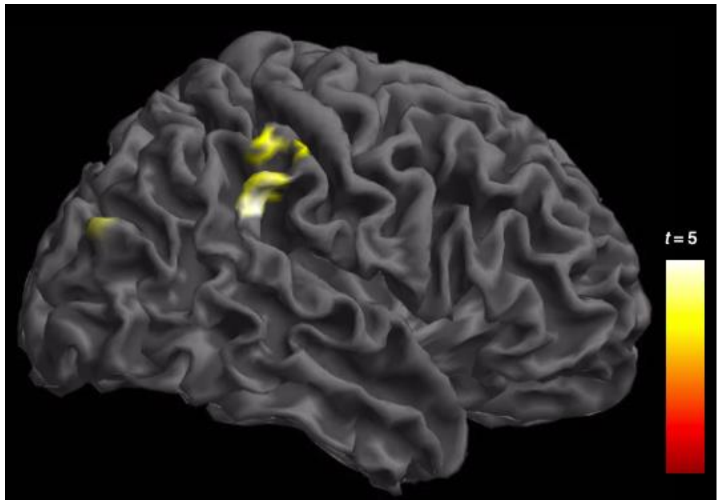


Figure 38: Greater IFG and Supramarginal Gyrus Activity to Novel Faces v. Perceptually Familiar Only Faces. The results of this exploratory whole-brain analysis are displayed on the right hemisphere.

3.3.5.5 Impact of Perceptual Person-knowledge Valence

We did not observe any increases in activity for faces associated with positive person-knowledge compared to negative person-knowledge. Additionally, we did not observe any increases in activity for faces associated with negative person-knowledge compared to positive person-knowledge.

3.3.5.6 Impact of Person-knowledge

We did not observe any increases in activity for faces associated with person-knowledge compared to faces that were just perceptually familiar. Additionally, we did not observe any increases in activity for faces that were just perceptually familiar compared to faces associated with person-knowledge.

3.3.6 Study 2c Discussion

The goal of the current fMRI study was to examine the neural correlates of forming impression of targets that were trained to be perceptually familiar and/or individuated via positive and negative person-knowledge. After five days of individuation training, participants generally were very accurate at face recognition (M = 0.975, SD = 0.037, Mdn = 1.000), attribution of valenced person-knowledge (M = 0.938, SD = 0.105, Mdn = 0.979), and cued recall of person-knowledge (M = 0.641, SD = 0.258, Mdn = 0.682).

We examined five confirmatory ROIs. For the DMPFC, we expected greater activity to (1) faces for which person-knowledge was available regardless of valence compared to just perceptually familiar faces and (2) White targets compared to Black targets regardless of valence. For the VMPFC, we expected greater activity to (1) faces for which positive person-knowledge was available compared to all other information types and (2) White targets paired with positive person-knowledge compared to Black targets paired with positive person-knowledge. For the precuneus, we expected greater activity to perceptually familiar faces compared to novel faces. For the amygdala, we expected greater amygdala activity to (1) novel compared to perceptually familiar faces, (2) novel Black faces compared to novel White faces, and (3) faces paired with negative compared to positive person-knowledge.

However, our findings only partially supported these hypotheses. Results indicated greater precuneus activity to faces paired with person-knowledge compared to novel faces and compared to faces not associated with person-knowledge. Greater precuneus activity to familiar faces is consistent with our hypothesis and research implicating the precuneus in perception of visually familiar faces (Gobbini & Haxby, 2006; Lee, Leung, Lee, Raine, & Chan, 2013). Additionally, greater precuneus activity to faces associated with person-knowledge compared to faces that are just perceptually familiar converges with findings of greater precuneus activity to personally familiar faces compared with famous familiar faces (Gobbini et al., 2004). One of the reasons for this difference may be due to differences in the amount of knowledge available about the targets (Gobbini et al., 2004). Results also indicated greater precuneus activity to White compared to Black faces. This converges with a study that found greater precuneus activity when viewing own-race compared to other-race faces displaying a neutral facial expression (Lee et al., 2008). Results indicated greater right amygdala activity to novel faces compared to faces paired with person-knowledge. Results indicated greater left amygdala activity to novel faces compared to faces that were just perceptually familiar. Greater amygdala activity to novel faces is consistent with our hypotheses and research implicating the amygdala in salience detection (Santos et al., 2011). Therefore, our confirmatory ROI results partially supported our hypotheses for a subset of the analyses, but as these results are still preliminary, they did not survive Bonferroni correction.

However, exploratory whole-brain analyses did not replicate our ROI findings or provide support for our hypotheses. We observed greater activity in the right pSTS for novel faces compared to faces associated with person-knowledge. While we did not hypothesize the involvement of the pSTS, these results are consistent with research indicating that the pSTS is sensitive to both ToM and faces (Deen, Koldewyn, Kanwisher, & Saxe, 2015). Novel faces are generally more salient than familiar faces and could require more attention when forming impressions (Handley, Kubota, & Cloutier, in preparation.). Because there was no available person-knowledge for the novel faces, participants must rely on the available perceptual information when forming impressions. Broadly, the STS is involved in making social inferences from facial cues (i.e., the eyes; Adams et al., 2010; Cloutier, Turk, & Macrae, 2008; Handley et al., 2021; Hoffman & Haxby, 2000; Schurz et al., 2014). Furthermore, the pSTS has been shown to be involved in mentalizing (Bruneau, Dufour, & Saxe, 2012; Deen et al., 2015; Dodell-Feder, Koster-Hale, Bedny, & Saxe, 2011; Moessnang et al., 2017) and face perception (Deen et al., 2015; Engell & McCarthy, 2013). For example, in one study assessing the anterior-posterior organization of the STS, the same participants completed a variety of tasks that often elicit STS activity (Deen et al., 2015). Results indicated that the pSTS was particularly sensitive to both mentalizing and face perception (Deen et al., 2015). Therefore, in the context of the current study, the involvement of the pSTS may indicate that participants were trying to engage in mentalizing to form impressions of the novel faces in the absence of any individuating information. Together these findings suggest that the pSTS supports important social cognitive processes required to infer meaning from social stimuli.

Again, we advise caution when interpreting these results. We speculate that the lack of significant differences depending on target race and information type is due to the study currently being underpowered. We aimed to collect 60 total participants and data collection is ongoing. We are hopeful that once we are better powered to detect these differences, the results will reveal differences depending on the extensively trained information type.

Chapter 4

GENERAL DISCUSSION

Here, we summarize and integrate the studies. However, for the behavioral studies of learning rates (1a, 2a) and face recognition (1c, 2b), we focus on the results from study 1 because study 2 was underpowered.

4.1 Learning Rates of Valenced Individuating Information for Targets Varying in Race

One of the main goals of these studies was to examine accuracy in recognizing and recalling faces varying in race and paired with either none, positive, or negative person-knowledge. To accomplish this, participants learned about Black or White male faces paired with either three pieces of positive person-knowledge, three pieces of negative person-knowledge, or not paired with any person-knowledge. Participants subsequently were tested on their ability of recognize the face as familiar or not, indicate what type of information was paired with the face, and to recall and generate the paired information. This encoding and recall sequence was repeated once a day for five days.

When examining the ability to correctly indicate whether the face was previously presented or novel, the results of study 1a revealed that our White participants displayed a robust other-race effect, where they were more accurate for racial ingroup versus racial outgroup faces even after five days of individuation training. However, participants were also better able to recognize faces paired with person-knowledge regardless of valence compared to faces that were just perceptually familiar and generally got better as sessions progressed. Interestingly, after the last session, participants were equally accurate for faces paired with negative person-knowledge regardless of valence. When examining the individual difference of lifetime interracial contact on recognition accuracy, results indicate that while those with less contact had better accuracy for faces paired with person-knowledge regardless of person-knowledge valence and target race, those with greater contact were equally accurate regardless of whether the face was just perceptually familiar or also paired with person-knowledge. This may be due to greater efficiency with face processing in general for those with greater contact. While we did not replicate the findings in study 2a and did not examine the influence of interracial contact due to being underpowered, results of study 2a also revealed an ORE until the last training session and greater recognition accuracy for faces paired with person-knowledge regardless of valence compared to faces that were just perceptually familiar. Overall, as participants gain more exposure to faces, their accuracy for White faces is at ceiling as they increase their individuation of the Black faces.

When examining the ability to correctly indicate the valence of person-knowledge paired with the face, if any, the results of study 1a revealed that accuracy increased more during the first three sessions and leveled out during the later sessions. Participants were also more accurate when recognizing that a face was paired with no knowledge (i.e., perceptually familiar) compared indicating what type of valenced information (either positive or negative) was paired with a face. This may be because it was easier to just remember that the face was familiar rather than having to remember the face was familiar plus remembering the associated valence. We additionally found that our White participants encoded information about their ingroup more deeply when there was a violation of expectation, when a White target was paired with negative information. This may be because negative person knowledge is counterstereotypic to affective associations of White people in the U.S. (Devine & Elliot, 1995; Weisbuch et al., 2009). According to social identity theory (Tajfel & Turner, 1979, 2004), our participants may be sensitive to negative information regarding the ingroup because these ingroup members may be ideologically threatening. Alternatively, separately from racial stereotypes, they may just have overall positive evaluations of their ingroup. One way to parse these two possible explanations would be to have both Black and White participants learn about Black and White faces paired with positive and negative person-knowledge. If we found that both Black and White participants displayed greater accuracy for White-negative pairs, then this finding is likely due to internalized positive societal associations of White people. However, if Black participants displayed greater accuracy for Black-negative pairs, then the finding is likely due to positive evaluations perceivers' own racial ingroup. Again, while we did not replicate these interactions in study 2a, perhaps due to being underpowered, results from study 2a indicate that participants had better accuracy for faces that were just perceptually familiar compared to faces paired with person-knowledge regardless of valence and participants displayed an ORE such that they were more accurate for White compared to Black faces for all days except the last day. We do not observe any effect of interracial contact on accuracy of information attribution.

When examining the ability to correctly recall and write down the paired statements, the results of study 1a revealed an ORE, such that participants were more accurate for White compared to Black faces for all days. Again, while we did not replicate this interaction in study 2a, perhaps due to being underpowered, results from study 2a indicate that participants had better accuracy for White compared to Black faces across most sessions except they did not differ in accuracy for Black and White faces paired with negative person-knowledge on session 1. However, both studies reveal a robust ORE. Furthermore, when including the individual differences in interracial contact in study 1a, participants with less interracial contact diverged in their recall accuracy depending on race as sessions increased, displaying greater accuracy for recall of White faces. However, accuracy for those with greater interracial contact converged as sessions increased, starting with greater accuracy for White compared to Black faces on session one and having equal accuracy by the last session. This may again be due to increased ability to individuate as individuals with more contact have increased exposure to Black faces. Additionally, participants with higher contact displayed greater recall for negative person-knowledge paired with Black targets and for positive person-knowledge paired with White targets, while lower contact participants displayed greater recall for negative person-knowledge paired with White targets. Overall, participants demonstrated a robust ORE effect across sessions with greater accuracy for White compared to Black faces.

Overall, the results of the learning rates study indicate a pervasive other race effect where our White participants displayed more accurate recognition and recall for White compared to Black participants. However, interracial contact may lead to diminished ORE after multiple exposures, especially when recalling specific paired person-knowledge. This supports the perceptual expertise model that contends that face memory is a skill that is continuously strengthened as we gain more experience with processing faces (Goldstein & Chance, 1985; Kelly et al., 2009; Quinn et al., 2020). Given that we tend to primarily encounter own-race faces, this imbalance in perceptual training may lead perceivers to process outgroup faces as a collection of facial features rather than a cohesive whole, which in turn may lead to poorer performance in other-race facial recognition (DeGutis, Wilmer, Mercado, & Cohan, 2013; Richler, Cheung, & Gauthier, 2011; Wang, Li, Fang, Tian, & Liu, 2012). Other-race faces may be processed in a more piecemeal manner based on facial features, unlike own-race faces which typically are processed in a configural manner (Cloutier & Macrae, 2007; Michel et al., 2006). For example, in a study examining mentalizing about people of different races, when motivated to attend to the task, high-contact White participants were more accurate at inferring both Black and White targets' mental states while the opposite was true for low-contact perceivers (Handley et al., 2021). These results suggest that contact may be associated with general changes in mentalizing irrespective of target race because perceivers with more interracial contact process Black and White faces more similarly (Handley et al., 2021). Interracial contact is associated with general changes in social cognition regardless of target race.

Additionally, participants were more accurate when recognizing faces paired with person-knowledge but were less accurate when indicating the specific type of paired information. This may be due to the difficulty in task. Indeed, it seemed to be harder for participants to identify the type of valence of the paired person-knowledge previously paired with a face in contrast to simply recognizing the face. In a previous study, participants viewed a series of images that varied on valence (positive, negative) and arousal (arousing, non-arousing) and were later unexpectedly tested on their recognition (Mickley Steinmetz & Kensinger, 2009). Results indicated that differences in accuracy did not differ as a function of image valence while arousing images were remember better than non-arousing images (Mickley Steinmetz & Kensinger, 2009). Therefore, in line with our results, participants were able to recognize that they had seen the valenced images before but neither positive nor negative valence provided any advantage (Mickley Steinmetz & Kensinger, 2009). This is consistent with the lack memory advantage for negative compared to positive person-knowledge as predicted by a negativity bias (Ohira et al., 2016; Ortony et al., 1983; Robinson-Riegler & Winton, 2010; Rozin & Royzman, 2001). However, a previous study has posited that the negativity bias may not be as pervasive when all the available information is similarly relevant (i.e., all immoral) because perceivers exert little cognitive effort in processing relevant information compared to when there is a mix of relevancy (both immoral and moral behavior) (Lupfer et al., 2000). In the current study, each target was presented with three statements of consistent, unambiguous valence. Individual differences may influence the tendency to form more negative or positive evaluations (Ito & Cacioppo, 2005; Norris, 2019; Norris et al., 2011). For example, a previous study found that people with stronger positivity offsets formed more positive impressions of targets described by only neutral information and people with stronger negativity biases formed even more negative impressions of targets described by negative information (Ito & Cacioppo, 2005). Therefore, our results indicating no differences between person-knowledge valence may provide support for the hypothesis that perceivers exert less effort when the information describing a target is consistent.

4.2 Face Recognition Generalizability

With this study, our goal was to examine the influence of individuation training on recognition of different faces. In other words, does extensive individuation training improve recognition accuracy to different faces. To accomplish this, participants saw novel faces and were then shown these now familiar faces as well as new novel faces and asked to indicate whether they had seen the face before. They completed this task with new faces both before and after independent, extensive individuation training (i.e., study 1a and 2a). In study 1c, participants were more accurate for White compared to Black faces both at pre-learning for novel faces and post-learning for familiar faces. In study 2b, participants were less accurate for familiar faces post-learning but this did not differ depending on the race of the face. This poorer performance post-learning may demonstrate interference from the training tasks and participants being unsure whether a face was familiar or novel.

In addition, we examined whether their individual learning rates of Black faces from the individuation training (study 1a) impacted their familiarity recognition of novel faces. Overall, regardless of learning rate for Black targets in the individuation training, participants generally displayed less accuracy during the post-learning task, perhaps due to interference from all the faces they encountered during the training sessions. This may also be the reason why analysis accounting for averaged learning rates of Black faces across recognition, attribution of valenced person-knowledge, and cued recall of person-knowledge, indicated that those who had a more difficult time learning were less accurate during the post-learning face recognition task. Similarly, analyses examining the impact of contact found that those with lower contact were less accurate during the post-learning face recognition task. Furthermore, participants with high average learning rate of Black faces and participants with high contact did not differ in their accuracy pre-learning to post-learning. This again suggest that a general advantage in face processing for high interracial contact perceivers is a result of not encounter interference from the extensive learning task.

Contrary to our hypotheses, we did not observe differences in face recognition as a function of race and learning rates of Black faces from the individuation training. Regardless of learning rates for Black targets in the individuation training, there was no effect on race-based recognition accuracy of independentt faces. This is contrary to predictions drawn from both the perceptual expertise (Goldstein & Chance, 1985; Kelly et al., 2009; Quinn et al., 2020) and social-cognitive motivation explanations (Hugenberg et al., 2010) of the ORE. However, a reduction of the ORE was observed for faces that were extensively trained (study 1a). We attempted to mimic interracial contact experienced throughout lifetime via five sessions of individuation training with 24 Black faces but were unsuccessful when generalizing this to an independent set of faces (but see Singh et al., 2021). Therefore, converging with a recent meta-analysis, interracial contact may only have an impact on the ORE in some conditions (Singh et al., 2021). This may indicate that people need to individuate a larger number of exemplars to overcome processing other race faces in a more piecemeal inexpert manner based on facial features, unlike own-race faces which typically are processed in a configural expert way (Cloutier & Macrae, 2007; Michel et al., 2006).

4.3 Neural Correlates of Faces Paired with Learned Person-knowledge

Overall, ROI results indicated support for only two our hypotheses. We found that the precuneus did display greater activity to faces that were associated with person-knowledge. Greater precuneus activity to familiar faces is consistent with our hypothesis and research implicating the precuneus in perception of visually familiar faces (Gobbini & Haxby, 2006; Lee, Leung, Lee, Raine, & Chan, 2013). Additionally, greater precuneus activity to faces associated with person-knowledge compared to faces that are just perceptually familiar converges with findings of greater precuneus activity to personally familiar faces compared with famous familiar faces (Gobbini et al., 2004). One of the reasons for this difference may be due to differences in the amount of knowledge where participants had more person-knowledge about the personally familiar faces (Gobbini et al., 2004) and in the current study, the availability of person-knowledge compared to just perceptual familiarity. Results also indicated greater precuneus activity to White compared to Black faces when examining only faces associated with person-knowledge. This converges with a study that found greater precuneus activity when viewing own-race compared to other-race faces displaying a neutral facial expression (Lee et al., 2008). The precuneus may also be preferentially involved in self-related processing (Kircher et al., 2000). This converges with the current finding of greater precuneus activity to racial ingroup faces because ingroups are more self-related compared to outgroups. We also found that the amygdala did display greater activity to novel faces. Greater amygdala activity to novel faces is consistent with our hypotheses and research implicating the amygdala in salience detection (Santos et al., 2011). However, as these results are still preliminary, none of the ROI results survive Bonferroni correction.

Results did not indicate any differences in ROI activity based on target race. While we did observe greater amygdala activity to novel faces likely due to the salience of novel faces, we predicted greater amygdala activity to novel Black compared to novel White faces due to the increased salience of Black faces as well. This and other predictions involved interactions between race and information type, which we were underpowered to detect.

While we did hypothesize differences in MPFC activity depending on availability and use of person-knowledge, we did not observe any differences in DMPFC or VMPFC activity for any analyses. Based on prior research, we expected greater DMPFC activity when person-knowledge was available compared to when faces were just perceptually familiar (Baron et al., 2011; Cloutier, Kelley, et al., 2011) and greater VMPFC activity when positive person-knowledge was available (Cloutier et al., 2012; Cloutier & Gyurovski, 2014; Dang et al., 2019; Mattan et al., 2017). This lack of differences is likely due to the current study being underpowered and we hope that as data collection continues, the results will provide support for our hypotheses and converge with the exiting research.

In our whole-brain analyses we observed greater activity in the right pSTS for novel faces compared to faces associated with person-knowledge. This converges with the results of a study examining the domain specificity of subregions within the STS (Deen et al., 2015). They found that the pSTS was largely selective for mentalizing and face processing (Deen et al., 2015), converging with other studies that found the pSTS involved in mentalizing (Bruneau et al., 2012; Dodell-Feder et al., 2011; Moessnang et al., 2017) and face perception (Engell & McCarthy, 2013). Our whole-brain results provide further support for posterior STS engagement when forming impressions of novel faces.

4.4 Limitations and Future Directions

An important limitation of the current studies is the inclusion of only White participants recruited from a university campus. This limits the generalizability of the results to perceivers of other races, age groups, and education levels. Therefore, future research should include a more diverse sample, particularly with respect to race. For example, this study could be replicated with Black participants instead of White participants to examine the relative impact of the ORE and culturally learned race-based stereotypes on individuation. Additionally, because the participants had to complete multiple sessions of online training and pass attention checks, the sample that completed the entire study are likely to be different from those who were excluded due to failing the attention checks or voluntarily withdrawing. For example, the final sample may be more conscientious than those who started but did not complete the study. Most of the studies (i.e., all except for the fMRI portion and study 1b post-learning) were completed online at the participant's convenience. While this was a convenient and effective way to collect these data, it is possible that environmental distractions influenced performance. However, we attempted to exclude participants who were not focused by employing catch trials where participants had to respond with a specific answer and were eliminated if they did not get a majority correct.

The use of only White and Black male stimuli also limits the potential generalizability of the results (Cheon, Melani, & Hong, 2020; Chiao & Cheon, 2010).

The stereotypes associated with White men and Black men are not the same stereotypes associated with other groups, such as Asian men or Black women. Therefore, it is important to employ diverse stimuli to more fully characterize how we form impressions and individuate others.

Furthermore, there are limitations due to the face and statement stimuli used in the current study. Firstly, the statements used to convey positive and negative person-knowledge, while equated at the group level on many dimensions including race stereotypicality and arousal, did differ at the stimuli level in arousal and valence. For example, “deliberately tripped an elderly person” ($M_{Arousal}$ = 4.946, $M_{Negativity}$ = 3.265) and “fell out of a tree while doing yard work” ($M_{Arousal}$ = 3.412, $M_{Negativity}$ = 1.686) are both statements used to convey negative person-knowledge that differ in arousal and negativity. While we tried to minimize these unavoidable stimuli-level variation by equating and counterbalancing, individual statements likely varied in memorability. Additionally, some statements were similar in their content which might have led to confusion by not being memorable enough. For example, “fixed a leaky faucet” ($M_{Arousal}$ = 2.000, $M_{Positivity}$ = 2.000) and “offered to help a neighbor fix a fence” ($M_{Arousal}$ = 3.594, $M_{Positivity}$ = 2.091) are both statements used to convey positive person-knowledge that are similar in content and valence. Therefore, although the stimuli were equated, there remains differences that may lead to better memory for some of the statements. Secondly, the trained faces, while equated at the group level on many dimensions including distinctiveness and attractiveness, did differ at the stimuli level due to natural human variation. While using real human faces is a strength of the current study because it better represents faces we encounter in real life, they can differ on dimensions that we cannot control. The faces were selected to be unambiguously Black or White but there is within race variation which may affect memorability or race-related affective associations. For example, people with more Afrocentric features are often judged to have more traits consistent with stereotypes of Black people in the U.S. (Blair, Judd, Sadler, & Jenkins, 2002) and have harsher criminal sentencing (Blair, Judd, & Chaplean, 2004). In the current study, there may be an undetected interaction where culturally learned negative affective associations facilitated learning negative person-knowledge of Black faces judged to have more Afrocentric features. This raises an interesting empirical question on the role of facial expressions in learning valenced person-knowledge of targets varying in race. While we deliberately chose neutral facial expressions, perhaps faces displaying an expression congruent to the assigned person-knowledge valence and affective stereotypes would facilitate learning. For example, there might be better memory for a Black person displaying a scowl paired with negative person-knowledge. Conversely, a mismatch between facial expression, race-based affective stereotypes, and person-knowledge valence could lead to more individuation since participants have to reconcile this mismatch (Heider et al., 2007; Macrae & Bodenhausen, 2000; Quadflieg et al., 2011; Srull & Wyer, 1989).

In the current study, we used novel faces and experimentally manipulated the amount of exposure to equated, valenced person-knowledge. This is one of the experimental benefits of the design because we can systematically control the available person-knowledge to ensure that all participants have roughly the same exposure to individuating information. However, this is also one of the limitations of the study because this is not how we generally learn about others in our daily interactions. For example, in a past study we used actors with whom participants were already familiar and therefore did not experimentally control for exact amount of information known about the actors (Dang et al., 2019). Additionally, we often learn about people from inferences from behaviors instead of written statements. Therefore, this current study where we experimentally control for amount and type of person-knowledge fills a gap in the literature where the stimuli are already known or participants are given more limited opportunities to learn about others.

Additionally, because the number of participants recruited so far for all three studies in Study 2 is below our desired sample size, the results should be interpreted cautiously. Readers should focus on the behavioral results for learning rates and face recognition from Study 1 because we were able to reach our target sample size of 70 participants and are therefore sufficiently powered to detect even the impact of individual differences on our outcome variables. The sample size for the fMRI study (study 2c) is also below our target sample size at 26 analyzed participants compared to our goal of 60 participants. Therefore, because we are looking at social processes after being trained on these previously novel faces, the results must also be interpreted conservatively.

4.5 Conclusion

The current research begins to elucidate the social-cognitive processes that contribute to individuation of others that vary in race and person-knowledge valence. We found that there is a pervasive other race effect where our White participants learned faster and more accurately for White compared to Black faces even after extensive training. Participants also were generally better able to recognize people who were associated with person-knowledge, but had more difficulty identifying the type of paired information, possibly because it was more difficult to identify the valence compared to identifying familiarity. However, people with greater interracial contact displayed convergence in their ability to recall the paired person-knowledge after extensive training while those with lower interracial contact diverged depending on target race and remained worse at recalling information about Black faces. These findings indicate that individual differences, such as interracial contact, may influence the way we learn about others. In an increasingly diverse world where we often interact with others who are different from ourselves, being able to individuate all people is important for our social interactions. We look forward to more research investigating the neural and psychological processes supporting how we form impressions of and learn individuating person-knowledge about a diverse set of people.

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Appendix A

STUDY 1

A.1 Study 1a: Learning Task

A.1.1 Omnibus Models

The omnibus models for the three DVs were as follows:

(1) Face recognition

```
lmer (DV ~ Race * Session * InformationType +
(1 + Race * Session * InformationType | subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

(2) Attribution of valenced person-knowledge

```
lmer (DV ~ Race * Session * InformationType +
(1 + Race + Session + InformationType +
Race:InformationType + Session:InformationType | subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

(3) Cued recall of person-knowledge

```
lmer (DV ~ Race * Session * Valence +
(1 + Race * Session * Valence || subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

The omnibus models for the three DVs including the individual difference of lifetime contact were as follows:

(4) Impact of contact on face recognition

```
lmer (DV ~ Race * Session * InformationType * Contact +
(1 + Race + Session + InformationType +
Race:Session + Race:InformationType + Session:InformationType |
subject),
```

```
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

(5) Impact of contact on attribution of valenced person-knowledge

```
lmer (DV ~ Race * Session * InformationType * Contact +
(1 + Race + Session + InformationType +
Race:InformationType + Session:InformationType | subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

(6) Impact of contact on cued recall of person-knowledge

```
lmer (DV ~ Race * Session * Valence * Contact +
(1 + Race * Session * Valence || subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

A.1.2 Face Recognition

Table A1: Greater Accuracy for White Targets.

Session	Info Type	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1	PF	-0.15	0.026	[-0.201, -0.100]	-5.820	103	< **.001**
	Pos PK	-0.168	0.023	[-0.213, -0.123]	-7.257	609	< **.001**
	Neg PK	-0.162	0.023	[-0.207, -0.118]	-7.108	272	< **.001**
2	PF	-0.147	0.022	[-0.189, -0.104]	-6.814	79	< **.001**
	Pos PK	-0.140	0.018	[-0.175, -0.104]	-7.733	261	< **.001**
	Neg PK	-0.127	0.018	[-0.163, -0.092]	-7.071	109	< **.001**
3	PF	-0.143	0.020	[-0.182, -0.105]	-7.297	69	< **.001**
	Pos PK	-0.112	0.016	[-0.143, -0.080]	-6.966	166	< **.001**
	Neg PK	-0.092	0.016	[-0.123, -0.061]	-5.733	69	< **.001**
4	PF	-0.140	0.021	[-0.180, -0.099]	-6.731	80	< **.001**
	Pos PK	-0.084	0.018	[-0.119, -0.048]	-4.631	261	< **.001**
	Neg PK	-0.057	0.018	[-0.092, -0.022]	-3.157	109	**.002**
5	PF	-0.136	0.024	[-0.184, -0.088]	-5.559	108	< **.001**
	Pos PK	-0.056	0.023	[-0.101, -0.010]	-2.408	609	**.016**
	Neg PK	-0.022	0.023	[-0.066, 0.023]	-0.944	272	.346

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Target race was contrast coded: Black (+0.5) and White (-0.5).

Table A2: Greater Accuracy for Person-knowledge Targets.

Session	Race	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1	Black	PF v. Neg PK	0.159	0.027	[0.106, 0.212]	5.925	134	< **.001**
		PF v. Pos PK	0.144	0.027	[0.091, 0.197]	5.344	144	< **.001**
		Pos PK v. Neg PK	-0.015	0.021	[-0.056, 0.026]	-0.72	1885	.471
	White	PF v. Neg PK	0.171	0.022	[0.129, 0.214]	7.852	208	< **.001**
		PF v. Pos PK	0.171	0.022	[0.129, 0.214]	7.852	208	< **.001**
		Pos PK v. Neg PK	-0.01	0.021	[-0.051, 0.032]	-0.458	1885	.647
2	Black	PF v. Pos PK	0.159	0.024	[0.113, 0.206]	6.694	83	< **.001**
		PF v. Neg PK	0.140	0.024	[0.094, 0.186]	5.936	85	< **.001**
		Pos PK v. Neg PK	-0.019	0.015	[-0.048, 0.010]	-1.299	1885	.194
	White	PF v. Neg PK	0.140	0.018	[0.105, 0.175]	7.793	97	< **.001**
		PF v. Pos PK	0.133	0.017	[0.099, 0.167]	7.677	104	< **.001**
		Pos PK v. Neg PK	-0.007	0.015	[-0.036, 0.023]	-0.448	1885	.655
3	Black	PF v. Neg PK	0.160	0.023	[0.115, 0.204]	7.033	69	< **.001**
		PF v. Pos PK	0.136	0.022	[0.092, 0.180]	6.087	69	< **.001**
		Pos PK v. Neg PK	-0.024	0.012	[-0.047, 0.000]	-1.935	1885	.053
	White	PF v. Neg PK	0.109	0.016	[0.076, 0.141]	6.591	69	< **.001**
		PF v. Pos PK	0.105	0.016	[0.074, 0.136]	6.695	69	< **.001**
		Pos PK v. Neg PK	-0.004	0.012	[-0.027, 0.02]	-0.302	1885	.762
4	Black	PF v. White PK	0.160	0.024	[0.113, 0.207]	6.720	83	< **.001**
		PF v. Pos PK	0.132	0.024	[0.086, 0.179]	5.608	85	< **.001**
		Pos PK v. Neg PK	-0.028	0.015	[-0.057, 0.001]	-1.86	1885	.063
	White	PF v. Neg PK	0.077	0.018	[0.042, 0.112]	4.296	97	< **.001**

		PF v. Pos PK	0.076	0.017	[0.042, 0.110]	4.408	107	< **.001**
		Pos PK v. Neg PK	-0.001	0.015	[-0.03, 0.028]	-0.046	1885	.963
5	Black	PF v. Neg PK	0.160	0.027	[0.108, 0.213]	5.971	134	< **.001**
		PF v. Pos PK	0.128	0.027	[0.076, 0.181]	4.770	144	< **.001**
		Pos PK v. Neg PK	-0.032	0.021	[-0.073, 0.009]	-1.514	1885	.130
	White	PF v. Neg PK	0.046	0.022	[0.003, 0.089]	2.096	208	**.037**
		PF v. Pos PK	0.048	0.022	[0.006, 0.091]	2.216	245	**.028**
		Pos PK v. Neg PK	0.002	0.021	[-0.039, 0.044]	0.109	1885	.913

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different contrast coding pairs depending on the conditions of interest: PF (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

Table A3: Increase in Accuracy Levels Out as Sessions Pass.

Race	Info Type	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Black	PF	1 v. 3	0.242	0.034	[0.176, 0.309]	7.144	164	< **.001**
	Pos PK	1 v. 3	0.273	0.033	[0.208, 0.338]	8.218	444	< **.001**
	Neg PK	1 v. 3	0.271	0.033	[0.207, 0.336]	8.227	434	< **.001**
	PF	3 v. 5	0.068	0.029	[0.010, 0.125]	2.302	1885	**.021**
	Pos PK	3 v. 5	0.042	0.032	[-0.021, 0.105]	1.301	1885	.193
	Neg PK	3 v. 5	0.050	0.032	[-0.013, 0.113]	1.558	1885	.119
	PF	1 v. 5	0.310	0.037	[0.237, 0.382]	8.369	116	< **.001**

	Pos PK	1 v. 5	0.315	0.039	[0.239, 0.391]	8.083	142	< **.001**
	Neg PK	1 v. 5	0.321	0.039	[0.246, 0.397]	8.308	138	< **.001**
	PF	1 v. 3	0.241	0.028	[0.187, 0.296]	8.653	290	< **.001**
	Pos PK	1 v. 3	0.160	0.033	[0.095, 0.226]	4.831	444	< **.001**
	Neg PK	1 v. 3	0.159	0.033	[0.094, 0.224]	4.819	434	< **.001**
	PF	3 v. 5	0.065	0.029	[0.007, 0.122]	2.192	1885	**.028**
White	Pos PK	3 v. 5	0.029	0.033	[-0.035, 0.093]	0.887	1954	.375
	Neg PK	3 v. 5	0.024	0.032	[-0.039, 0.087]	0.742	1954	.458
	PF	1 v. 5	0.306	0.028	[0.252, 0.360]	11.043	197	< **.001**
	Pos PK	1 v. 5	0.189	0.030	[0.130, 0.249]	6.256	275	< **.001**
	Neg PK	1 v. 5	0.183	0.030	[0.124, 0.241]	6.121	262	< **.001**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v. Session 5 (+0.5); and Session 3 (-0.5) v. Session 5 (+0.5).

Table A4: Greatest Increase in Accuracy Occurs During Session 2.

Race	Info Type	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
	PF	1 v. 2	0.122	0.031	[0.061, 0.182]	3.960	499	< **.001**
Black	Pos PK	1 v. 2	0.208	0.033	[0.143, 0.273]	6.259	635	< **.001**
	Neg PK	1 v. 2	0.191	0.033	[0.126, 0.255]	5.787	624	< **.001**

	PF	2 v. 3	0.120	0.029	[0.063, 0.178]	4.107	1885	< **.001**
	Pos PK	2 v. 3	0.065	0.032	[0.002, 0.129]	2.025	1885	**.043**
	Neg PK	2 v. 3	0.081	0.032	[0.018, 0.143]	2.521	1885	**.012**
White	PF	1 v. 2	0.194	0.031	[0.133, 0.254]	6.301	499	< **.001**
	Pos PK	1 v. 2	0.136	0.033	[0.071, 0.201]	4.088	635	< **.001**
	Neg PK	1 v. 2	0.153	0.033	[0.088, 0.217]	4.635	624	< **.001**
	PF	2 v. 3	0.048	0.029	[-0.010, 0.105]	1.627	1885	.104
	Pos PK	2 v. 3	0.025	0.032	[-0.038, 0.088]	0.770	1885	.441
	Neg PK	2 v. 3	0.006	0.032	[-0.056, 0.069]	0.194	1885	.846

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are two different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 2 (+0.5) and Session 2 (-0.5) v. Session 3 (+0.5).

Table A5: The Difference in Accuracy Between White and Black Targets Decreased as Sessions Passed.

Info Type	Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	1 v. 3	0.075	0.024	[0.028, 0.122]	3.132	1885	**.002**
Pos PK	1 v. 3	0.075	0.021	[0.034, 0.117]	3.557	1747	**< .001**
Neg PK	1 v. 3	0.075	0.022	[0.033, 0.118]	3.463	1816	**.001**
PF	3 v. 5	0.014	0.027	[-0.038, 0.067]	0.531	1954	.596
Pos PK	3 v. 5	0.014	0.025	[-0.034, 0.063]	0.575	1885	.565
Neg PK	3 v. 5	0.014	0.025	[-0.035, 0.063]	0.570	1885	.569
PF	1 v. 5	0.089	0.022	[0.045, 0.133]	3.986	1885	**< .001**
Pos PK	1 v. 5	0.089	0.027	[0.037, 0.142]	3.366	69	**.001**
Neg PK	1 v. 5	0.089	0.027	[0.037, 0.142]	3.366	69	**.001**
PF	1 v. 2	0.013	0.025	[-0.037, 0.062]	0.502	1885	.616
Pos PK	1 v. 2	0.013	0.023	[-0.032, 0.057]	0.559	1747	.576
Neg PK	1 v. 2	0.013	0.023	[-0.033, 0.058]	0.548	1816	.584
PF	2 v. 3	0.063	0.027	[0.010, 0.115]	2.343	1954	**.019**
Pos PK	2 v. 3	0.063	0.025	[0.014, 0.111]	2.542	1885	**.011**
Neg PK	2 v. 3	0.063	0.025	[0.014, 0.111]	2.518	1885	**.012**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Target race was contrast coded: Black (+0.5) and White (-0.5). There are five different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v. Session 5 (+0.5); Session 3 (-0.5) v. Session 5 (+0.5); Session 1 (-0.5) v. Session 2 (+0.5); and Session 2 (-0.5) v. Session 3 (+0.5).

A.1.3 Attribution of Valenced Person-knowledge

Table A6: Greater Accuracy for White vs. Black Targets Associated with Negative Person-knowledge.

Info Type	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	0.002	0.015	[-0.028, 0.031]	0.105	67	.916
Pos PK	-0.016	0.014	[-0.043, 0.012]	-1.096	1881	.273
Neg PK	-0.094	0.014	[-0.122, -0.066]	-6.594	1880	< **.001**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Target race was contrast coded: Black (+0.5) and White (-0.5).

Table A7: Greater Accuracy for Counterstereotypic White Targets.

Race	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Black	PF v. Neg PK	-0.085	0.024	[-0.132, -0.039]	-3.603	69	**.001**
	PF v. Pos PK	-0.055	0.025	[-0.104, -0.007]	-2.243	69	**.028**
	Pos PK v. Neg PK	0.030	0.016	[-0.001, 0.061]	1.898	195	.059
White	PF v. Neg PK	0.011	0.021	[-0.030, 0.051]	0.522	69	.603
	PF v. Pos PK	-0.038	0.022	[-0.081, 0.006]	-1.699	105	.092
	Pos PK v. Neg PK	-0.048	0.016	[-0.079, -0.017]	-3.020	195	**.003**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different condition contrast coding pairs depending on the conditions of interest: PF (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

Table A8: Greatest Accuracy for Perceptually Familiar Targets After Session 3.

Session	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1	PF v. Pos PK	-0.006	0.024	[-0.053, 0.042]	-0.237	146	.813
	PF v. Neg PK	0.002	0.023	[-0.043, 0.047]	0.072	163	.943
	Pos PK v. Neg PK	-0.007	0.019	[-0.044, 0.030]	-0.355	369	.723
2	PF v. Pos PK	-0.026	0.021	[-0.068, 0.015]	-1.239	86	.219

	PF v. Neg PK	-0.018	0.022	[-0.061, 0.026]	-0.800	69	.426
	Pos PK v. Neg PK	-0.008	0.014	[-0.036, 0.020]	-0.550	125	.583
	PF v. Pos PK	-0.046	0.020	[-0.086, -0.007]	-2.325	69	**.023**
3	PF v. Neg PK	-0.037	0.019	[-0.074, -0.001]	-2.014	69	**.048**
	Pos PK v. Neg PK	-0.009	0.012	[-0.033, 0.015]	-0.729	69	.468
	PF v. Pos PK	-0.067	0.021	[-0.109, -0.026]	-3.166	87	**.002**
4	PF v. Neg PK	-0.057	0.019	[-0.094, -0.020]	-3.001	69	**.004**
	Pos PK v. Neg PK	-0.010	0.014	[-0.038, 0.018]	-0.706	125	.482
	PK v. Pos PK	-0.088	0.024	[-0.136, -0.040]	-3.588	152	< **.001**
5	PK v. Neg PK	-0.077	0.023	[-0.122, -0.031]	-3.301	69	**.002**
	Pos PK v. Neg PK	-0.011	0.019	[-0.048, 0.026]	-0.588	368	.557

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different condition contrast coding pairs depending on the conditions of interest: PF (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

Table A9: Greater Accuracy for Session 3 vs. Session 1.

Info Type	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	1 v. 3	0.250	0.034	[0.183, 0.316]	7.360	68	< **.001**
	1 v. 5	0.238	0.035	[0.170, 0.306]	6.862	68	< **.001**
	3 v. 5	-0.012	0.023	[-0.057, 0.034]	-0.506	1949	.613
Pos PK	1 v. 3	0.144	0.026	[0.094, 0.195]	5.638	279	< **.001**
	1 v. 5	0.144	0.026	[0.093, 0.196]	5.498	256	< **.001**
	3 v. 5	0.000	0.024	[-0.047, 0.047]	-0.001	1949	.999
Neg PK	1 v. 3	0.164	0.026	[0.114, 0.214]	6.398	281	< **.001**
	1 v. 5	0.152	0.026	[0.100, 0.203]	5.764	258	< **.001**
	3 v. 5	-0.013	0.024	[-0.060, 0.035]	-0.523	1949	.601

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different condition contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v. Session 5 (+0.5); and Session 3 (-0.5) v. Session 5 (+0.5).

Table A10: Accuracy Increases as Sessions Pass.

Info Type	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	1 v. 2	0.166	0.025	[0.117, 0.214]	6.717	327	< **.001**
	2 v. 3	0.081	0.023	[0.036, 0.126]	3.537	1949	< **.001**
Pos PK	1 v. 2	0.083	0.025	[0.034, 0.133]	3.312	349	**.001**
	2 v. 3	0.061	0.024	[0.014, 0.108]	2.558	1949	**.011**
Neg PK	1 v. 2	0.128	0.025	[0.052, 0.123]	5.086	355	< **.001**
	2 v. 3	0.036	0.024	[-0.011, 0.083]	1.500	1949	.134

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are two different condition contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 2 (+0.5) and Session 2 (-0.5) v. Session 3 (+0.5).

A.1.4 Cued Recall of Person-knowledge

Table A11: Greater Accuracy for White Targets.

Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1	-0.038	0.011	[-0.059, -0.017]	-3.536	109	**.001**
2	-0.049	0.010	[-0.068, -0.030]	-4.997	78	< **.001**
3	-0.060	0.010	[-0.079, -0.041]	-6.165	69	< **.001**
4	-0.070	0.010	[-0.091, -0.050]	-6.895	84	< **.001**
5	-0.081	0.012	[-0.104, -0.058]	-6.955	146	< **.001**

Significant effects are bolded. Degrees of freedom vary due to the random effects. modeling. Target race was contrast coded: Black (+0.5) and White (-0.5).

Table A12: Accuracy Increased as Sessions Passed.

Race	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Black	1 v. 3	0.118	0.020	[0.079, 0.157]	5.936	185	< **.001**
	1 v. 5	0.210	0.030	[0.151, 0.269]	7.033	85	< **.001**
	3 v. 5	0.092	0.021	[0.050, 0.134]	4.303	162	< **.001**
White	1 v. 3	0.161	0.020	[0.122, 0.201]	8.106	184	< **.001**
	1 v. 5	0.258	0.030	[0.200, 0.317]	8.638	85	< **.001**
	3 v. 5	0.095	0.022	[0.053, 0.137]	4.401	166	< **.001**

Significant effects are bolded. Degrees of freedom vary due to the random effects. modeling. There are three different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v. Session 5 (+0.5); and Session 3 (-0.5) v. Session 5 (+0.5).

A.1.5 Impact of Contact on Face Recognition

We analyzed simple effects for the 3-way interaction of Race x Session x Information Type. Accuracy for White faces is greater than for Black faces for every information type for every session except faces paired with negative person-knowledge on session 5 (Table A13). Accuracy for perceptually familiar faces was less than faces paired with positive and negative person-knowledge, but there was no difference between the two person-knowledge conditions regardless of target race (Table A14). Comparing accuracy across sessions 1 v. 3, 3 v. 5, and 1 v. 5, accuracy was greater for later sessions for all information types within target race except when comparing person-knowledge conditions of sessions 3 and 5 (Table A15). Comparing sessions 1 v. 2 and 2 v. 3, accuracy for sessions 2 and 3, respectively, was greater for all information types within target race, except for all information type comparisons between session 2 and 3 for White targets (Table A16). See Figure A1.

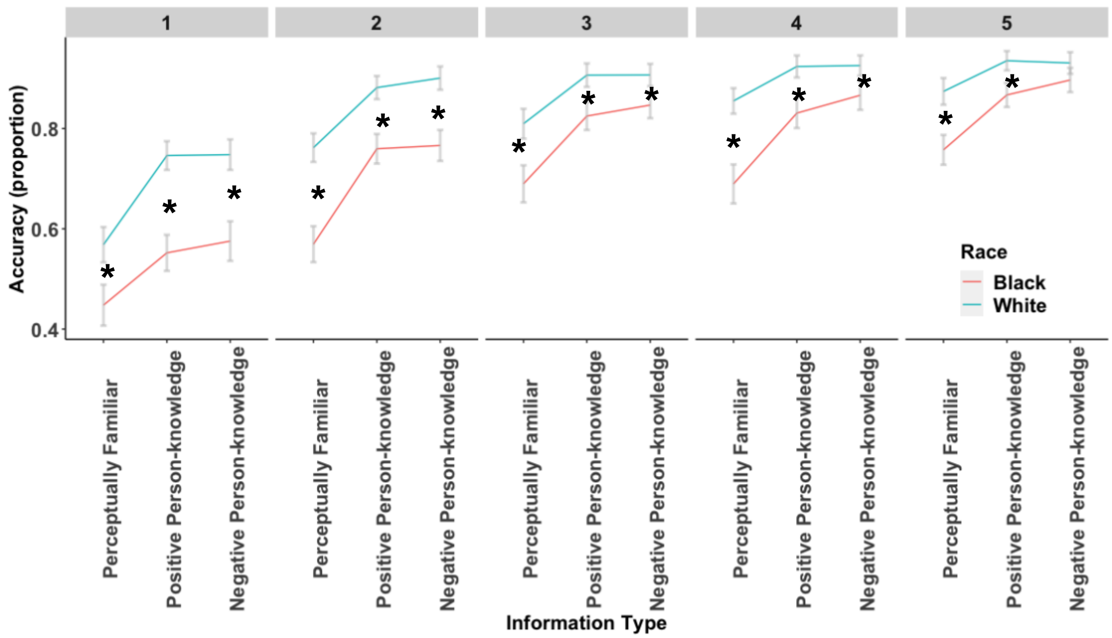

Figure A1: Greater Accuracy for White Targets and Person-knowledge Targets. Standard error bars are displayed.

Table A13: Greater Accuracy for White Targets.

Session	Info Type	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1	PF	-0.15	0.025	[-0.199, -0.101]	-6.001	104	< **.001**
	Pos PK	-0.168	0.023	[-0.213, -0.123]	-7.294	621	< **.001**
	Neg PK	-0.162	0.023	[-0.207, -0.118]	-7.127	270	< **.001**
2	PF	-0.147	0.021	[-0.188, -0.106]	-7.009	78	< **.001**
	Pos PK	-0.14	0.018	[-0.175, -0.105]	-7.796	265	< **.001**
	Neg PK	-0.127	0.018	[-0.162, -0.092]	-7.096	107	< **.001**
3	PF	-0.143	0.019	[-0.181, -0.105]	-7.430	68	< **.001**
	Pos PK	-0.112	0.016	[-0.143, -0.081]	-7.036	167	< **.001**
	Neg PK	-0.092	0.016	[-0.123, -0.061]	-5.758	68	< **.001**
4	PF	-0.14	0.021	[-0.180, -0.099]	-6.763	79	< **.001**
	Pos PK	-0.084	0.018	[-0.119, -0.049]	-4.669	265	< **.001**
	Neg PK	-0.057	0.018	[-0.092, -0.022]	-3.168	107	**.002**
5	PF	-0.136	0.025	[-0.184, -0.088]	-5.543	106	< **.001**
	Pos PK	-0.056	0.023	[-0.101, -0.011]	-2.420	621	**.016**
	Neg PK	-0.022	0.023	[-0.066, 0.023]	-0.947	270	.345

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Target race was contrast coded: Black (+0.5) and White (-0.5).

Table A14: Greater Accuracy for Person-knowledge Targets.

Session	Race	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1	Black	PF v. Neg PK	0.159	0.026	[0.108, 0.211]	6.053	137	< **.001**
		PF v. Pos PK	0.144	0.026	[0.092, 0.196]	5.444	146	< **.001**
		Pos PK v. Neg PK	-0.015	0.021	[-0.056, 0.026]	-0.720	1880	.471
	White	PF v. Neg PK	0.171	0.022	[0.129, 0.214]	7.967	214	< **.001**
		PF v. Pos PK	0.162	0.022	[0.119, 0.204]	7.496	244	< **.001**
		Pos PK v. Neg PK	-0.010	0.021	[-0.051, 0.032]	-0.458	1880	.647
2	Black	PF v. Pos PK	0.159	0.019	[0.122, 0.197]	8.398	138	< **.001**
		PF v. Neg PK	0.140	0.023	[0.095, 0.185]	6.079	85	< **.001**
		Pos PK v. Neg PK	-0.019	0.015	[-0.048, 0.01]	-1.299	1880	.194
	White	PF v. Neg PK	0.140	0.018	[0.106, 0.174]	7.963	98	< **.001**
		PF v. Pos PK	0.133	0.017	[0.100, 0.167]	7.736	106	< **.001**
		Pos PK v. Neg PK	-0.007	0.015	[-0.036, 0.022]	-0.448	1880	.654
3	Black	PF v. Neg PK	0.160	0.022	[0.116, 0.203]	7.247	68	< **.001**
		PF v. Pos PK	0.136	0.022	[0.093, 0.179]	6.251	68	< **.001**
		Pos PK v. Neg PK	-0.024	0.012	[-0.047, 0.000]	-1.935	1880	.053
	White	PF v. Neg PK	0.109	0.016	[0.077, 0.140]	6.762	68	< **.001**
		PF v. Pos PK	0.105	0.016	[0.074, 0.135]	6.748	68	< **.001**
		Pos PK v. Neg PK	-0.004	0.012	[-0.027, 0.020]	-0.302	1880	.762
4	Black	PF v. White PK	0.160	0.023	[0.115, 0.205]	6.906	83	< **.001**
		PF v. Pos PK	0.132	0.023	[0.087, 0.177]	5.744	85	< **.001**
		Pos PK v. Neg PK	-0.028	0.015	[-0.057, 0.001]	-1.861	1880	.063
	White	PF v. Neg PK	0.077	0.018	[0.043, 0.112]	4.389	98	< **.001**

		PF v. Pos PK	0.076	0.020	[0.038, 0.115]	3.910	135	< **.001**
		Pos PK v. Neg PK	-0.001	0.015	[-0.030, 0.028]	-0.046	1880	.963
5	Black	PF v. Neg PK	0.160	0.026	[0.109, 0.212]	6.101	137	< **.001**
		PF v. Pos PK	0.128	0.026	[0.077, 0.180]	4.860	146	< **.001**
		Pos PK v. Neg PK	-0.032	0.021	[-0.073, 0.009]	-1.514	1880	.130
	White	PF v. Neg PK	0.046	0.022	[0.004, 0.088]	2.127	214	**.035**
		PF v. Pos PK	0.048	0.022	[0.006, 0.090]	2.226	244	**.027**
		Pos PK v. Neg PK	0.002	0.021	[-0.039, 0.044]	0.109	1880	.913

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different contrast coding pairs depending on the conditions of interest: PF (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

Table A15: Increase in Accuracy Levels Out as Sessions Pass.

Race	Info Type	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
	PF	1 v. 3	0.242	0.034	[0.176, 0.309]	7.127	161	< **.001**
	Pos PK	1 v. 3	0.273	0.033	[0.208, 0.338]	8.200	434	< **.001**
	Neg PK	1 v. 3	0.271	0.033	[0.207, 0.336]	8.208	425	< **.001**
Black	PF	1 v. 5	0.310	0.037	[0.237, 0.382]	8.386	115	< **.001**
	Pos PK	1 v. 5	0.315	0.039	[-0.08, -0.032]	8.097	141	< **.001**
	Neg PK	1 v. 5	0.321	0.039	[0.246, 0.397]	8.323	137	< **.001**
	PF	3 v. 5	0.068	0.029	[0.010, 0.126]	2.301	1880	**.022**

	Pos PK	3 v. 5	0.042	0.032	[-0.021, 0.106]	1.300	1880	.194
	Neg PK	3 v. 5	0.050	0.032	[-0.013, 0.113]	1.554	1948	.120
	PF	1 v. 3	0.241	0.028	[0.186, 0.296]	8.623	283	< **.001**
	Pos PK	1 v. 3	0.160	0.033	[0.095, 0.226]	4.821	434	< **.001**
	Neg PK	1 v. 3	0.159	0.033	[0.094, 0.224]	4.809	425	< **.001**
	PF	1 v. 5	0.306	0.028	[0.251, 0.360]	10.997	192	< **.001**
White	Pos PK	1 v. 5	0.189	0.030	[0.130, 0.249]	6.232	267	< **.001**
	Neg PK	1 v. 5	0.183	0.030	[0.124, 0.242]	6.097	255	< **.001**
	PF	3 v. 5	0.065	0.029	[0.007, 0.122]	2.191	1880	**.029**
	Pos PK	3 v. 5	0.029	0.033	[-0.035, 0.093]	0.887	1948	.375
	Neg PK	3 v. 5	0.024	0.032	[-0.039, 0.087]	0.743	1948	.458

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v. Session 5 (+0.5); and Session 3 (-0.5) v. Session 5 (+0.5).

Table A16: Greatest Increase in Accuracy Occurs During Session 2.

Race	Info Type	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Black	PF	1 v. 2	0.122	0.031	[0.061, 0.182]	3.948	485	< **.001**
	Pos PK	1 v. 2	0.208	0.033	[0.142, 0.273]	6.242	619	< **.001**
	Neg PK	1 v. 2	0.191	0.033	[0.126, 0.256]	5.771	608	< **.001**
	PF	2 v. 3	0.120	0.029	[0.063, 0.178]	4.105	1880	< **.001**

	Pos PK	2 v. 3	0.065	0.032	[0.002, 0.129]	2.024	1880	**.043**
	Neg PK	2 v. 3	0.081	0.032	[0.018, 0.143]	2.518	1880	**.012**
White	PF	1 v. 2	0.194	0.031	[0.133, 0.254]	6.283	485	< **.001**
	Pos PK	1 v. 2	0.136	0.033	[0.070, 0.201]	4.077	619	< **.001**
	Neg PK	1 v. 2	0.153	0.033	[0.088, 0.218]	4.621	608	< **.001**
	PF	2 v. 3	0.048	0.029	[-0.01, 0.105]	1.626	1880	.104
	Pos PK	2 v. 3	0.025	0.032	[-0.038, 0.088]	0.769	1880	.442
	Neg PK	2 v. 3	0.006	0.032	[-0.057, 0.069]	0.194	1880	.846

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are two different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 2 (+0.5) and Session 2 (-0.5) v. Session 3 (+0.5).

Lastly, we examined if the magnitude of difference between accuracy for perceived Black and White targets with the same information type differed across session. This difference was larger for later sessions for the comparison between session 1 v. 3, and 2 v. 3, and 1 v. 5 for all information types (Table A17).

Table A17: The Difference in Accuracy Between White and Black Targets Decreased as Sessions Passed.

Info Type	Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	1 v. 3	0.075	0.024	[0.028, 0.122]	3.130	1880	**.002**
Pos PK	1 v. 3	0.075	0.021	[0.034, 0.117]	3.556	1744	**< .001**
Neg PK	1 v. 3	0.075	0.022	[0.033, 0.118]	3.462	1812	**.001**
PF	1 v. 5	0.089	0.022	[0.045, 0.133]	3.985	1880	**< .001**
Pos PK	1 v. 5	0.089	0.026	[0.038, 0.141]	3.388	68	**.001**
Neg PK	1 v. 5	0.089	0.026	[0.038, 0.141]	3.388	68	**.001**
PF	3 v. 5	0.014	0.027	[-0.038, 0.067]	0.530	1948	.596
Pos PK	3 v. 5	0.014	0.025	[-0.034, 0.063]	0.574	1880	.566
Neg PK	3 v. 5	0.014	0.025	[-0.035, 0.063]	0.569	1880	.569
PF	1 v. 2	0.013	0.025	[-0.037, 0.062]	0.502	1880	.616
Pos PK	1 v. 2	0.013	0.023	[-0.032, 0.057]	0.559	1744	.576
Neg PK	1 v. 2	0.013	0.023	[-0.033, 0.058]	0.548	1812	.584
PF	2 v. 3	0.063	0.027	[0.010, 0.115]	2.341	1948	**.019**
Pos PK	2 v. 3	0.063	0.025	[0.014, 0.111]	2.539	1880	**.011**
Neg PK	2 v. 3	0.063	0.025	[0.014, 0.111]	2.516	1880	**.012**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Target race was contrast coded: Black (+0.5) and White (-0.5). There are five different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v.

Session 5 (+0.5); Session 3 (-0.5) v. Session 5 (+0.5); Session 1 (-0.5) v. Session 2 (+0.5); and Session 2 (-0.5) v. Session 3 (+0.5).

Table A18: Lower Contact Participants were Less Accurate for Perceptually Familiar Faces.

Contact	Info Type	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Low	PF v. Pos PK	0.191	0.037	[0.119, 0.264]	5.162	68	< **.001**
Average	PF v. Pos PK	0.121	0.016	[0.088, 0.153]	7.322	68	< **.001**
High	PF v. Pos PK	0.050	0.037	[-0.023, 0.123]	1.350	68	.182
Low	PF v. Neg PK	-0.220	0.036	[-0.29, -0.150]	-6.154	68	< **.001**
Average	PF v. Neg PK	-0.134	0.016	[-0.165, -0.103]	-8.445	68	< **.001**
High	PF v. Neg PK	-0.048	0.036	[-0.118, 0.022]	-1.356	68	.180
Low	Pos PK v. Neg PK	-0.029	0.015	[-0.058, 0.001]	-1.906	1180	.057
Average	Pos PK v. Neg PK	-0.014	0.007	[-0.027, -0.000]	-2.028	1180	**.043**
High	Pos PK v. Neg PK	0.002	0.015	[-0.028, 0.031]	0.103	1180	.918

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different contrast coding pairs depending on the conditions of interest: PF (+0.5) v. Neg PK (-0.5); PF (-0.5) v. Pos PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

Table A19: No Differences in Accuracy by Information Type Depending on Contact Level.

Info Type	*b*	SE	*95% CIs*	*t*(68)	*p-value*
PF	0.009	0.028	[-0.046, 0.064]	0.323	.748
Pos PK	-0.026	0.021	[-0.068, 0.016]	-1.228	.224
Neg PK	-0.034	0.022	[-0.077, 0.010]	-1.523	.132

Significant effects are bolded. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Contact was centered on average (0).

A.1.6 Impact of Contact on Attribution of Valenced Person-knowledge

First, we analyzed simple effects for the Race x Information Type 2-way interaction. Accuracy for White faces is greater than for Black faces for negative person-knowledge pairs (Table A20). Accuracy for perceptually familiar faces is greater compared to both positive and negative person-knowledge but there is no difference between the two person-knowledge conditions for Black targets (Table A21). Accuracy for negative person-knowledge faces is greater compared to positive person-knowledge but there is no difference between any other information types for White targets (Table A21). See Figure A2.

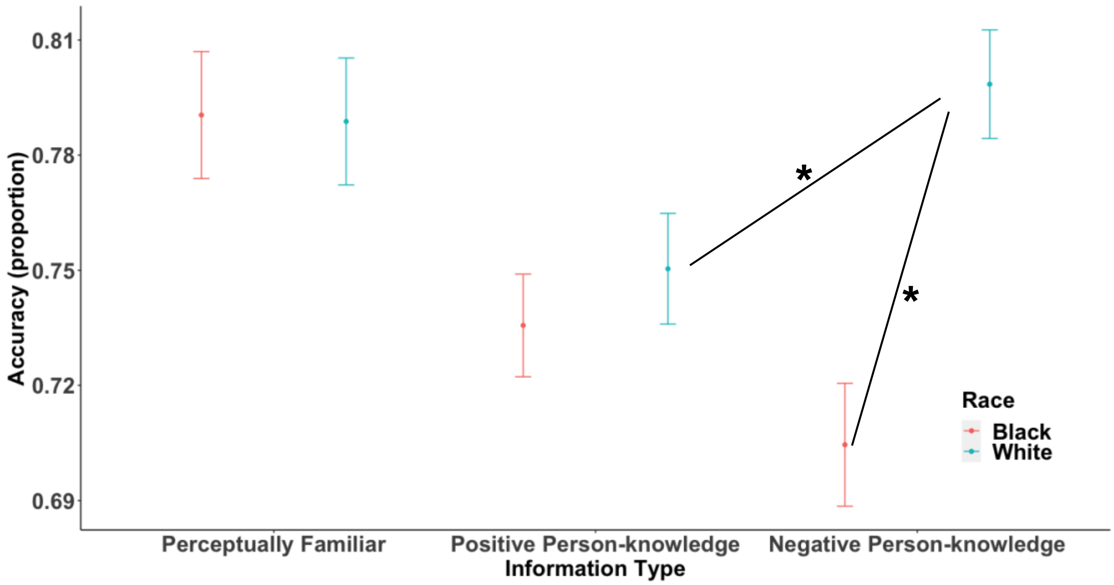

Figure A2: Greater Accuracy for Counterstereotypic White Targets. Standard error bars are displayed.

Table A20: Greater Accuracy for White vs. Black Targets Associated with Negative Person-knowledge.

Info Type	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	0.002	0.014	[-0.025, 0.029]	0.138	474	.890
Pos PK	-0.016	0.014	[-0.043, 0.012]	-1.095	1876	.274
Neg PK	-0.094	0.014	[-0.122, -0.066]	-6.601	1875	< **.001**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Target race was contrast coded: Black (+0.5) and White (-0.5).

Table A21: Greater Accuracy for Counterstereotypic White Targets.

Race	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Black	PF v. Neg PK	-0.086	0.021	[-0.127, -0.044]	-4.063	110	< **.001**

	PF v. Pos PK	-0.055	0.022	[-0.099, -0.012]	-2.477	103	**.015**
	Pos PK v. Neg PK	0.030	0.016	[-0.001, 0.061]	1.920	198	.056
White	PF v. Neg PK	0.011	0.021	[-0.031, 0.052]	0.503	110	.616
	PF v. Pos PK	-0.038	0.022	[-0.081, 0.006]	-1.695	103	.093
	Pos PK v. Neg PK	-0.048	0.016	[-0.079, -0.017]	-3.054	197	**.003**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different condition contrast coding pairs depending on the conditions of interest: PF (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

Next, we analyzed simple effects for the Session x Information Type 2-way interaction. Accuracy for perceptually familiar faces is greater than both positive and negative person-knowledge faces in sessions 3, 4, and 5 but there was no difference between the two person-knowledge conditions (Table A22). Comparing sessions 1 v. 3, 3 v.5, and 1 v.5 accuracy for sessions 3 and 5 is always greater than session 1 for all information types but there was no difference comparing sessions 3 v.5 regardless of information type (Table A23). Lastly, comparing sessions 1 v.2 and 2 v.3, accuracy for later sessions is greater for all information types except for negative person-knowledge conditions between session 2 v.3 (Table A24). See Figure A3.

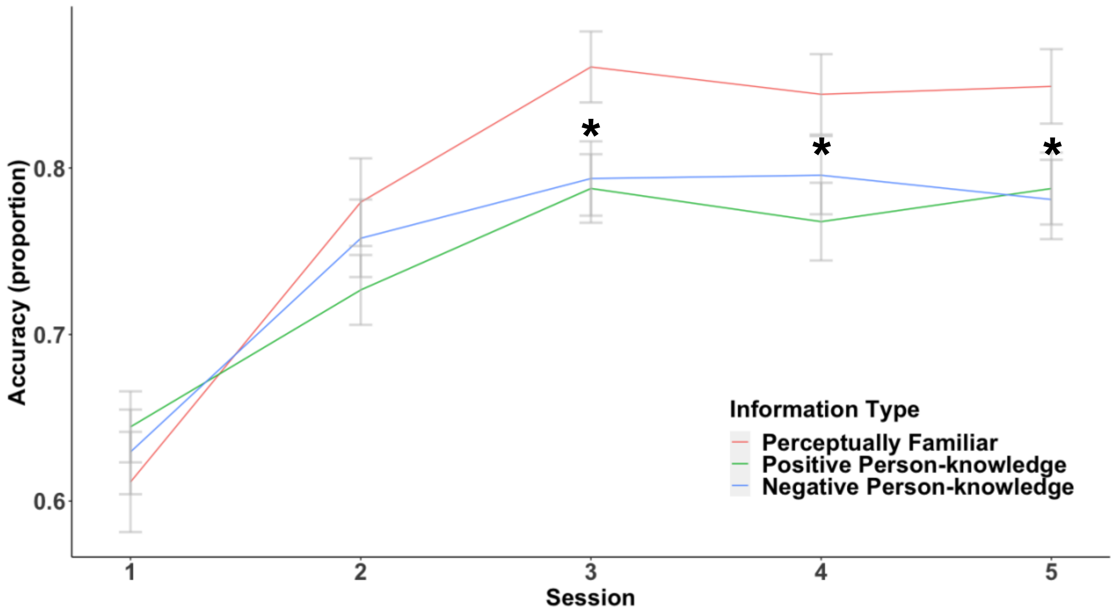

Figure A3: Greatest Accuracy for Perceptually Familiar Targets After Session 3. Standard error bars are displayed.

Table A22: Greatest Accuracy for Perceptually Familiar Targets After Session 3.

Session	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1	PF v. Pos PK	-0.005	0.024	[-0.053, 0.042]	-0.221	146	.825
	PF v. Neg PK	0.002	0.023	[-0.044, 0.047]	0.066	162	.948
	Pos PK v. Neg PK	-0.007	0.019	[-0.044, 0.030]	-0.357	378	.721
2	PF v. Pos PK	-0.026	0.021	[-0.068, 0.016]	-1.222	85	.225
	PF v. Neg PK	-0.018	0.020	[-0.057, 0.021]	-0.903	88	.369
	Pos PK v. Neg PK	-0.008	0.014	[-0.035, 0.020]	-0.557	126	.578
3	PF v. Pos PK	-0.047	0.020	[-0.086, -0.007]	-2.317	68	**.024**
	PF v. Neg PK	-0.037	0.019	[-0.074, -0.001]	-2.009	68	**.049**
	Pos PK v. Neg PK	-0.009	0.012	[-0.032, 0.015]	-0.742	68	.460
4	PF v. Pos PK	-0.067	0.021	[-0.109, -0.026]	-3.163	85	**.002**
	PF v. Neg PK	-0.057	0.020	[-0.096, -0.018]	-2.866	88	**.005**
	Pos PK v. Neg PK	-0.010	0.014	[-0.037, 0.017]	-0.716	125	.475
5	PF v. Pos PK	-0.088	0.024	[-0.135, -0.040]	-3.604	145	< **.001**
	PF v. Neg PK	-0.076	0.023	[-0.122, -0.031]	-3.295	161	**.001**
	Pos PK v. Neg PK	-0.011	0.019	[-0.048, 0.026]	-0.593	377	.553

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different condition contrast coding pairs depending on the conditions of interest: PF (-0.5) v Neg PK (+0.5); PF (-0.5) v Pos PK (+0.5); and Pos PK (+0.5) v Neg PK (-0.5).

Table A23: Greater Accuracy for Session 3 vs. Session 1.

Info Type	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	1 v. 3	0.248	0.025	[0.199, 0.297]	9.861	254	< **.001**
	1 v. 5	0.236	0.026	[0.185, 0.286]	9.129	233	< **.001**
	3 v. 5	-0.012	0.023	[-0.057, 0.034]	-0.506	1943	.613
Pos PK	1 v. 3	0.144	0.026	[0.094, 0.195]	5.625	273	< **.001**
	1 v. 5	0.144	0.026	[0.093, 0.196]	5.485	250	< **.001**
	3 v. 5	0.000	0.024	[0.047, -0.047]	-0.001	1943	.999
Neg PK	1 v. 3	0.164	0.026	[0.114, 0.215]	6.386	274	< **.001**
	1 v. 5	0.152	0.026	[0.100, 0.203]	5.753	252	< **.001**
	3 v. 5	-0.013	0.024	[-0.06, 0.035]	-0.522	1943	.601

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different condition contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v Session 3 (+0.5); Session 1 (-0.5) v Session 5 (+0.5); and Session 3 (-0.5) v Session 5 (+0.5).

Table A24: Accuracy Increases as Sessions Pass.

Info	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	1 v. 2	0.166	0.025	[0.117, 0.214]	6.693	318	< **.001**
	2 v. 3	0.081	0.023	[0.036, 0.126]	3.537	1943	< **.001**

Pos PK	1 v. 2	0.083	0.025	[0.034, 0.133]	3.300	339	**.001**
	2 v. 3	0.061	0.024	[0.014, 0.108]	2.558	1943	**.011**
Neg PK	1 v. 2	0.128	0.025	[0.079, 0.178]	5.069	345	< **.001**
	2 v. 3	0.036	0.024	[-0.011, 0.083]	1.499	1943	.134

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are two different condition contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v Session 2 (+0.5) and Session 2 (-0.5) v Session 3 (+0.5).

A.1.7 Impact of Contact on Cued Recall of Person-knowledge

Table A25: Lower Contact Participants Display a Memory Advantage for White Targets as Sessions Increase.

Contact	Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Low	1	-0.011	0.027	[-0.063, 0.041]	-0.399	145	.691
	3	-0.070	0.022	[-0.113, -0.028]	-3.225	67	**.002**
	5	-0.130	0.026	[-0.182, -0.078]	-4.917	144	< **.001**
Average	1	-0.038	0.012	[-0.061, -0.015]	-3.187	147	**.002**
	3	-0.059	0.010	[-0.078, -0.040]	-6.041	68	< **.001**
	5	-0.080	0.012	[-0.103, -0.057]	-6.727	148	< **.001**
High	1	-0.065	0.027	[-0.117, -0.012]	-2.423	151	**.017**
	3	-0.047	0.022	[-0.090, -0.004]	-2.149	69	**.035**
	5	-0.029	0.027	[-0.082, 0.023]	-1.096	151	.275

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. Target race was contrast coded: Black (+0.5) and White (-0.5).

Table A26: Greater Accuracy as Sessions Pass.

Contact	Race	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Low	White	1 v. 3	0.190	0.040	[0.111, 0.27]	4.697	1271	< **.001**
		3 v. 5	0.061	0.042	[-0.02, 0.143]	1.473	1271	.141
		1 v. 5	0.256	0.068	[0.123, 0.389]	3.778	83	< **.001**
	Black	1 v. 3	0.113	0.041	[0.033, 0.193]	2.769	1271	**.006**
		3 v. 5	0.031	0.041	[-0.05, 0.113]	0.752	1271	.452
		1 v. 5	0.143	0.068	[0.011, 0.276]	2.115	83	**.037**
Average	White	1 v. 3	0.162	0.018	[0.126, 0.198]	8.913	1271	< **.001**
		3 v. 5	0.096	0.019	[0.060, 0.133]	5.147	1271	< **.001**
		1 v. 5	0.256	0.030	[0.197, 0.316]	8.491	84	< **.001**
	Black	1 v. 3	0.119	0.018	[0.084, 0.155]	6.532	1271	< **.001**
		3 v. 5	0.093	0.019	[0.056, 0.129]	4.982	1271	< **.001**
		1 v. 5	0.209	0.030	[0.149, 0.268]	6.909	84	< **.001**
High	White	1 v. 3	0.134	0.041	[0.053, 0.214]	3.257	1271	**.001**
		3 v. 5	0.132	0.042	[0.049, 0.215]	3.107	1272	**.002**
		1 v. 5	0.257	0.068	[0.123, 0.391]	3.768	85	< **.001**
	Black	1 v. 3	0.126	0.042	[0.045, 0.207]	3.033	1271	**.002**
		3 v. 5	0.154	0.042	[0.072, 0.237]	3.665	1271	< **.001**
		1 v. 5	0.274	0.068	[0.141, 0.407]	4.031	84	< **.001**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. There are three different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v. Session 5 (+0.5); and Session 3 (-0.5) v. Session 5 (+0.5).

Table A27: Higher Contact Participants Displayed Greater Recall for Black Targets Paired with Negative Person-knowledge.

Race	Contact	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
White	Low	-0.036	0.020	[-0.075, 0.003]	-1.801	131	.074
White	Average	-0.006	0.009	[-0.024, 0.011]	-0.706	133	.482
White	High	0.023	0.020	[-0.016, 0.063]	1.156	136	.250
Black	Low	0.017	0.020	[-0.022, 0.056]	0.851	132	.396
Black	Average	-0.019	0.009	[-0.037, -0.002]	-2.150	135	**.033**
Black	High	-0.055	0.020	[-0.095, -0.016]	-2.739	138	**.007**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. Person-knowledge valence was contrast coded: positive (+0.5) and negative (-0.5).

Table A28: No Difference in Accuracy within Race and Valence Depending on Contact.

Race	Valence	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
White	Positive	0.006	0.026	[-0.044, 0.057]	0.244	69	.808
White	Negative	-0.008	0.026	[-0.060, 0.043]	-0.32	69	.750
Black	Positive	-0.004	0.021	[-0.046, 0.038]	-0.201	70	.841
Black	Negative	0.014	0.022	[-0.029, 0.057]	0.628	70	.532

Degrees of freedom vary due to the random effects modeling. Contact was centered on average (0).

Table A29: Greater Accuracy for White Targets.

Valence	Contact	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Positive	Low	-0.044	0.024	[-0.092, 0.003]	-1.819	102	.072
	Average	-0.065	0.011	[-0.086, -0.044]	-6.040	103	< **.001**
	High	-0.086	0.024	[-0.134, -0.039]	-3.548	104	**.001**
Negative	Low	-0.097	0.024	[-0.144, -0.049]	-3.979	103	< **.001**
	Average	-0.052	0.011	[-0.074, -0.031]	-4.815	105	< **.001**

High	-0.008	0.025	[-0.056, 0.040]	-0.323	107	.747

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. Target race was contrast coded: Black (+0.5) and White (-0.5).

A.2 Study 1b: Evaluative Priming Task

A.2.1 Omnibus Models

We ran two models separating the data by session. The omnibus models for the are as follows:

(1) Pre-learning

```
lmer (logRT ~ Prime Face Race * Word Valence +
(1 + Race + Word Valence || subject),
control = lmerControl (optimizer = “bobyqa”, optCtrl = list(maxfun =
100000)), data = data)
```

(2) Post-learning

```
lmer (logRT ~ Info Type * Prime Face Race * Word Valence +
(1 + Info Type + Word Valence | subject),
control = lmerControl (optimizer = “bobyqa”, optCtrl = list(maxfun =
100000)), data = data)
```

The omnibus models for the two DVs including the individual difference of lifetime contact are as follows:

(1) Impact of Contact on Pre-learning

```
lmer (logRT ~ Prime Face Race * Word Valence * Contact +
(1 + Word Valence + Contact | subject),
control = lmerControl (optimizer = “bobyqa”, optCtrl = list(maxfun =
100000)), data = data)
```

(2) Impact of Contact on Post-learning

```
lmer (logRT ~ Info Type * Prime Face Race * Word Valence * Contact +
```

```
(1 + Info Type + Word Valence + Contact | subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

A.2.2 Post-learning Session

Table A30: Slowest to Classify Positive Words After Primed with a Novel Face.

Valence	Contrast	*b*	*95% CIs*	*t-value*	*df*	*p-value*
Positive	Novel v. PF	-0.010	[-0.016, -0.004]	-3.165	244	**.002**
	Novel v. Pos PK	-0.011	[-0.017, -0.005]	-3.516	247	**.001**
	Novel v. Neg PK	-0.011	[-0.018, -0.005]	-3.491	212	**.001**
	PF v. Neg PK	-0.001	[-0.008, 0.005]	-0.476	237	.635
	PF v. Pos PK	-0.001	[-0.007, 0.005]	-0.381	14141	.703
	Neg PK v. Pos PK	0.000	[-0.006, 0.006]	0.118	14143	.906
Negative	Novel v. PF	-0.001	[-0.007, 0.005]	-0.259	237	.796
	Novel v. Pos PK	0.004	[-0.002, 0.010]	1.441	241	.151
	Novel v. Neg PK	0.000	[-0.006, 0.007]	0.080	205	.936
	PF v. Neg PK	0.001	[-0.005, 0.007]	0.342	234	.733
	PF v. Pos PK	0.005	[-0.001, 0.011]	1.747	14141	.081
	Neg PK v. Pos PK	0.004	[-0.002, 0.010]	1.388	14142	.165

Significant effects are bolded. All SE = 0.003. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are six different contrast coding pairs depending on the conditions of interest: Novel (-0.5) v. PF (+0.5); Novel (-0.5) v. Pos PK (+0.5); Novel (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); and Neg PK (-0.5) v. Pos PK (+0.5).

Table A31: Slower to Classify Negative Words After Primed with Positive Person-knowledge Faces.

Info Type	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Novel	0.007	0.004	[-0.008, -0.001]	1.809	237	.072
PF	-0.002	0.004	[-0.001, 0.006]	-0.557	240	.578

Neg PK	-0.005	0.004	[-0.001, 0.006]	-1.245	241	.214
Pos PK	-0.009	0.004	[-0.004, 0.003]	-2.263	239	**.025**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Prime word valence was contrast coded: positive (+0.5) and negative (-0.5).

A.2.3 Impact of Contact on Pre-learning Session

Table A32: Low Contact Participants were Slower After Primed with a White Face During the Pre-learning Session.

Contact	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Low	0.009	0.004	[0.001, 0.016]	2.342	14149	**.019**
Average	0.002	0.002	[-0.001, 0.005]	1.081	14148	.280
High	-0.005	0.004	[-0.013, 0.002]	-1.405	14148	.160

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. Prime race was contrast coded: Black (-0.5) and White (+0.5).

A.2.4 Impact of Contact on Post-learning Session

We analyzed simple effects for this 2-way interaction. While there were no differences by information type when classifying negative words, when classifying positive words participants were slower when primed with a novel face than all other information types (Table A33). Lastly, comparing classification of positive and negative words by face prime information type, there was only a difference when primed with a positive person-knowledge faces where positive faces words were classified faster than negative words (Table A34). See Figure A4.

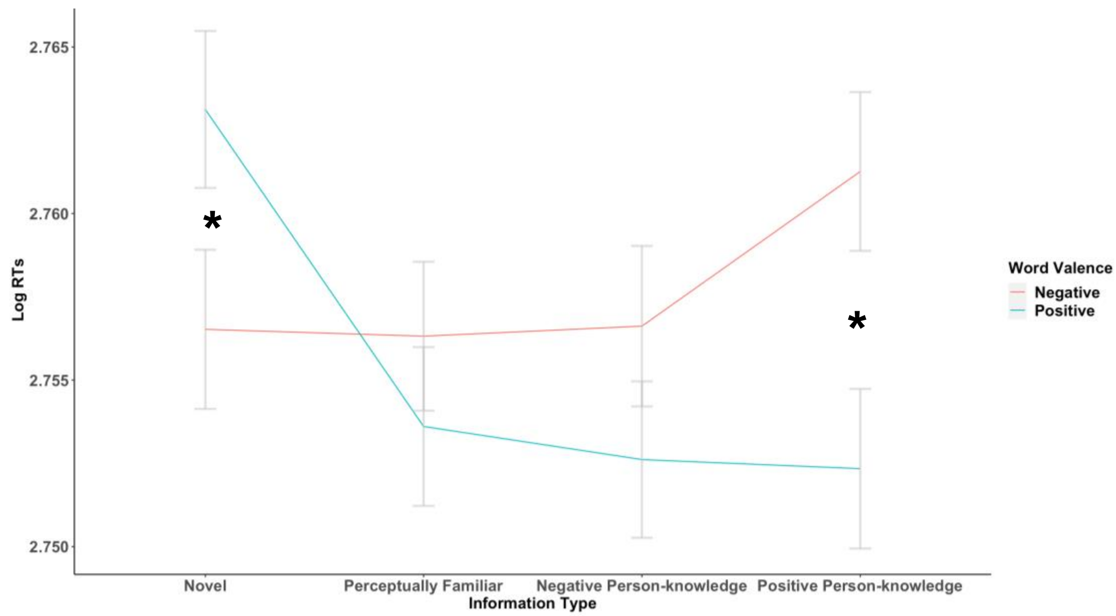

Figure A4: Slower Classification of Negative Words when Primed with a Positive Person-knowledge Target. Standard error bars are displayed.

Table A33: Slowest to Classify Positive Words After Primed with a Novel Face.

Valence	Contrast	*b*	*95% Cis*	*t-value*	*df*	*p-value*
Positive	Novel v. PF	-0.010	[-0.016, -0.004]	-3.165	244	**.002**
	Novel v. Pos PK	-0.011	[-0.017, -0.005]	-3.516	247	**.001**
	Novel v. Neg PK	-0.011	[-0.018, -0.005]	-3.491	212	**.001**
	PF v. Neg PK	-0.001	[-0.008, 0.005]	-0.476	237	.635
	PF v. Pos PK	-0.001	[-0.007, 0.005]	-0.381	14141	.703
	Neg PK v. Pos PK	0.000	[-0.006, 0.006]	0.118	14143	.906
Negative	Novel v. PF	-0.001	[-0.007, 0.005]	-0.259	237	.796
	Novel v. Pos PK	0.004	[-0.002, 0.010]	1.441	241	.151
	Novel v. Neg PK	0.000	[-0.006, 0.007]	0.080	205	.936
	PF v. Neg PK	0.001	[-0.005, 0.007]	0.342	234	.733

PF v. Pos PK	0.005	[-0.001, 0.011]	1.747	14141	.081
Neg PK v. Pos PK	0.004	[-0.002, 0.010]	1.388	14142	.165

Significant effects are bolded. All SE = 0.003. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are six different contrast coding pairs depending on the conditions of interest: Novel (-0.5) v PF (+0.5); Novel (-0.5) v Pos PK (+0.5); Novel (-0.5) v Neg PK (+0.5); PF (-0.5) v Neg PK (+0.5); PF (-0.5) v Pos PK (+0.5); and Neg PK (-0.5) v Pos PK (+0.5).

Table A34: Slower to Classify Negative Words After Positive Person-knowledge Face Prime.

Info Type	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Novel	0.007	0.004	[-0.008, -0.001]	1.809	237	.072
PF	-0.002	0.004	[-0.001, 0.006]	-0.557	240	.578
Neg PK	-0.005	0.004	[-0.001, 0.006]	-1.245	241	.214
Pos PK	-0.009	0.004	[-0.004, 0.003]	-2.263	239	**.025**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. Prime word valence was contrast coded: positive (+0.5) and negative (-0.5).

A.3 Study 1c: Independent Face Recognition Task

A.3.1 Omnibus Models

The omnibus models are as follows:

(1) Independent face recognition accuracy as a function of face recognition learning rate

```
lmer (DV ~ Race * Session * Familiarity * LearningRate +
(1 + Race * Session * Familiarity || subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

(2) Independent face recognition accuracy as a function of attribution of valenced person-knowledge learning rate

```
lmer (DV ~ Race * Session * Familiarity * LearningRate +
(1 | subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

(3) Independent face recognition accuracy as a function of cued recall of person-knowledge learning rate

```
lmer (DV ~ Race * Session * Familiarity * LearningRate +
(1 | subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

(4) Independent face recognition accuracy as a function of average learning rate

```
lmer (DV ~ Race * Session * Familiarity * LearningRate +
(1 | subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

We additionally ran another model without the learning rates in the series of the learned memory tasks. The omnibus model was as follows:

(5) Independent face recognition accuracy without learning rates

```
lmer (Accuracy ~ Race * Session * Familiarity +
(1 + Session + Familiarity | subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

Accuracy data were analyzed using a 2 (Race: Black, White) x 5 (Session: pre-learning, post-learning) × 2 (Familiarity: novel, familiar) linear mixed effects model, with session and familiarity varying within subjects.

As in study 1a, we present modified analyses that include a main effect of and all possible interactions with lifetime contact. The omnibus model for the DV including the individual difference of lifetime contact are as follows:

(6) Impact on contact on independent face recognition accuracy

```
lmer (Accuracy ~ Race * Session * Familiarity * Contact +
(1 + Session + Familiarity + Contact || subject),
control = lmerControl (optimizer = "bobyqa", optCtrl = list(maxfun =
100000)), data = data)
```

A.3.2 Independent Face Recognition Accuracy as a Function of Face Recognition Learning Rate

Table A35: Participants with Lower Learning Rates Displayed Greater Accuracy for Novel Faces.

Learning Rate	*b*	SE	*95% CIs*	*t*(68)	*p-value*
Low	-0.109	0.028	[-0.164, -0.054]	-3.899	**< .001**
Average	-0.067	0.02	[-0.105, -0.028]	-3.372	**.001**
High	-0.024	0.028	[-0.079, 0.031]	-0.853	.396

Significant effects are bolded.

Table A36: Accuracy within Familiarity did not differ by Learning Rate.

Condition	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Familiar	0.268	0.24	[-0.203, 0.739]	1.115	82	.268
Novel	-0.532	0.282	[-1.085, 0.021]	-1.887	75	.063

Degrees of freedom vary due to the random effects modeling.

Table A37: Greater Accuracy for White Compared to Black Novel Targets Pre-learning.

Condition	Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Novel	Pre	-0.113	0.026	[-0.163, -0.062]	-4.388	235	**< .001**
	Post	-0.004	0.025	[-0.053, 0.044]	-0.181	291	.857
Familiar	Pre	0.001	0.025	[-0.048, 0.050]	0.056	295	.955
	Post	-0.047	0.024	[-0.094, 0.000]	-1.949	347	.052

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling.

Table A38: Greater Accuracy for White Novel and Black Familiar Pre- vs. Post-learning.

Condition	Race	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Novel	Black	0.041	0.027	[-0.013, 0.095]	1.499	283	.135
	White	-0.067	0.027	[-0.121, -0.014]	-2.461	283	**.014**
Familiar	Black	-0.097	0.027	[-0.150, -0.045]	-3.627	290	**< .001**
	White	-0.049	0.027	[-0.102, 0.004]	-1.823	290	.069

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling.

Table A39: More Accurate for Novel vs. Familiar Targets.

Race	Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Black	Pre	0.021	0.029	[-0.037, 0.078]	0.706	245	.481
	Post	-0.118	0.028	[-0.174, -0.062]	-4.136	240	**< .001**
White	Pre	-0.094	0.029	[-0.151, -0.037]	-3.217	245	**.001**
	Post	-0.075	0.028	[-0.131, -0.019]	-2.643	240	**.009**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling.

A.3.3 Independent Face Recognition Accuracy as a Function of Attribution of valenced person-knowledge Learning Rate

Table A40: Greater Accuracy for White Compared to Black Novel Targets Pre-learning.

Condition	Session	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Novel	Pre	-0.113	0.028	[-0.167, -0.058]	-4.009	< **.001**
	Post	-0.004	0.028	[-0.055, 0.056]	-0.159	.874
Familiar	Pre	0.001	0.028	[-0.059, 0.050]	0.050	.960
	Post	-0.047	0.028	[-0.101, 0.007]	-1.671	.095

Significant effects are bolded.

Table A41: Greater Accuracy for White Novel and Black Familiar Pre- vs. Post-learning.

Condition	Race	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Novel	Black	0.041	0.028	[-0.013, 0.095]	1.457	.146
	White	-0.067	0.028	[-0.122, -0.013]	-2.393	**.017**
Familiar	Black	-0.097	0.028	[-0.152, -0.043]	-3.460	**.001**
	White	-0.049	0.028	[-0.103, 0.006]	-1.739	.083

Significant effects are bolded.

Table A42: More Accurate for Novel vs. Familiar Targets.

Race	Session	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Black	Pre	0.021	0.028	[-0.034, 0.075]	0.730	.466
	Post	-0.118	0.028	[-0.172, -0.063]	-4.187	< **.001**
White	Pre	-0.094	0.028	[-0.148, -0.039]	-3.329	**.001**
	Post	-0.075	0.028	[-0.130, -0.021]	-2.675	**.008**

Significant effects are bolded.

A.3.4 Independent Face Recognition Accuracy as a Function of Cued Recall of Person-knowledge Learning Rate

Table A43: Greater Accuracy for White Compared to Black Novel Targets Pre-learning.

Condition	Session	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Novel	Pre	-0.113	0.028	[-0.168, -0.058]	-3.973	**< .001**
	Post	-0.004	0.028	[-0.059, 0.050]	-0.158	.875
Familiar	Pre	0.001	0.028	[-0.054, 0.056]	0.050	.960
	Post	-0.047	0.028	[-0.102, 0.008]	-1.656	.098

Significant effects are bolded.

Table A44: Greater Accuracy for White Novel and Black Familiar Pre- vs. Post-learning.

Condition	Race	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Novel	Black	0.041	0.028	[-0.014, 0.096]	1.444	.149
	White	-0.067	0.028	[-0.122, -0.012]	-2.371	**.018**
Familiar	Black	-0.097	0.028	[-0.152, -0.042]	-3.429	**.001**
	White	-0.049	0.028	[-0.104, 0.006]	-1.724	.085

Significant effects are bolded.

Table A45: More Accurate for Novel vs. Familiar Targets.

Race	Session	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Black	Pre	0.021	0.028	[-0.034, 0.076]	0.724	.470
	Post	-0.118	0.028	[-0.173, -0.063]	-4.149	**< .001**
White	Pre	-0.094	0.028	[-0.149, -0.039]	-3.299	**.001**
	Post	-0.075	0.028	[-0.130, -0.020]	-2.651	**.008**

Significant effects are bolded.

A.3.5 Independent Face Recognition Accuracy as a Function of Average Learning Rate

Table A46: Those with Greater Learning Rates Were More Accurate Post-learning.

Session	*b*	SE	*95% CIs*	*t*(119)	*p-value*
Pre	-0.073	0.508	[-1.063, 0.917]	-0.144	.885
Post	1.254	0.508	[0.264, 2.244]	2.466	**.015**

Significant effects are bolded.

Table A47: Those with Lower Average Learning Rates Were More Accurate Pre-learning.

Learning Rate	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Low	-0.077	0.019	[-0.113, -0.040]	-4.022	< **.001**
Average	-0.043	0.014	[-0.070, -0.016]	-3.060	**.002**
High	-0.010	0.019	[-0.047, 0.027]	-0.514	.608

Significant effects are bolded.

Table A48: Greater Accuracy for White Compared to Black Novel Targets Pre-learning.

Condition	Session	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Novel	Pre	-0.113	0.028	[-0.167, -0.058]	-3.999	< **.001**
	Post	-0.004	0.028	[-0.059, 0.050]	-0.159	.874
Familiar	Pre	0.001	0.028	[-0.053, 0.056]	0.050	.960
	Post	-0.047	0.028	[-0.102, 0.008]	-1.667	.096

Significant effects are bolded.

Table A49: Greater Accuracy for White Novel and Black Familiar Pre- vs. Post-learning.

Condition	Race	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Novel	Black	0.041	0.028	[-0.014, 0.096]	1.454	.147
	White	-0.067	0.028	[-0.122, -0.013]	-2.387	**.017**
Familiar	Black	-0.097	0.028	[-0.152, -0.043]	-3.452	**.001**
	White	-0.049	0.028	[-0.104, 0.006]	-1.735	.083

Significant effects are bolded.

Table A50: More Accurate for Novel vs. Familiar Targets.

Race	Session	*b*	SE	*95% CIs*	*t*(476)	*p-value*
Black	Pre	0.021	0.028	[-0.034, 0.075]	0.729	.467
	Post	-0.118	0.028	[-0.172, -0.063]	-4.176	< **.001**
White	Pre	-0.094	0.028	[-0.148, -0.039]	-3.321	**.001**
	Post	-0.075	0.028	[-0.130, -0.021]	-2.669	**.008**

Significant effects are bolded.

A.3.6 Independent Face Recognition Accuracy without Learning Rates

Table A51: Greater Accuracy for White Compared to Black Novel Targets Pre-learning and White Familiar Targets Post-learning.

Condition	Session	*b*	SE	*95% CIs*	*t*(345)	*p-value*
Novel	1	-0.113	0.024	[-0.159, -0.067]	-4.785	< **.001**
	5	-0.004	0.024	[-0.051, 0.042]	-0.19	.849
Familiar	1	0.001	0.024	[-0.045, 0.048]	0.060	.952
	5	-0.047	0.024	[-0.093, -0.001]	-1.994	**.047**

Significant effects are bolded.

Table A52: Greater Accuracy for White Novel and Black Familiar Pre- vs. Post-learning.

Condition	Race	*b*	SE	*95% CIs*	*t*(287)	*p-value*
Novel	Black	0.041	0.027	[-0.011, 0.093]	1.537	.125
	White	-0.067	0.027	[-0.12, -0.015]	-2.523	**.012**
Familiar	Black	-0.097	0.027	[-0.15, -0.045]	-3.649	< **.001**
	White	-0.049	0.027	[-0.101, 0.003]	-1.834	.068

Significant effects are bolded.

Table A53: More Accurate for Novel vs. Familiar Targets.

Race	Session	*b*	SE	*95% CIs*	*t*(233)	*p-value*
Black	1	0.021	0.029	[-0.036, 0.077]	0.715	.475
	5	-0.118	0.029	[-0.174, -0.061]	-4.098	**< .001**
White	1	-0.094	0.029	[-0.15, -0.037]	-3.258	**.001**
	5	-0.075	0.029	[-0.132, -0.019]	-2.618	**.009**

Significant effects are bolded.

A.3.7 Impact of Contact on Independent Face Recognition Accuracy

Table A54: Lower Contact Participants Displayed Greater Accuracy Pre-learning.

Contact	*b*	SE	*95% CIs*	*t*(68)	*p-value*
Low	-0.123	0.037	[-0.197, -0.050]	-3.304	**.002**
Average	-0.043	0.017	[-0.076, -0.011]	-2.598	**.012**
High	0.037	0.037	[-0.036, 0.110]	0.994	.324

Significant effects are bolded.

We analyzed simple effects for the 3-way interaction of Race x Session x Familiarity that did not include contact. As with the results from independent face recognition accuracy as a function of face recognition learning rate, participants were more accurate when classifying White faces as novel pre-learning compared to Black faces and when classifying White faces as familiar post-learning compared to Black faces (Table A55). Participants were also more accurate when classifying White faces as novel pre-learning compared to post-learning and Black faces as familiar pre-learning compared to post-learning (Table A56). Lastly, participants were more accurate at classifying Black faces as familiar compared to novel pre-learning and White faces as novel compared to familiar pre-learning and post-learning (Table A57). See Figure 15.

Results were similar to those from independent face recognition accuracy as a function of face recognition learning rate with the exception that when learning rates are not included, participants were additionally better at recognizing White familiar targets post-learning.

A55: Greater Accuracy for White Compared to Black Novel Targets Pre-learning and White Familiar Targets Post-learning.

Condition	Session	*b*	SE	*95% CIs*	*t*(345)	*p-value*
Novel	Pre	-0.113	0.024	[-0.159, -0.067]	-4.785	< **.001**
	Post	-0.004	0.024	[-0.051, 0.042]	-0.190	.849
Familiar	Pre	0.001	0.024	[-0.045, 0.048]	0.060	.952
	Post	-0.047	0.024	[-0.093, -0.001]	-1.994	**.047**

Significant effects are bolded.

Table A56: Greater Accuracy for White Novel and Black Familiar Pre- vs. Post-learning.

Condition	Race	*b*	SE	*95% CIs*	*t*(287)	*p-value*
Novel	Black	0.041	0.027	[-0.011, 0.093]	1.537	.125
	White	-0.067	0.027	[-0.12, -0.015]	-2.523	**.012**
Familiar	Black	-0.097	0.027	[-0.15, -0.045]	-3.649	< **.001**
	White	-0.049	0.027	[-0.101, 0.003]	-1.834	.068

Significant effects are bolded.

Table A57: More Accurate for Novel vs. Familiar Targets.

Race	Session	*b*	SE	*95% CIs*	*t*(233)	*p-value*
Black	1	0.021	0.029	[-0.036, 0.077]	0.715	.475
	5	-0.118	0.029	[-0.174, -0.061]	-4.098	< **.001**
White	1	-0.094	0.029	[-0.15, -0.037]	-3.258	**.001**
	5	-0.075	0.029	[-0.132, -0.019]	-2.618	**.009**

Significant effects are bolded.

Appendix B

STUDY 2

B.1 Study 2a: Learning Task

B.1.1 Omnibus Models

The omnibus models for the three DVs were as follows:

(1) Face recognition

```
lmer (DV ~ Race * Session * InfoType +
(1 + Race + Session + InfoType +
Race:Session + Race:InfoType + Session:InfoType || subject),
control = lmerControl (optimizer = “bobyqa”, optCtrl = list(maxfun =
100000)), data = data)
```

(2) Attribution of valenced person-knowledge

```
lmer (DV ~ Race * Session * InfoType +
(1 + Race + Session + InfoType +
Race:InfoType + Session:InfoType || subject),
control = lmerControl (optimizer = “bobyqa”, optCtrl = list(maxfun =
100000)), data = data)
```

(3) Cued recall of person-knowledge

```
lmer (DV ~ Race * Session * Valence +
(1 + Race + Session + Valence +
Race:Session + Race:Valence || subject),
control = lmerControl (optimizer = “bobyqa”, optCtrl = list(maxfun =
100000)), data = data)
```

B.1.2 Face Recognition

Table B1: Greater Accuracy for White Targets.

Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1	-0.141	0.018	[-0.176, -0.106]	-7.847	88	**< .001**
2	-0.104	0.014	[-0.133, -0.076]	-7.273	37	**< .001**
3	-0.068	0.013	[-0.093, -0.042]	-5.216	25	**< .001**
4	-0.031	0.014	[-0.059, -0.003]	-2.170	37	**.036**
5	0.005	0.018	[-0.030, 0.040]	0.304	86	.762

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. Target race was contrast coded: Black (+0.5) and White (-0.5).

Table B2: Greatest Increase in Accuracy from Session 1 to Session 2.

Race	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
White	1 v. 3	0.171	0.031	[0.111, 0.232]	5.526	39	**< .001**
White	3 v. 5	0.011	0.025	[-0.037, 0.059]	0.448	702	.654
White	1 v. 2	0.159	0.029	[0.102, 0.217]	5.420	44	**< .001**
White	2 v. 3	0.012	0.025	[-0.036, 0.060]	0.497	702	.619
Black	1 v. 3	0.301	0.031	[0.240, 0.362]	9.679	39	**< .001**
Black	3 v. 5	0.048	0.025	[0.000, 0.097]	1.944	716	.052
Black	1 v. 2	0.267	0.029	[0.209, 0.325]	9.060	45	**< .001**
Black	2 v. 3	0.034	0.025	[-0.015, 0.083]	1.371	716	.171

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. There are four different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 3 (-0.5) v. Session 5 (+0.5); Session 1 (-0.5) v. Session 2 (+0.5); and Session 2 (-0.5) v. Session 3 (+0.5).

Table B3: Greater Accuracy for Targets Associated with Person-knowledge.

Contrast	Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Pos PK v. PF	1	0.137	0.023	[0.091, 0.182]	5.895	85	**< .001**
	2	0.114	0.019	[0.078, 0.151]	6.160	37	**< .001**

	3	0.092	0.017	[0.059, 0.125]	5.466	25	< **.001**
	4	0.070	0.019	[0.034, 0.106]	3.787	36	**.001**
	5	0.048	0.023	[0.003, 0.093]	2.091	83	**.040**
Neg PK v. PF	1	0.132	0.025	[0.082, 0.181]	5.221	65	< **.001**
	2	0.112	0.021	[0.070, 0.153]	5.268	33	< **.001**
	3	0.092	0.020	[0.053, 0.131]	4.643	25	< **.001**
	4	0.072	0.020	[0.033, 0.111]	3.642	28	**.001**
	5	0.052	0.022	[0.009, 0.094]	2.390	38	**.022**
Pos PK v. Neg PK	1	0.005	0.021	[-0.036, 0.046]	0.230	716	.818
	2	0.003	0.015	[-0.026, 0.032]	0.186	660	.852
	3	0.001	0.012	[-0.023, 0.024]	0.053	691	.958
	4	-0.001	0.015	[-0.030, 0.027]	-0.101	701	.919
	5	-0.004	0.021	[-0.046, 0.038]	-0.168	741	.867

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different contrast coding pairs depending on the conditions of interest: PF (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

Table B4: Greatest Increase in Accuracy from Session 1 to Session 2.

Info Type	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
PF	1 v. 3	0.284	0.034	[0.218, 0.350]	8.427	54	< **.001**
	3 v. 5	0.048	0.031	[-0.013, 0.108]	1.549	716	.122
	1 v. 2	0.264	0.033	[0.200, 0.328]	8.112	66	< **.001**
	2 v. 3	0.020	0.031	[-0.040, 0.081]	0.660	716	.509
Pos PK	1 v. 3	0.201	0.035	[0.132, 0.269]	5.755	62	< **.001**
	3 v. 5	0.024	0.032	[-0.039, 0.086]	0.746	712	.456
	1 v. 2	0.175	0.034	[0.109, 0.241]	5.208	75	< **.001**
	2 v. 3	0.025	0.032	[-0.037, 0.088]	0.799	712	.425
Neg PK	1 v. 3	0.224	0.035	[0.155, 0.292]	6.433	61	< **.001**
	3 v. 5	0.017	0.032	[-0.045, 0.079]	0.543	709	.587
	1 v. 2	0.200	0.034	[0.134, 0.266]	5.966	74	< **.001**

2 v. 3	0.023	0.032	[-0.039, 0.086]	0.741	709	.459

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are four different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 3 (+0.5); Session 3 (-0.5) v. Session 5 (+0.5); Session 1 (-0.5) v. Session 2 (+0.5); and Session 2 (-0.5) v. Session 3 (+0.5).

B.1.3 Attribution of Valenced Person-knowledge

Table B5: Greatest Increase in Accuracy during the First Three Sessions.

Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
1 v. 2	0.209	0.040	[0.130, 0.288]	5.179	25	**< .001**
2 v. 3	0.056	0.021	[0.014, 0.098]	2.639	716	**.008**
1 v. 3	0.265	0.041	[0.185, 0.345]	6.485	25	**< .001**
3 v. 5	0.019	0.021	[-0.023, 0.061]	0.890	716	.374

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. There are four different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 2 (+0.5); Session 2 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v. Session 3 (+0.5); and Session 3 (-0.5) v. Session 5 (+0.5).

Table B6: Greater Accuracy for Perceptually Familiar Faces.

Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Pos PK v. Neg PK	-0.007	0.014	[-0.034, 0.019]	-0.546	716	.585
Pos PK v. PF	-0.045	0.020	[-0.083, -0.007]	-2.303	25	**.030**
Neg PK v. PF	-0.038	0.016	[-0.068, -0.007]	-2.426	25	**.023**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. PF = perceptually familiar faces, Pos PK = positive person-knowledge faces, Neg PK = negative person-knowledge faces. There are three different contrast coding pairs depending on the conditions of interest: PF (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

B.1.4 Cued Recall of Person-knowledge

Table B7: Greater Accuracy for White Targets.

Valence	Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Negative	1	-0.020	0.024	[-0.066, 0.026]	-0.837	105	.404
	2	-0.042	0.019	[-0.079, -0.005]	-2.254	47	**.029**
	3	-0.065	0.017	[-0.099, -0.030]	-3.695	31	**.001**
	4	-0.087	0.020	[-0.126, -0.048]	-4.383	53	**< .001**
	5	-0.109	0.026	[-0.160, -0.059]	-4.262	136	< **.001**
Positive	1	-0.111	0.026	[-0.161, -0.061]	-4.353	92	< **.001**
	2	-0.104	0.020	[-0.144, -0.064]	-5.066	42	< **.001**
	3	-0.097	0.019	[-0.134, -0.060]	-5.115	28	< **.001**
	4	-0.089	0.021	[-0.131, -0.048]	-4.240	44	**< .001**
	5	-0.082	0.027	[-0.135, -0.030]	-3.088	115	**.003**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. Target race was contrast coded: Black (+0.5) and White (-0.5).

Table B8: Steady Increase in Accuracy Across Sessions.

Valence	Race	Contrast	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Negative	Black	1 v. 2	0.194	0.059	[0.078, 0.311]	3.270	481	**.001**
		2 v. 3	0.127	0.061	[0.007, 0.246]	2.082	481	**.038**
		1 v. 3	0.321	0.058	[0.207, 0.435]	5.524	140	< **.001**
		3 v. 5	0.132	0.061	[0.012, 0.252]	2.162	481	**.031**
	White	1 v. 2	0.227	0.059	[0.110, 0.343]	3.815	481	< **.001**
		2 v. 3	0.170	0.061	[0.051, 0.289]	2.794	481	**.005**
		1 v. 3	0.397	0.058	[0.283, 0.511]	6.828	140	< **.001**
		3 v. 5	0.144	0.061	[0.024, 0.264]	2.359	481	**.019**
Positive	Black	1 v. 2	0.201	0.059	[0.084, 0.317]	3.376	481	**.001**
		2 v. 3	0.160	0.061	[0.040, 0.279]	2.625	481	**.009**
		1 v. 3	0.360	0.058	[0.246, 0.474]	6.202	140	< **.001**
		3 v. 5	0.137	0.061	[0.017, 0.257]	2.246	481	**.025**
	White	1 v. 2	0.360	0.058	[0.052, 0.144]	6.202	140	< **.001**
		2 v. 3	0.129	0.061	[0.008, 0.249]	2.091	481	**.037**
		1 v. 3	0.330	0.059	[-0.144, -0.052]	5.629	143	< **.001**
		3 v. 5	0.139	0.061	[0.019, 0.259]	2.277	481	**.023**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. There are four different contrast coding pairs depending on the session contrasts of interest: Session 1 (-0.5) v. Session 2 (+0.5); Session 2 (-0.5) v. Session 3 (+0.5); Session 1 (-0.5) v. Session 1 (+0.5); and Session 3 (-0.5) v. Session 5 (+0.5).

B.2 Study 2b: Face Recognition Task

B.2.1 Omnibus Models

We additionally ran another model without the learning rates in the series of the learned memory tasks. The omnibus model was as follows:

(7) Independent face recognition accuracy without learning rates

```
lmer (Accuracy ~ Race * Session * Familiarity +
(1 + Session + Familiarity || subject),
control = lmerControl (optimizer = “bobyqa”, optCtrl = list(maxfun =
100000)), data = data)
```

Accuracy data were analyzed using a 2 (Race: Black, White) x 5 (Session: pre-learning, post-learning) × 2 (Familiarity: novel, familiar) linear mixed effects model, with session and familiarity varying within subjects.

B.2.2 Independent Face Recognition Accuracy

Table B9: Less Accurate for Familiar Targets Post-learning than Pre-learning.

Familiarity	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Novel	-0.009	0.031	[-0.070, 0.051]	-0.298	59	.767
Familiar	-0.167	0.031	[-0.228, -0.106]	-5.353	60	< **.001**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. Session was contrast coded: Pre-learning (+0.5) and Post-learning (-0.5).

Table B10: Less Accurate for Familiar vs. Novel Targets Post-learning.

Session	*b*	SE	*95% CIs*	*t-value*	*df*	*p-value*
Pre	-0.003	0.033	[-0.068, 0.061]	-0.104	57	.917
Post	-0.161	0.032	[-0.224, -0.098]	-5.027	52	**< .001**

Significant effects are bolded. Degrees of freedom vary due to the random effects modeling. Familiarity was contrast coded: Familiar (+0.5) and Novel (-0.5).

B.3 Study 2c: Neural Correlates of Impression Formation

B.3.1 ROI: Novel v. Other Faces

Table B11: Greater Right Amygdala Activity to Novel v. Perceptually Familiar Faces.

Contrast	*b*	SE	*95% CIs*	*t*(179)	*p-value*
Novel v PF	-0.126	0.058	[-0.240, -0.012]	-2.167	**.032**
Novel v Pos PK	-0.093	0.059	[-0.207, 0.022]	-1.582	.115
Novel v Neg PK	-0.089	0.058	[-0.204, 0.025]	-1.526	.129
PF v Pos PK	0.033	0.059	[-0.082, 0.149]	0.567	.572
PF v Neg PK	0.037	0.059	[-0.079, 0.152]	0.625	.533
Pos PK v Neg PK	-0.003	0.059	[-0.119, 0.112]	-0.058	.954

Significant effects are bolded. There are six different contrast coding pairs depending on the conditions of interest: Novel (-0.5) v. PF (+0.5); Novel (-0.5) v. Pos PK (+0.5); Novel (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); PF (-0.5) v. Neg PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

Table B12: Greater Right Hippocampus Activity to Novel v. Perceptually Familiar Faces.

Contrast	*b*	SE	*95% CIs*	*t*(179)	*p-value*
Novel v PF	-0.103	0.044	[-0.188, -0.017]	-2.342	**.02**
Novel v Pos PK	-0.060	0.044	[-0.147, 0.026]	-1.367	.173
Novel v Neg PK	-0.073	0.044	[-0.159, 0.013]	-1.663	.098
PF v Pos PK	0.042	0.044	[-0.045, 0.129]	0.950	.343
PF v Neg PK	0.029	0.044	[-0.057, 0.116]	0.664	.507
Pos PK v Neg PK	0.013	0.044	[-0.074, 0.099]	0.286	.775

Significant effects are bolded. There are six different contrast coding pairs depending on the conditions of interest: Novel (-0.5) v. PF (+0.5); Novel (-0.5) v. Pos PK (+0.5); Novel (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); PF (-0.5) v. Neg PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

B.3.2 ROI: Perceptually Familiar v. Other Faces

Table B13: Greater Left Amygdala Activity to Novel v. Perceptually Familiar Faces.

Contrast	*b*	SE	*95% CIs*	*t*(179)	*p-value*
Novel v PF	-0.099	0.04	[-0.177, -0.021]	-2.49	**.014**
Novel v Pos PK	-0.034	0.04	[-0.113, 0.045]	-0.844	.400
Novel v Neg PK	-0.026	0.04	[-0.106, 0.053]	-0.656	.512
PF v Pos PK	0.065	0.04	[-0.138, 0.144]	1.616	.108
PF v Neg PK	0.073	0.04	[-0.006, 0.151]	1.808	.072
Pos v Neg PK	-0.008	0.04	[-0.087, 0.072]	-0.187	.852

Significant effects are bolded. There are six different contrast coding pairs depending on the conditions of interest: Novel (-0.5) v. PF (+0.5); Novel (-0.5) v. Pos PK (+0.5); Novel (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); PF (-0.5) v. Neg PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

B.3.3 ROI: Negative Person-knowledge v. Other Faces

Table B14: Greater Precuneus Activity to Negative Person-knowledge v. Novel Faces.

Contrast	*b*	SE	*95% CIs*	*t*(179)	*p-value*
Novel v PF	0.021	0.074	[-0.124, 0.166]	0.289	.773
Novel v Pos PK	0.076	0.074	[-0.069, 0.220]	1.024	.307
Novel v Neg PK	0.157	0.073	[0.014, 0.299]	2.155	**.032**
PF v Pos PK	0.054	0.074	[-0.091, 0.199]	0.732	.465
PF v Neg PK	0.135	0.073	[-0.008, 0.279]	1.845	.067

Pos PK v Neg PK	-0.081	0.074	[-0.225, 0.063]	-1.100	.273

Significant effects are bolded. There are six different contrast coding pairs depending on the conditions of interest: Novel (-0.5) v. PF (+0.5); Novel (-0.5) v. Pos PK (+0.5); Novel (-0.5) v. Neg PK (+0.5); PF (-0.5) v. Pos PK (+0.5); PF (-0.5) v. Neg PK (+0.5); and Pos PK (+0.5) v. Neg PK (-0.5).

B.3.4 Exploratory Whole-brain: Perceptual Familiarity and Person-knowledge

Table B15: Greater Activity to Novel v. Person-knowledge Faces

				MNI Coordinates		
Brain Region	*k*	*t*	*p*	*x*	*y*	*z*
Person-knowledge > Novel						
N/A						
Novel > Person-knowledge						
R Posterior Superior Temporal Sulcus	116	4.81	< .001	51	-60	0
R Middle Occipital Gyrus	81	4.88	< .001	42	-81	15

B.3.5 Exploratory Whole-brain: Perceptual Familiarity and Positive Person-knowledge

Table 16: Greater Activity to Novel v. Positive Person-knowledge Faces

				MNI Coordinates		
Brain Region	*k*	*t*	*p*	*x*	*y*	*z*
Positive Person-knowledge > Novel						
N/A						
Novel > Positive Person-knowledge						
R Posterior Superior Temporal Sulcus	23	3.96	< .001	57	-66	0
R Middle Occipital Lobe	45	4.24	< .001	33	-81	9

B.3.6 Exploratory Whole-brain: Perceptual Familiarity and Negative Person-knowledge

Table 17: Greater Activity to Novel v. Negative Person-knowledge Faces

				MNI Coordinates		
Brain Region	*k*	*t*	*p*	*x*	*y*	*z*
Negative Person-knowledge > Novel						
N/A						
Novel > Negative Person-knowledge						
R Posterior Superior Temporal Sulcus	98	4.92	< .001	51	-54	3
R Middle Occipital Gyrus	46	4.42	< .001	42	-78	30
L Supramarginal Gyrus	35	4.71	< .001	-60	-40	37
R Supramarginal Gyrus	45	3.91	< .001	60	-44	42

B.3.7 Exploratory Whole-brain: Perceptual Familiarity

Table 18: Greater Activity to Novel v. Perceptually Familiar Only Faces

				MNI Coordinates		
Brain Region	*k*	*t*	*p*	*x*	*y*	*z*
Perceptually Familiar > Novel						
N/A						
Novel > Perceptually Familiar						
R Middle Occipital Gyrus	33	5.04	< .001	41	-84	27
L Inferior Frontal Gyrus	10	4.26	< .001	-54	21	27
R Supramarginal Gyrus	129	5.45	< .001	60	-33	48
L Inferior Parietal Lobe	91	4.91	< .001	-60	-42	39

Appendix C

IRB/HUMAN SUBJECTS APPROVAL

Institutional Review Board
210H Hullihen Hall
Newark, DE 19716
Phone: 302-831-2137
Fax: 302-831-2828

DATE:	April 5, 2022
TO:	Jasmin Cloutier, PhD
FROM:	University of Delaware IRB
STUDY TITLE:	[1396663-12] Race-Familiarity
SUBMISSION TYPE:	Continuing Review/Progress Report
ACTION:	APPROVED
EFFECTIVE DATE:	April 5, 2022
NEXT REPORT DUE:	April 9, 2023
REVIEW TYPE:	Administrative Review
REVIEW CATEGORY:	Expedited review category # *(4,7)*

Thank you for your Continuing Review/Progress Report submission to the University of Delaware Institutional Review Board (UD IRB). The UD IRB has reviewed and APPROVED the proposed research and submitted documents via Administrative Review in compliance with the pertinent federal regulations.

As the Principal Investigator for this study, you are responsible for, and agree that:

- All research must be conducted in accordance with the protocol and all other study forms as approved in this submission. Any revisions to the approved study procedures or documents must be reviewed and approved by the IRB prior to their implementation. Please use the UD amendment form to request the review of any changes to approved study procedures or documents.
- Informed consent is a process that must allow prospective participants sufficient opportunity to discuss and consider whether to participate. IRB-approved and stamped consent documents must be used when enrolling participants and a written copy shall be given to the person signing the informed consent form.
- Unanticipated problems, serious adverse events involving risk to participants, and all non-compliance issues must be reported to this office in a timely fashion according with the UD requirements for reportable events. All sponsor reporting requirements must also be followed.

The UD IRB REQUIRES the submission of a PROGRESS REPORT DUE ON April 9, 2023. A continuing review/progress report form must be submitted to the UD IRB at least 45 days prior to the due date to allow for the review of that report.

If you have any questions, please contact the UD IRB Office at (302) 831-2137 or via email at hsrb-research@udel.edu. Please include the study title and reference number in all correspondence with this office.

INSTITUTIONAL REVIEW BOARD