Reflexive Activation of Monoracial Categories During Multiracial Categorization

John Andrew H. Chwe[a], David J. Lick[b] and Jonathan B. Freeman[a]

[a] Department of Psychology, Columbia University

[b] Google

Author Note:

This research was supported in part by National Science Foundation Grant BCS-1423708 (J.B.F.). Correspondence concerning this article should be addressed to John Andrew Chwe, Columbia University, Department of Psychology, 1180 Amsterdam Ave, New York, NY 10027. Email jc5751@columbia.edu or jon.freeman@columbia.edu.

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Abstract

Previous research has examined the real-time cognitive processes underlying perceivers' ability to resolve racial ambiguity into monoracial categorizations, but such processes for Multiracial categorizations are less clear. Using a novel, three-choice mouse-tracking paradigm, we found that when perceivers categorized faces as Multiracial their hand movements revealed an initial attraction to a monoracial category (Study 1). Moreover, exposure to Multiracial individuals moderated these effects. When measured (Study 2) or manipulated (Study 3), Multiracial exposure reduced monoracial category activation and activation occurred for both morphed and real Multiracial faces (Study 4). Together, the findings suggest that Multiracial categorizations emerge from dynamic competition between relatively more accessible monoracial categories and a less accessible Multiracial category, which is attenuated through greater exposure to Multiracial targets. This research is the first to chart out the real-time dynamics underlying Multiracial categorizations and offers a new theoretical account of this increasingly common form of social categorization.

Keywords: social categorization, race, Multiracial, mouse tracking, exposure

Reflexive Activation of Monoracial Categories During Multiracial Categorization

Multiracial people are currently the fastest-growing demographic group in the United States. Between 2010 and 2020, the number of people identifying as Multiracial increased by 276%, with current estimates indicating as many as 1 in 5 Americans will identify as Multiracial by the year 2060 (Jones et al., 2021; Colby & Ortman, 2015). Such demographic trends raise new questions for theories of social categorization. Much of the existing research on race has tacitly assumed that perceivers sort others into a common set of monoracial categories. Traditionally, perceivers would be asked to view a series of faces and make forced-choice judgments of each person's race using a small number of discrete categories (e.g., Black, White, Asian), demonstrating that perceivers readily and rapidly sort others into monoracial categories given minimal information (Ito & Urland, 2005; Macrae & Bodenhausen, 2000; Willadsen-Jensen & Ito, 2006).

In terms of categorizing mixed-race or racially ambiguous individuals, existing work offers several insights. First, when a Multiracial response option is not available, perceivers often categorize mixed-race targets according to their lower-status identity (e.g., Halberstadt et al., 2011; Ho et al., 2011; Peery & Bodenhausen, 2008). This tendency, known as hypodescent, implies that perceivers are more likely to categorize Black-White Multiracial individuals as Black than as White. Second, perceivers do use Multiracial labels when available. When judging racially ambiguous faces morphed between members of different racial groups, perceivers categorized the targets as Multiracial more often than as Black or White (Chen & Hamilton, 2012; Chen et al., 2014). Third, because mixed-race communities only became widely visible recently, Multiracial categorizations differ from monoracial categorizations in notable ways. For most perceivers, monoracial categories were learned earlier in life and used more often than Multiracial categories, making them readily accessible. Consistent with this perspective, Multiracial categorizations have been shown to be less cognitively efficient and take longer to complete in terms of response latencies (Chen & Hamilton, 2012) as well as require more cognitive resources to complete (Peery & Bodenhausen, 2008), relative to monoracial judgments.

This growing body of work has focused primarily on the products of categorization – that is, decisions about whether a target belongs to one category (e.g., Black) or another (e.g., Multiracial). Although we often experience race categorizations as automatic, all-or-nothing judgments, person perception models such as the Dynamic Interactive (DI) model suggest that they dynamically evolve over the course of hundreds of milliseconds in competition with other possible categorizations (Freeman et al., 2010). During this process, bottom-up facial features become integrated with top-down social cognitive processes to form perceptions of social categories, which in turn may lead to biases or prejudiced evaluations (Freeman et al., 2020; Freeman & Ambady, 2011). However, such models have generally ignored the process of how perceivers arrive at a Multiracial categorization when such a response is made available.

Real-Time Dynamics

Current models of social categorization have accounted for the real-time dynamics underlying a variety of sex, race, age, and emotion categorizations, including monoracial categorizations of racially ambiguous targets (Freeman et al., 2010; Freeman & Johnson, 2016; Brown et al., 2017; Hester et al., 2023; Yamauchi & Xiao, 2018). However, such models fail to account for how perceivers make explicit Multiracial categorizations and resolve racial ambiguity outside the constraint of monoracial categories. According to the DI model, social categorizations result from a dynamic competition process between multiple partially-active categories that stabilize over time. In early moments of processing, social category representations reflect tentative results from face processing and tend to be partially consistent with alternate social categories because the initial sketch of a face partially supports multiple interpretations. As the ongoing accrual of more face information continues, a categorical percept is sharpened (e.g., Black) while other representations (e.g., White) are pushed out. These competitive dynamics are particularly pronounced in cases of ambiguity, as an ambiguous mixture of facial cues will trigger stronger partial parallel activation of social categories that must compete over time.

The current set of studies aim to extend the DI framework to test a new account of Multiracial categorization. Implementing a Multiracial category representation alongside other monoracial categories in the DI model would subject it to the same competitive dynamics as other race categories. When presented with a face, feature detectors in the facial cue level would begin placing excitatory and inhibitory pressures on race category representations, such as White, Black, and Multiracial. Because these categories are related through mutually inhibitory connections, the increasing activation of one category leads to lateral inhibition of all others, inducing a dynamic competition process. For faces that bear cues associated both the White and Black categories, the White, Black, and Multiracial category nodes would all be expected to activate depending on the strength of the associated cues, and this would lead to a competition between monoracial categories and the Multiracial category representation prior one category representation “winning” out (for details, see Freeman & Ambady, 2011).

Accessibility and Multiracial Exposure

The activation of such race categories depends on many factors, including their cognitive accessibility. In the DI model, accessibility is driven by the strength of the cue–category connections (bottom-up) responsible for activating race-category representations from facial cues, as well as the stereotype–category connections (top-down) that modulate those representations based on conceptual associations. When a perceiver is chronically exposed to members belonging to a racial category, the bottom-up connections for that category would be especially strong and developed, facilitating the category’s activation. Moreover, having deeper and more elaborate conceptual associations pertaining to a racial category, which could increase with exposure, would increase the strength and number of top-down connections for that category. Thus, there are multiple routes through which greater exposure to members of a racial group, or stereotypes and concepts about that group, could make its category representation more accessible in the mind of a perceiver. Accessibility in the model is also affected by contextual and high-level factors as well (e.g., goal-driven attention).

It has long been known that object categories encountered less frequently are recognized more slowly than more frequently encountered categories (Oldfield & Wingfield, 1965), and that social categories representing “cultural defaults” are more quickly categorized than non-default categories (Zarate & Smith, 1990). Thus, from this perspective, when processing a racially ambiguous face a relatively greater exposure to monoracial over Multiracial categories over perceivers’ lifetime would result in more readily and rapidly activated monoracial categories, with Multiracial category activation lagging behind. As discussed earlier, this premise has received some empirical support. Multiracial categorizations tend to have delayed reaction times (Chen & Hamilton, 2012) and require more cognitive resources (Peery & Bodenhausen, 2008) relative to monoracial categorizations. Moreover, greater exposure to Multiracial individuals increases the use of a Multiracial category (Pauker et al., 2018).

The concept of Multiracial identity has been gaining an increasing public awareness, whereas monoracial identities have been entrenched in the common milieu for far longer. The Multiracial category may therefore be less chronically accessible than monoracial categories due to relatively low exposure for most perceivers (Chen & Hamilton, 2012), resulting in monoracial categories having an early advantage in the dynamic competition process. However, shifting demographics may change these tendencies, with exposure to Multiracial people or stereotypes and concepts about Multiracial people increasing the accessibility of Multiracial categorizations through either bottom-up or top-down routes. Although myriad factors influence the tendency to use Multiracial categorizations (e.g., race essentialism or egalitarian beliefs), prior research has demonstrated that perceivers living in areas with a greater percentage of Multiracial individuals are more likely to use the label "Multiracial" for ambiguous targets (Pauker et al., 2018), and it has been hypothesized that individuals living in regions that have institutionalized a Multiracial category will be more likely to use such a category (Pauker et al., 2018; Chen, et al., 2018a; Chen et al., 2014; Chen, 2019). Moreover, Multiracial perceivers themselves, who would be expected to be most chronically exposed to Multiracial identities or concepts about those identities, tend to use the Multiracial category more readily in categorizing others (Iankilevitch et al., 2020).

However, prior research has generally viewed Multiracial categorizations as being inefficient only because they are less cognitively accessible, rather than facing active interference from more accessible monoracial categories. Mouse-tracking is a useful tool that has long been used to measure how perceivers resolve a target into a binary categorization (for reviews, Freeman, 2018; Stillman et al., 2018). However, moving beyond binary categorizations, a novel three-choice mouse-tracking paradigm could track the real-time resolution of targets into Multiracial categorizations. Such a paradigm could disentangle a straightforward Multiracial category inaccessibility account from the DI model's predictions where monoracial categories actively compete with the Multiracial category.

In such a paradigm, White, Black, and Multiracial response options can be structured such that inefficiency in Multiracial categorization is reflected only by vertical movement on the screen, while activation and interference from monoracial categories is reflected entirely by horizontal movement (see Figure 1). If interference from monoracial categories does not impact Multiracial categorizations, we would expect perceivers' hand trajectories to take longer to select the Multiracial (relative to a monoracial) response. Critically, however, while these trajectories would take longer to traverse the vertical axis of the screen toward the Multiracial response, they should show a relatively direct path with no systematic deviation along the horizontal axis to monoracial category response (Figure 1). Alternatively, the inefficiency of Multiracial judgments may arise due to a reflexive tendency to activate monoracial categories. If true, we would expect hand trajectories to chart an indirect path toward the Multiracial response option; perceivers would initially be simultaneously attracted to a monoracial category response before stabilizing on the Multiracial category response, thereby revealing a systematic bias along the horizontal axis (Figure 1). However, such inefficiency would not be explained only by a reduced accessibility of the Multiracial category, but also by an early activation of monoracial categories that induce competition with a Multiracial categorization. To be clear, our dynamic competition account is not inconsistent with these prior accounts, but rather it builds on them and additionally implicates the central role that competitive dynamics play in furnishing Multiracial categorizations.

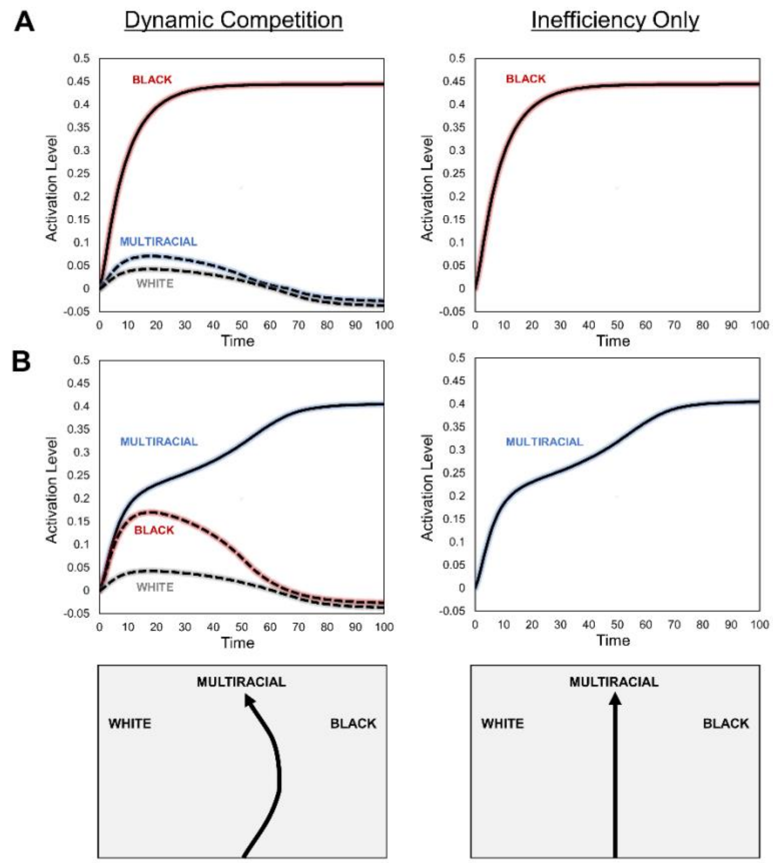

Figure 1. Schematic of Multiracial categorization dynamics with and without monoracial category interference. Multiracial categorizations could be influenced by partial activations of competing monoracial categories. (A) Prior research has demonstrated that perceiving a monoracial face activates multiple racial categories at once (left), rather than a single category in isolation (right). (B) Similarly, Multiracial categorizations could be in part explained by partial activation of competing monoracial categories. If competitive activations from monoracial categories contribute to Multiracial categorizations, then deviation to monoracial categories during Multiracial categorizations should be observed in a three-choice mouse-tracking paradigm (left). Alternatively, if Multiracial categorizations are merely less efficient and entail slower evidence accumulation without any active interference from monoracial categories, no horizontal deviation would be observed in a three-choice mouse-tracking paradigm (right).

The Present Research

We developed a three-choice mouse tracking task to assess perceivers' simultaneous attraction to monoracial as well as Multiracial response options when categorizing racially ambiguous and mixed-race targets. This method allowed us to test whether perceivers show relatively direct but slow progress toward Multiracial judgments, or whether they show an initial reflexive attraction toward monoracial categories en route to a Multiracial judgment, as predicted. In this work, we focus on Black/White Multiracial individuals as a starting point in investigating the dynamics of Multiracial categorizations, recognizing that future research must examine the generalizability of the findings to categorizing Multiracial individuals of other heritages. Study 1 provided an initial test of these possibilities by comparing response trajectories across monoracial and Multiracial categorizations. Study 2 examined real-world exposure to Multiracial individuals and tested whether it impacts race categorization by decreasing the reflexive activation of monoracial categories. Study 3 then explored how shifting demographics might change these dynamics by experimentally exposing perceivers to Multiracial targets. As prior research has cast doubt on the generalizability of using morphed faces (Gaither et al., 2019), we wished to demonstrate that our results replicate with real Multiracial faces. In Study 4 we strengthened our prior findings by replicating the monoracial attraction effect using real Multiracial faces as well as addressing alternative explanations of the effect. Together, this work offers a new account of the dynamically competitive nature of Multiracial categorizations and how such dynamics are shaped by exposure to Multiracial individuals. All materials, data, and code can be found here: https://osf.io/qf5cx/?view_only=262d55a73c604cceaf39191202d5fd3c.

Study 1

In Study 1, we aimed to establish that perceivers exhibit an initial, reflexive attraction toward traditional monoracial categories, which then gives way to Multiracial categorizations. The study involved two sets of race category judgments: One in which only monoracial labels were available (two-choice [2C] categorization task: Black, White), and one in which monoracial and Multiracial labels were available (three-choice [3C] categorization task: Black, Multiracial, White). This approach allowed us to test how response dynamics from a traditional two-choice categorization task were related to response dynamics during a three-choice categorization task. Consistent with previous work (Chen & Hamilton, 2012; Peery & Bodenhausen, 2008), we expected that Multiracial judgments would be less efficient than monoracial judgments (i.e., longer reaction times). More critically, we predicted that mouse trajectories would show an attraction toward monoracial categories in the early moments of social perception. Rather, whatever monoracial category label perceivers would apply in a two-choice categorization task, we expected this monoracial category to partially activate during the process of categorizing the face as Multiracial (in a three-choice categorization task).

Method

Participants. One hundred and twenty-eight participants from Amazon Mechanical Turk completed the study (gender: 57% female, 43% male; age: M=35.59, SD=12.43; race: 79.84% White, 6.45% Black, 5.65% Asian, 3.23% Multiracial, 2.42% American Indian, and 2.42% other).[1] Without any direct precedent for this research and recognizing that power analyses for effects in multi-level models are an unresolved issue, we based our target sample size on existing research concerning the categorization of Multiracial targets (Chen & Hamilton, 2012). Given that Studies 2 and 3 involved the introduction of a between-subject factor or individual differences in exposure, we increased target sample size in those studies accordingly.

Stimuli. Stimuli were 75 faces that captured a wide range of racial prototypicality ranging from prototypically White to prototypically Black. We selected front-facing photographs of 25 self-identified White and Black men with neutral expressions from the Chicago Face Database (Ma et al., 2015). We used male faces only for the current study due to the known effects of gender stereotypes and race and gender interactions (Johnson et al., 2012; Xie et al., 2021). We then randomly paired each of the Black faces with one of the White faces (without replacement). Using Psychomorph software (Tiddeman et al., 2001), we placed 129 landmark points around each target's face before mathematically averaging each pair to form a composite image. We saved the morphed image that was 50% White and 50% Black from each pair, resulting in 25 Black-White morphs. Thus, the final stimulus set included 75 images total: 25 White faces, 25 Black faces, and 25 Black-White morphs.

Procedure. Participants completed two tasks in fixed order. In the first task, they categorized the race of 75 faces using two response options – Black and White (two-choice, or 2C, task). In the second task, they categorized the same 75 faces using three response options – Black, White, and Multiracial (three-choice, or 3C, task). The order was fixed rather than counterbalanced in the present study because the mere mention of the possibility of a third "Multiracial" option in the second task could reasonably affect response patterns in the 2C task (we examine this issue directly in studies that follow). After completing both sets of judgments, participants provided demographic information (gender, race, age) and were debriefed.

Participants made race categorizations using a Javascript-based extension of the MouseTracker software (Freeman & Ambady, 2010). At the beginning of each trial, participants pressed a start button at the bottom center of the screen, triggering a face stimulus to appear. They categorized the stimulus by moving their cursor from the start button to the appropriate response option located at the top of the screen. For the 2C task, Black and White category response buttons were placed in the upper left- and right-hand corners of the screen (left vs. right counterbalanced across participants). For the three-choice task, the Black and White response buttons were similarly located in the upper left- and right-hand corners of the screen (left vs. right counterbalanced across participants); however, an additional Multiracial button was also located in the top center of the screen. All response options were equidistant from the start button to ensure that any observed differences in mean mouse trajectories could not be attributed to proximity of the response buttons (Figure 2).

Consistent with prior research (e.g., Freeman et al., 2010), we set an initiation deadline of 400 ms and a response deadline of 2,000 ms for each judgment so that we could track the categorization process as it unfolded in real time. If participants did not begin moving their mouse within 400 ms or did not complete their judgment within 2,000 ms of pressing the start button, they received a warning message following completion of the trial that encouraged them to work faster. MouseTracker recorded the streaming *x, y* coordinates of participants' mouse cursors, providing millisecond-resolution data about the dynamics underlying each judgment.

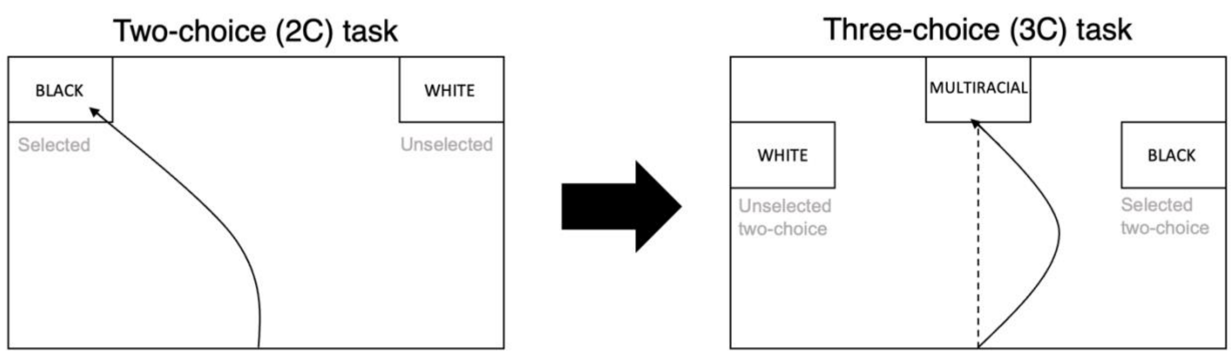

Figure 2. Depiction of study design. Participants completed a two-choice (2C) categorization task and a three-choice (3C) categorization task. The dotted line is an idealized mean trajectory for the Multiracial response free of any monoracial influence. Hypothetical observed trajectories (solid black lines) are shown for the 2C and 3C tasks. In Studies 1 and 3, mouse trajectory attraction in the 3C task was calculated relative to the response chosen for the same stimulus in the 2C task. Thus, positive values indicate attraction to the selected 2C response (which was remapped to the right of the screen), negative values indicate attraction to the unselected 2C response (which was remapped to the left of the screen), and values near zero indicate a lack of attraction to monoracial categories. In Study 2, mouse trajectory attraction in the 3C task was calculated relative to the more probable (remapped to right of the screen) or less probable

(remapped to left of the screen) categorization according to independent participants (Study 2 participants did not complete the 2C mouse-tracking task).

Results

We rescaled mouse trajectories for each judgment into a standard *x, y* coordinate space (top-left: [-1,1.5]; bottom-right: [1, 0]; bottom-center: [0, 0]) and normalized responses into 100 evenly-spaced time steps. Trajectories that deviated to the left of center therefore had negative *x* values while trajectories that deviated to the right of center had on positive *x* values. We remapped trajectories for analysis such that the 2C selected response was always on the right and the 2C unselected response was always on the left. With zero indicating the middle of the screen, negative *x*-coordinates indicate attraction to the 2C unselected response and positive *x*-coordinates indicate attraction to the 2C selected response. The Multiracial response option was always located in the center of the screen; *x*-coordinates near zero indicate a straight-line trajectory from the start button to the Multiracial label in the 3C task (Figure 2).

We tested most of our hypotheses with multilevel regression models using generalized estimating equations (GEEs) using the “geepack” package in R, which appropriately account for the nested data in our within-subject design (Zeger & Liang, 1986; Højsgaard et al., 2006). When examining binary outcomes, we specified a binomial distribution and a logit link function; when examining continuous outcomes, we specified a normal distribution. We effect-coded categorical predictors and mean-centered continuous predictors prior to entering them into regression equations. For analyses with categorical outcomes, we report Wald chi-square tests (X^2), which are conceptually similar to the *F*-test in a traditional analysis of variance. We follow-up on significant chi-square tests with pairwise comparisons of each category. For analyses with continuous outcomes, we report Wald *z* tests. Unstandardized regression coefficients (*B*) are reported. Follow-up tests were conducted using the “emmeans” package in R, with Tukey correction for multiple comparisons (Lenth, 2022). For analyses conducted using ANOVAs, we used the “afex” package in R (Singmann et al., 2015). Greenhouse-Geisser sphericity correction was used where necessary. Reaction time results for all studies can be found in the Supplementary Materials. In all studies, we also ensure that our findings are driven by a continuous process of multiply activated categories (e.g., parallel activation of Multiracial and Black categories), rather than discrete, stage-based errors (e.g., initial activation of one category followed by corrective activation of another category) in the Supplementary Materials.

Categorization Outcomes. We began by confirming that participants' categorization of the White faces, Black faces, and White-Black morphs conformed to our expectations. We avoid labeling these judgments as accurate or inaccurate because Multiracial identities are complex social constructs precluding any "correct" response (Sanchez et al., 2009). Instead, we refer to categorizations that match our a priori definition of the target's race as "concordant" (e.g., labeling a Black-White morph as Multiracial) and categorizations that do not match our definition of the target's race as "discordant" (e.g., labeling a Black-White morph as Black), consistent with prior work (Chen & Hamilton, 2012).

We conducted a one-way repeated measures ANOVA with a priori race as a within-subjects factor (*White, Black, Multiracial*) and proportion of concordant responses as the dependent variable. The ANOVA found a significant main effect of a priori race, F(1.81, 230.21)=23.10, η_g^2=0.056, p<0.001. Replicating prior findings (Chen & Hamilton, 2012), participants provided significantly fewer concordant responses to a priori Multiracial targets (M=0.767, SE=0.019) when compared to a priori White targets (M=0.855, SE=0.017), t(127)=4.915, p<0.001, or Black targets (M=0.878, SE=0.017), t(127)=5.797, p<0.001.

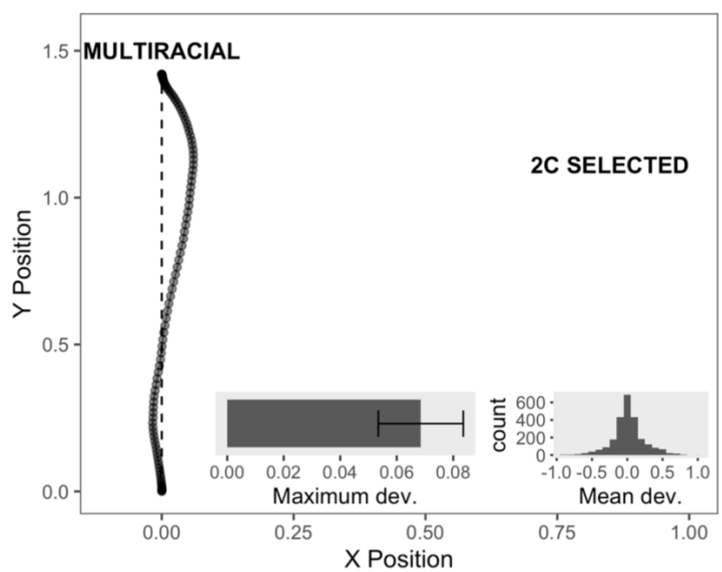

Figure 3. Participants demonstrate a reflexive attraction to monoracial categories in Study 1. The dashed black line indicates an idealized straight-line trajectory (x=0) from the start button to the Multiracial response option. The mean trajectory across all trials is depicted in black, remapped such that the option selected in the two-choice (2C) task is on the right. Mean and standard error of maximum deviations are shown, showing a positive and significant effect (in

the direction of the 2C selected response). A histogram of mean deviations is depicted, which appears unimodally distributed and did not show evidence of multimodality, indicating that attraction to monoracial categories is derived from parallel competition between monoracial and Multiracial categories. Note that the x and y axes are not to scale.

Monoracial Attraction. More importantly, we test whether Multiracial categorizations were subject to competitive dynamics exerted by monoracial categories. We predict that even when participants ultimately categorize a target as Multiracial, they will be initially attracted to the monoracial category that is more readily accessible for that given target (i.e., the monoracial category they indicate for the target in a two-choice task). Thus, we restricted our analysis to concordant Multiracial categorizations (i.e., a priori Multiracial targets ultimately categorized as Multiracial) to focus exclusively on Multiracial targets and ensure that any monoracial attraction effects are not driven by prototypically Black or White faces. This is a more conservative test of our hypothesis, because observing monoracial attraction for prototypically Black or White faces receiving a Multiracial categorization could be confounded with an erroneous response.

With trajectories remapped such that the 2C selected response was on the right and the 2C unselected response was on the left, we used two complementary measures of spatial attraction toward the 2C selected response. First, we used the signed absolute value of the maximum horizontal x-position (*maximum deviation*). Thus, if the greatest deviation was in the direction of the 2C selected response (on the right), this measure would return the largest positive value; if the greatest deviation was in the direction of the 2C unselected response (on the left), this measure would return the largest negative value. Second, to capture deviation along the entire length of the trajectory rather than a maximum point of deviation, we calculated the mean of the entire time series of horizontal x-position (*mean deviation*); accordingly, deviation toward the 2C selected response (on the right) was incorporated as positive values and deviation toward 2C unselected response (on the left) incorporated as negative values. Effectively, these complementary measures provide the three-choice mouse-tracking equivalent of the maximum perpendicular deviation (MD) and area under the curve (AUC) measures widely used for the classic two-choice mouse-tracking paradigm (Freeman & Ambady, 2010).

These measures and the aforementioned response remapping (unselected 2C response x=-1, Multiracial response x=0, selected 2C response x=1) allow us to test our key hypothesis in a straightforward manner, predicting that maximum deviation and mean deviation values will be greater than 0 (i.e., in the direction of the response selected in the 2C task). In our GEE regression framework, this would be indicated by a significantly positive regression coefficient in an intercept-only model. In separate regressions, maximum deviation and mean deviation values were predicted in intercept-only models. Indeed, participants exhibited an attraction in the 3C task toward the monoracial category that they had idiosyncratically used to categorize the same target in the constrained 2C task, indicated by both maximum deviation (B=0.068, SE=0.018, $CI_{95\%}$=[0.033, 0.104], z=3.753, p=0.0002) and mean deviation (B=0.015, SE=0.006, $CI_{95\%}$=[0.004, 0.026], z=2.758, p=0.006) (Figure 3).

Discussion

Study 1 used mouse tracking to provide insight to the dynamics underlying monoracial and Multiracial categorizations. When Multiracial labels were available, perceivers consistently used it to categorize Black-White targets. Although perceivers made use of both Multiracial and monoracial labels when they were provided, the categorization process underlying these judgments was quite different. Multiracial response trajectories were generally slower than monoracial judgments and exhibited a systematic bias toward monoracial categories. Specifically, when ultimately categorizing targets as Multiracial, participants' mouse trajectories showed a strong and consistent attraction to the monoracial response option they had used to categorize the target in the two-choice task. Thus, while judgments of Black-White morphs ultimately favored the Multiracial category, response dynamics were biased in favor of monoracial categories. Whichever monoracial category was selected in a two-choice task for a given face was the category that initially interfered with participants' categorization process prior to selecting the Multiracial response.

Study 2

Study 1 revealed biases in the processes underlying Multiracial categorization. Although perceivers used the Multiracial category to label others, they did so relatively inefficiently and only after being initially attracted to monoracial categories. In Study 2, given the role of exposure outlined earlier, we predicted that real-world exposure to Multiracial individuals would reduce perceivers' reflexive attraction to monoracial categories. We also aimed to address a concern from Study 1 that the task demands of a 2C categorization task, which only provided monoracial options, may have artificially induced monoracial attraction effects in the 3C task. Thus, we removed the 2C categorization task for this study and instead used each face stimulus' likelihood of monoracial vs. Multiracial categorization from an independent group of participants to examine the reflexive attraction to monoracial categories in the 3C task. Finally, to increase the generality of our findings, we aimed to replicate the effects of Study 1 using different face stimuli.

Method

Participants. Participants were recruited from Mechanical Turk and Prolific. One hundred seventy-six participants (age M=34.13 years, SD=9.60 years; 36.42% female, 63.58% male; 80.92% White, 9.25% Black, 5.20% Asian, 1.16% Multiracial, 1.73% American Indian, and 1.73% other; see Footnote 1) completed the 3C task used in Study 1 (without completing the 2C task).

To generate an index of likelihood of monoracial vs. Multiracial categorization for every face stimulus based on explicit responses, an independent group of 49 participants (age M=44.00 years; SD=15.19 years; 52.08% male, 45.83% female, and 2.09% other; 83.33% White, 4.17% Black, 4.17% Asian, 2.08% Multiracial, 2.08% American Indian, and 4.17% other; see Footnote 1) completed the 2C categorization task used in Study 1.

Stimuli. To increase the generality of our findings, we used a different stimulus set than that of Study 1. Here, we used a database of 120 faces used in prior research on Multiracial categorization, comprising 40 monoracial Black, 40 monoracial White, and 40 Black-White morphs (20 men and 20 women within each condition). The faces were created by Chen, Pauker, Gaither, Hamilton, and Sherman (2018) using morphing procedures like those described in Study 1. Importantly, the monoracial White and Black faces were 50/50 blends of two monoracial identities. Thus, all the faces in this stimulus set were created by morphing, helping to rule out concerns that observed differences in monoracial and Multiracial categorization processes are an artifact of the stimulus generation procedure.

Procedure. Unlike Study 1, participants completed only the 3C task. As before, the stimuli were presented in randomized order within each block and the location of the Black and White labels was counterbalanced across participants (with the Multiracial label always in the center). After completing their evaluations, participants completed self-report measures of exposure to White, Black, and Multiracial individuals based on previous work (Pauker et al., 2018; Sanchez et al., 2015). On three separate 1-7 Likert scales, participants were asked to report how many of their acquaintances, friends, and close friends are White, Black, and Multiracial.

Participants were also asked to estimate the percentage of individuals in their city, workplace, and neighborhood who are White, Black, and Multiracial, to assess more general levels of exposure to Multiracial individuals (as opposed to their own relationships). We used a subjective rather than objective measure of the presence of Multiracial individuals in a participant's local environment because we reasoned that a subjective measure has greater specificity to participants' understanding of their daily encounters, as well as the fact that Multiracial individuals tend to be racially ambiguous (leading subjective categorizations to potentially diverge from objective indices).

Finally, participants provided demographic information (gender, race, age, education level, income) and were debriefed. As real-world racial exposure may be expected to vary with education level and income, these were additionally included in the demographics to serve as covariates. An independent sample of participants completed a complementary 2C task, categorizing each target as either Black or White.

Results

We followed the same general analytic strategy for mouse-trajectory data described in Study 1. However, rather than predicting 3C attraction effects based on a participant's own unique monoracial categorization from a 2C task, we predicted attraction based on the probability of White/Black categorization from independent participants.

To create an aggregate index of participants' Multiracial exposure (relative to exposure to monoracial individuals), the three items measuring acquaintances, friends, close friends who are Multiracial and the items estimating percentages of Multiracial people in the workplace, neighborhood, and city were averaged and subtracted from the average of the six equivalent items for White and Black targets. The estimated percentages were rescaled to values 1-7 in order to be aggregated. We use this exposure difference score (Multiracial exposure score) in all subsequent analyses, which reflects to what extent a participant has greater exposure to Multiracial individuals relative to their overall exposure to other individuals. Reaction time results are provided in the Supplementary Materials.

Categorization Outcomes. We conducted a repeated-measures ANCOVA on the proportion of concordant responses with a priori race as a within-subjects factor (*White, Black, Multiracial*) and Multiracial exposure score as a between-subject covariate. There was a significant main effect of a priori race, with participants making fewer concordant Multiracial categorizations (M=0.446) than Black categorizations (M=0.825, t(174)=18.800, p <.0001) or White categorizations (M=0.899, t(174)=22.580, p <.0001), $F(1.49, 258.62)=379.50$, $\eta_g^2=0.483$, $p<0.0001$. There was also a main effect of Multiracial exposure, with higher-exposure (+1 SD) participants making fewer concordant categorizations than lower-exposure (-1 SD) participants overall, $F(1, 174)=32.91$, $\eta_g^2=0.097$, $p<0.001$, and a significant interaction, $F(1.49, 258.62)=3.39$, $\eta_g^2=.008$, $p=0.049$. The decreased proportion of concordant categorizations among participants with higher levels of exposure was strongest for Black categorizations ($M_{higher}=0.746$, $SE_{higher}=0.020$; $M_{lower}=0.904$, $SE_{lower}=0.020$; $t(174)=5.494$, $p<0.0001$), slightly less strong for Multiracial categorizations ($M_{higher}=0.363$, $SE_{higher}=0.027$; $M_{lower}=0.529$, $SE_{lower}SE=0.027$; $t(174)=4.325$, $p=0.0004$), and least strong for White categorizations ($M_{higher}=0.859$, $SE_{higher}=0.018$; $M_{lower}=0.941$, $SE_{lower}=0.018$; $t(174)=3.288$, $p=0.015$). These effects may reflect that increased Multiracial exposure lead participants to diversify their race categorizations (e.g., Nicolas et al., 2019).

Monoracial Attraction. Using the independent group of participants' White/Black categorizations from the 2C task, we calculated a measure of monoracial prototypicality for each target ranging between 0=ambiguity (50% Black/50% White) and 1=prototypicality (100% White or 100% Black). Responses were remapped such that whichever monoracial category was more probable (>50%) was remapped to the right of the screen (x=1), and whichever monoracial category was less probable (<50%) remapped to the left of the screen (x=-1). Thus, we predicted that a) trajectories for Multiracial categorizations would show an attraction toward the right of the screen overall, indicated by a significantly positive intercept (replicating Study 1); b) increasing levels of monoracial prototypicality for given targets would increase the strength of the attraction effect; and c) the attraction effect would be relatively diminished among high-exposure participants.

For a priori Multiracial targets that were ultimately categorized as Multiracial, we regressed maximum deviation and mean deviation from the 3C task, separately, onto monoracial prototypicality, Multiracial exposure score, and their interaction. Participants in the 3C task were attracted to the monoracial category used on average by independent participants in the 2C task for a given target, as indicated by a significantly positive intercept (maximum deviation: $B=0.101$, $SE=0.017$, $CI_{95\%}=[0.068, 0134]$, $z=6.007$, $p<.0001$; mean deviation: $B=0.026$, $SE=0.005$, $CI_{95\%}=[0.015, 0.036]$, $z=4.681$, $p<0.0001$) (Figure 4). There was also an effect of monoracial prototypicality (maximum deviation: B=0.196, SE=0.050, $CI_{95\%}$=[0.098, 0.294], z=3.910, p<0.0001; mean deviation: B=0.063, SE=0.016, $CI_{95\%}$=[0.032, 0.094], z=3.963, p<0.0001), such that attraction to the monoracial category increased as that category was more readily used by independent participants for a given target. Critically, there was also a significant effect of exposure (maximum deviation: B=-0.066, SE=0.019, $CI_{95\%}$=[-0.103, -0.029], z=3.489, p=0.0004; mean deviation: B=-0.016, SE=0.006, $CI_{95\%}$=[-0.027, -0.004], z=2.687, p=0.007). While participants with less exposure (-1 SD) demonstrated strong and significant monoracial attraction (maximum deviation: B=0.155, SE=0.019, $CI_{95\%}$=[0.118, 0.191], z=8.330, p<0.0001; mean deviation: B=0.038, SE=0.005, $CI_{95\%}$=[0.028, 0.049], z=7.220, p<0.0001), this was attenuated considerably in participants with more exposure (+1 SD), whose monoracial attraction effect was either not significant or reached only marginal significance (maximum deviation: B=0.048, SE=0.026, $CI_{95\%}$=[-0.003, 0.099], z=1.840, p=0.066; mean deviation: B=0.013, SE=0.009, $CI_{95\%}$=[-0.004, 0.030], z=1.480, p=0.139) (Figure 4). The interaction was not significant (maximum deviation: B=-0.029, SE=0.064, $CI_{95\%}$=[-0.154, 0.096], z=0.454, p=0.649; mean deviation: B=0.005, SE=0.018, $CI_{95\%}$=[-0.029, 0.040], z=0.289, p=0.772). To ensure that our findings are not driven by individual differences in education level or income, which may covary with exposure level, we conducted additional analyses statistically adjusting for education level and income. Both our overall monoracial attraction effect and its reduction by real-world exposure remained significant after adjusting for these covariates (see Supplementary Materials).

Discussion

We found that real-world levels of exposure to Multiracial individuals reduced perceivers' attraction toward monoracial categories during Multiracial categorizations. Such findings hold after controlling for other factors such as income and education level, suggesting that our observed effects are indeed a product of greater exposure to Multiracial individuals. Moreover, by removing a 2C task from the present study and using independent participants' White/Black categorization data to model mouse trajectories, we ensure that the results of Study 1 were not spuriously produced by the task demands of the 2C task increasing the salience of monoracial categories. Interestingly, participants with greater levels of Multiracial exposure demonstrated less concordant categorizations across the board. One explanation is that because such participants are exposed to greater racial diversity and natural phenotypical variability that exists in the faces of real-world people identifying as Multiracial, their categorizations exhibit more diversification (Nicolas et al., 2019). More importantly, however, the findings show that individuals with greater levels of Multiracial exposure are better able to furnish Multiracial categorizations without reflexive interference from monoracial categories.

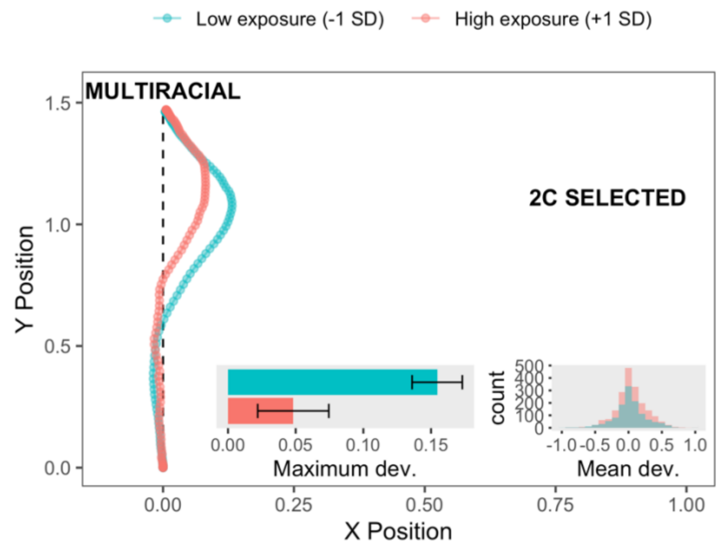

Figure 4. Real-world exposure decreases monoracial attraction in Study 2. The dashed black line indicates an idealized straight-line trajectory (x=0) from the start button to the Multiracial response option. The mean trajectories across all trials for participants with more and less exposure is depicted, remapped such that the option selected in the two-choice (2C) task is on the right. Mean and standard error of maximum deviations are shown, indicating that participants with more Multiracial exposure had a reduced monoracial attraction effect. Histograms of mean deviations for the two exposure levels are depicted. Both appear unimodally distributed and did not show evidence of multimodality, indicating that attraction to monoracial categories for both exposure levels is derived from parallel competition between monoracial and Multiracial categories. Note that the x and y axes are not to scale.

Study 3

While Study 2 measured real-world levels of Multiracial exposure, to demonstrate a more causal role of exposure we aim to provide converging evidence by manipulating exposure in Study 3. We predicted that experimentally exposing perceivers to Multiracial individuals would reduce perceivers' reflexive attraction to monoracial categories. As the DI model assumes both visual and conceptual factors can contribute to the Multiracial category's increased accessibility, our manipulation exposed participants to a series of Multiracial individuals by providing both types of information.

Method

Participants. Given the between-subject design with two groups (Multiracial exposure vs. control exposure), we doubled our target sample size of the previous studies, with 393 Mechanical Turk and Prolific users completing the study (52.76% male, 45.67% female, 1.05% other, and 0.52% decline; age M=41.50 years, *SD*=14.44 years; 76.38% White, 6.04% Black, 9.71% Asian, 3.66% Multiracial, 0.79% American Indian, 3.41% other; see Footnote 1). The Multiracial exposure group included 193 participants, and the control exposure group included 200 participants.

Stimuli. We used the identical face stimuli of Study 2. For timing considerations, we used a subset of the targets for the exposure manipulation (2 White, 2 Black, 10 Multiracial), and another subset for the categorization tasks (42 women – 14 White, 14 Black, 14 Black-White morphs; 42 men – 14 White, 14 Black, 14 Black-White morphs).

Procedure. Participants were randomly assigned to complete one of two exposure tasks (Multiracial exposure vs. control exposure), in which they imagined the lives of 14 individual humans or 14 individual non-human avatars for 20 seconds each, respectively. Details concerning the manipulation can be found in the Supplementary Materials. We used non-human avatars as a control because exposing participants to human avatars, such as those belonging to monoracial identities, could increase the accessibility of monoracial categories and confound the results. Each target was presented in a profile that included a facial photo and basic demographic information (e.g., age, heritage, geographic location). In the control condition, the photos consisted of a series of cartoon faces varying in color (*yellow, red, blue*), shape (*round, square, oval*), eye size (*large, medium, small*), and ear type (*none, straight, curly*). The heritage information in the non-human avatar profiles referred to the color of the avatar's face (2 yellow, 2 red, 10 blue). In the Multiracial condition, the photos consisted of face stimuli. The heritage information in the human profiles referred to each target's race (2 White, 2 Black, 10 Multiracial). Aside from the heritage information, all other profile cues were identical across the control and Multiracial conditions. For example, a profile in the Multiracial condition read: "This is Bobby. He's 24 years old, lives in Georgia, and is Multiracial."

Following the exposure manipulation, participants completed the 2C and 3C tasks in fixed order, just as in Study 1. Having demonstrated in Study 2 that the 2C task demands do not artificially induce the monoracial attraction effects, here we return to modeling participants' attraction effects for each target based on their unique 2C categorization for the target (rather than the average probability from independent participants), to maximize precision. Participants categorized the 84 faces using the same 2C and 3C mouse-tracking tasks as in Studies 1 and 2. After completing the categorization tasks, participants provided demographic information (gender, race, age).

Results

We followed the same analytic strategy described in Studies 1 and 2. Reaction time results are provided in the Supplementary Materials.

Categorization Outcomes. We conducted a mixed-model ANOVA on the proportion of concordant responses with a priori race as a within-subjects factor (*White, Black, Multiracial*) and exposure condition (*Multiracial, control*) as a between-subjects factor. There was a significant main effect of a priori race, $F(1.82, 711.09)=119.26$, $\eta_g^2=.131$, $p<0.0001$, and a significant interaction between a priori race and exposure condition, $F(1.82, 711.09)=26.39$, $\eta_g^2=.032$, $p<0.0001$. The main effect of exposure condition was not significant, $F(1, 391)=0.02$, $\eta_g^2<.001$, $p=0.878$. Overall, participants made fewer concordant Multiracial categorizations ($M=0.713$, $SE=0.012$) than White categorizations ($M=0.877$, $SE=0.009$), $t(391)=13.267$, $p<.0001$, or Black categorizations ($M=0.855$, $SE=0.009$), $t(391)=11.413$, $p<.0001$. Decomposing the interaction, participants exposed to Multiracial targets made significantly more concordant categorizations for Multiracial targets ($M=0.762$, $SE=0.015$) than those exposed to control targets ($M=0.664$, $SE=0.015$), $t(391)=4.594$, $p<0.001$, and significantly fewer concordant categorizations for Black targets ($M=0.829$, $SE=0.012$) than those exposed to control targets ($M=0.881$, $SE=0.012$), $t(391)=3.041$, $p=0.030$. There was no difference in concordant categorizations between the Multiracial exposure ($M=0.856$, $SE=0.013$) and control exposure ($M=0.897$, $SE=0.013$) conditions for White targets, $t(391)=2.254$, $p=0.216$.

Monoracial Attraction. For trials resulting in Multiracial categorizations for a priori Multiracial faces, we separately regressed maximum deviation and mean deviation from the 3C task onto exposure condition (Multiracial, control). Replicating our previous results, participants were initially attracted toward the monoracial category they used in the 2C task to categorize each target that they ultimately categorized as Multiracial, indicated by a positive and significant intercept (maximum deviation: $B=0.120$, $SE=0.009$, $CI_{95\%}=[0.101, 0.139]$, $z=12.245$, $p<0.0001$; mean deviation: $B=0.035$, $SE=0.003$, $CI_{95\%}=[0.029, 0.042]$, $z=11.180$, $p<0.0001$) (Figure 4).

Critically, there was a significant effect of exposure condition (maximum deviation: B=-0.027, SE=0.009, $CI_{95\%}$=[-0.047, -0.008], z=2.772, p=0.006; mean deviation: B=-0.007, SE=0.003, $CI_{95\%}$=[-0.013, -0.0005], z=2.116, p=0.034). The attraction to monoracial categories was considerably reduced in the Multiracial exposure condition (maximum deviation: B=0.093, SE=0.013, $CI_{95\%}$=[0.069, 0.118], z=7.410, p<0.0001; mean deviation: B=0.029, SE=0.004, $CI_{95\%}$=[0.020, 0.037], z=6.840, p<0.0001) compared to the control exposure condition (maximum deviation: B=0.148, SE=0.015, $CI_{95\%}$=[0.118, 0.177], z=9.770, p<0.0001; mean deviation: B=0.042, SE=0.005, $CI_{95\%}$=[0.033, 0.051], z=8.880, p<0.0001). Thus, manipulated exposure to Multiracial people reduced perceivers' reflexive attraction toward monoracial categories (Figure 5).

Discussion

Corroborating the effects of Study 2 that measured real-world exposure, we found that experimentally inducing greater exposure to Multiracial individuals led to a corresponding reduction in the reflexive activation of monoracial categorizing when categorizing targets as Multiracial. This implicates a causal role of exposure in these activation dynamics. Interestingly, while Study 2 found that higher levels of Multiracial exposure were associated with less concordant categorizations for all three categories, suggesting a broad diversification in race categorization (Nicolas et al., 2019), here we found that Multiracial exposure effectively increased the use of the Multiracial category (more concordant categorizations for Multiracial targets and less concordant categorizations for monoracial targets), which is consistent with previous research (Chen & Hamilton, 2012). This difference may be related to manipulating vs. measuring exposure. Manipulating exposure in Study 3 would have increased the accessibility of the Multiracial category and encouraged greater use, while levels of real-world exposure without experimentally increasing category accessibility in Study 2 may more naturally reflect a diversification of race categorization responses. While the current work is focused on activation dynamics and did not have clear predictions about categorization outcomes, future work could aim to clarify the role of exposure in race categorization outcomes.

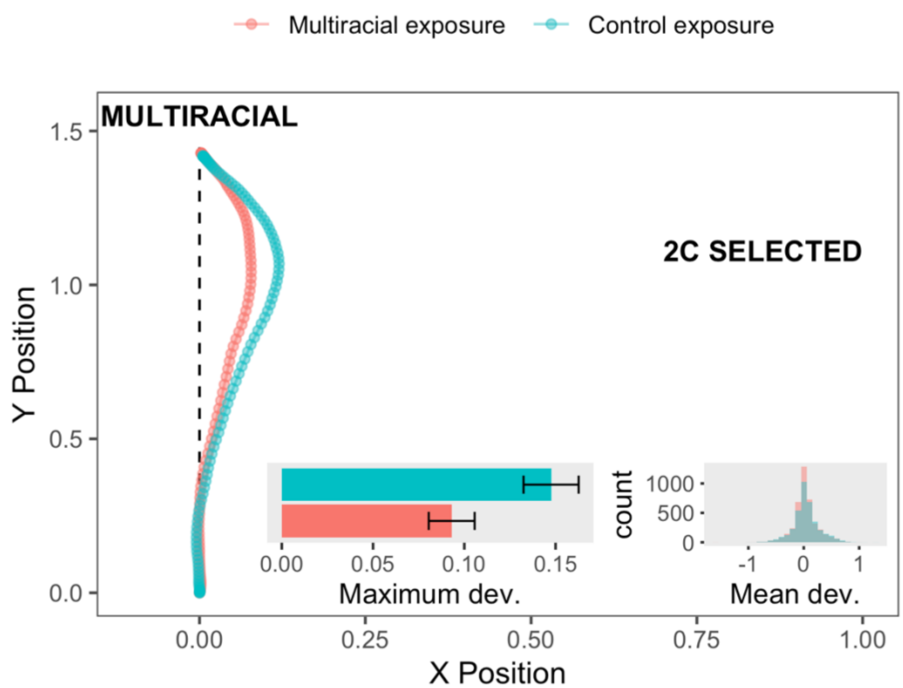

Figure 5. Manipulated exposure decreases monoracial attraction in Study 3. The dashed black line indicates an idealized straight-line trajectory (x=0) from the start button to the Multiracial response option. The mean trajectory across all trials for participants in the Control and Multiracial exposure conditions is depicted, remapped such that the option selected in the two-choice (2C) task is on the right. Mean and standard error of maximum deviations are shown, indicating that Multiracial exposure led to a reduction in the monoracial attraction effect. Histograms of mean deviations for the two exposure conditions are depicted. Both appear unimodally distributed and did not show evidence of multimodality, indicating that attraction to monoracial categories in both conditions is derived from parallel competition between monoracial and Multiracial categories. Note that the x and y axes are not to scale.

Study 4

The previous three studies establish that monoracial categories are initially activated when Multiracial categorizations are being made and that this effect is mitigated by both measured and manipulated exposure to Multiracial individuals. However, prior research has cast some doubt on generalizability between real Multiracial faces and computer-generated or morphed versions (Gaither et al., 2019). Here we aimed to demonstrate generalizability to real Multiracial faces. We also sought to eliminate the possibility that participants may have found neither response option (White, Black, or Multiracial) appropriate on some trials or lacked a Multiracial category representation altogether, which in theory might spuriously produce what appears to be a monoracial attraction effect. Rather than reflecting actual competitive dynamics, monoracial attraction could reflect a participant not possessing a Multiracial representation at all. Thus, we provided participants with the opportunity to indicate that no response options were suitable for a given face.

Using real Multiracial faces, we again replicated a strong monoracial attraction effect (maximum deviation: B=0.096, SE=0.010, $CI_{95\%}$=[0.076, 0.116], z=9.426, p<0.0001; mean deviation: B=0.027, SE=0.003, $CI_{95\%}$=[0.021, 0.033], z=8.187, p<0.0001) (Supplementary Figure S1).[2] Participants very rarely indicated that the response options provided were not suitable for a given face, and excluding such trials did not change the results. See Supplementary Materials for full details of Study 4. These results demonstrate generalizability to real faces and alleviates the concern that the competitive dynamics and monoracial attraction effect may have spuriously resulted from other response options not being provided (e.g., Latinx) or participants finding the Multiracial category option unsuitable or confusing.

General Discussion

Four studies employed a novel three-choice mouse tracking task to better understand the dynamics behind Multiracial categorizations. While we replicated prior work showing that perceivers tend to experience cognitive delays in furnishing a Multiracial categorization, we explained this inefficiency by showing that participants initially activate a monoracial category that competes with the Multiracial category prior to ultimately arriving at a Multiracial categorization (Study 1). We then showed that this reflexive activation of monoracial categories is affected by both measured and manipulated exposure to Multiracial individuals. With greater Multiracial exposure, participants were able to arrive at Multiracial categorizations with less hinderance from initially activated monoracial categories (Studies 2 & 3). Finally, we additionally replicated our results using real Multiracial faces and eliminated the possibility that our findings are due to a lack of a Multiracial category representation (Study 4). Together, these results are consistent with the perspective that Multiracial categorizations result from a dynamic competition process involving relatively more accessible monoracial categories and a less accessible Multiracial category.

These findings provide important theoretical insights in understanding social categorization. As described earlier, the DI model posits that relevant visual cues trigger multiple social category representations that dynamically compete for activation. This dynamic process has been documented for a wide array of social category judgments, including monoracial categories (Freeman et al., 2010; Melnikoff et al., 2021), gender (Freeman et al., 2008), traits (Van der Biest et al., 2023; Martens et al., 2012) and emotional expressions (Korb et al., 2023; Yamauchi & Xiao, 2018). The current studies are the first to extend these findings to Multiracial categories, showing that perceivers co-activate both monoracial and Multiracial categories while disambiguating targets with mixed-race features. In doing so, our findings add to a growing consensus that social categorizations emerge from dynamically competitive processes involving the graded activation of multiple category representations (Freeman et al., 2020).

Our findings also contribute to the growing literature on Multiracial categorization. The current studies replicate key findings of previous research, showing that perceivers frequently utilize the Multiracial label to categorize mixed-race targets when it is made available (Chen & Hamilton, 2012) and that Multiracial categorizations are associated with cognitive delays relative to monoracial categorizations (Chen & Hamilton, 2012; Peery & Bodenhausen, 2008). In the present research, mouse tracking allowed us to visualize the categorization process more completely, revealing that perceivers have a default bias toward monoracial categorizations even when they ultimately judge a target to be Multiracial. This default bias appears to reflect the relative accessibility of monoracial categories, as increasing the accessibility of the Multiracial category through exposure was able to reduce monoracial categories' advantage during the dynamic competition process. By experimentally exposing perceivers to Multiracial targets, we were able to provide more causal evidence that exposure to Multiracial individuals plays a role in determining the relative advantage or disadvantage of the Multiracial category in the categorization process.

However, future research could better characterize the precise mechanisms underlying exposure's effects. While the DI model assumes both bottom-up visually based and top-down conceptually based routes through which exposure can shape the accessibility of monoracial and Multiracial categories, future studies could disentangle the relative contribution of each route to the effects observed. Moreover, while the default activation of monoracial categories was attenuated consistently by both long-term, real-world exposure and brief exposure in the lab, interestingly real-world exposure was associated with less concordant categorizations for all three categories. One explanation is that individuals who have been chronically exposed to more Multiracial individuals heed racial boundaries less, as they encode the inherent perceptual complexity or "messiness" of socially constructed racial categories. In the context of the DI model, this would translate into more nuanced and granular cue associations for racial categories. Accordingly, perceivers with long-term, natural exposure to such perceptual diversity may be expected to exhibit a more diverse range of categorization responses. Future research could test this possibility directly. More important to the present research, however, such long-term exposure to Multiracial individuals attenuates a default, reflexive bias toward monoracial categories.

The present findings may have critical implications for evaluations of Multiracial individuals. Existing research on evaluations of Multiracial people is mixed, with some studies showing that Multiracial people are evaluated more positively than monoracial people (Binning et al., 2009; Halberstadt & Winkielman, 2014; Townsend et al., 2009) and others showing that Multiracial people are evaluated less positively than monoracial people (Chesley & Wagner, 2003; Jackman et al., 2001; Sanchez & Bonam, 2009). One explanation for the variability in findings is that perceivers might evaluate Multiracial targets differently depending on the activation of monoracial categories early in the categorization process, as we have documented here. Indeed, even fleeting attraction to a category can trigger partial activation of attitudes (Yu et al., 2012; Freeman, Pauker, & Sanchez, 2016; Smeding et al., 2016; Cummins & De Houwer, 2021) and stereotypes (e.g., Freeman et al., 2010; Freeman & Ambady, 2009). Thus, even when two targets are both labeled as Multiracial and with identical response times, a default bias toward different monoracial categories initially might contribute to the targets' downstream evaluations in dramatic ways, despite categorizations and response times being identical.

As national demographic patterns change, increasing the use of Multiracial as a category in daily interactions is important for the well-being of Multiracial individuals (Chen, 2019). Similar to the denial of other social identities, Multiracial identity denial or invalidation is an established psychological stressor and linked to a wide variety of negative outcomes in physical and psychological health (Albuja et al., 2019; Townsend et al., 2009; Sanchez, 2010; Campbell & Troyer, 2007). For those who identify as Multiracial, it is important for social psychology to understand how the category of Multiracial can be brought onto an "even playing field" with monoracial categories that enjoy greater accessibility and reflexive activation. The 3C mouse-tracking paradigm may be useful as a methodological tool to index such competitive dynamics as researchers aim to create conditions that increase the reflexive use of the Multiracial category.

The current studies are not without their limitations. Our studies examined only one type of mixed-race identity, that of Black-White Multiracial individuals. There are clearly other Multiracial identities whose experiences may not be equivalent to those of Black-White Multiracial individuals, especially given the unique history of racial prejudice against Black Americans. It will be important for future studies to test whether and how the current findings apply to other Multiracial identities, such as Asian-White or Asian-Black identities, among any number of others (Garay & Remedios, 2021). It is important to note that, while our measures of Multiracial exposure implicitly reference Black/White Multiracial identity via the context of the experiment, it is possible that participants drew on other intersections of Multiracial identity (e.g., Black/Asian, Asian/White) in providing responses. Such a possibility raises more fundamental questions about the generality vs. specificity of Multiracial category representations and the role of Multiracial exposure in its various forms. When manipulating Multiracial exposure, we used non-human avatars rather than monoracial individuals in order to avoid increasing the accessibility monoracial categories, which would confound the results. However, it is possible that in doing so the manipulation may have activated humanness rather than Multiraciality, which future studies manipulating Multiracial exposure can better assess. Finally, we should note that our findings apply to a culturally and historically specific moment (Chen et al., 2018a; Pauker et al., 2018). Future research that compares categorization tendencies across time and location would help to clarify the role exposure plays in shaping categorization processes.

In summary, our findings show that, even when given the opportunity to categorize a target as Multiracial, a reflexive monoracial category activation in the early moments of social perception is observed. As perceivers gain additional exposure to mixed-race people due to shifting demographic trends, the current work suggests that Multiracial labels may become increasingly accessible, thereby allowing perceivers to categorize others who identify as Multiracial as indeed Multiracial without an early inference from other monoracial categories that a target may not identify with.

Footnotes

Footnote 1. Due to server error, demographics did not save for 4 participants in Study 1, 3 participants in Study 2, 12 participants in Study 3, 1 independent rater of Study 3, and 6 participants in Study 4.

Footnote 2. An inadvertent change in the color profile of the monoracial faces used in Study 4 occurred during cropping. This impacted all monoracial faces equally.

References

Albuja, A. F., Gaither, S. E., Sanchez, D. T., Straka, B., & Cipollina, R. (2019). Psychophysiological stress responses to bicultural and biracial identity denial. *Journal of Social Issues*, *75*(4), 1165-1191.

Binning, K. R., Unzueta, M. M., Huo, Y. J., & Molina, L. E. (2009). The interpretation of Multiracial status and its relation to social engagement and psychological well-being. *Journal of Social Issues*, *65*, 35-49.

Brown, C. C., Raio, C. M., & Neta, M. (2017). Cortisol responses enhance negative valence perception for ambiguous facial expressions. *Scientific Reports*, *7*(1), 15107.

Campbell, M. E., & Troyer, L. (2007). The implications of racial misclassification by observers. *American Sociological Review*, *72*(5), 750-765.

Chen, J. M. (2019). An integrative review of impression formation processes for multiracial individuals. Social and Personality Psychology Compass, 13(1), e12430.

Chen, J. M., Couto, M.C.P.D.P., Sacci, A., & Dunham, Y. (2018a). To be or not to be (Black or Multiracial or White): Cultural variation in racial boundaries. *Social Psychological and Personality Science*, *9*, 763-772.

Chen, J. M., & Hamilton, D. L. (2012). Natural ambiguities: Racial categorization of Multiracial individuals. *Journal of Experimental Social Psychology*, *48*, 152-164.

Chen, J. M., Moons, W. G., Gaither, S. E., Hamilton, D. L., & Sherman, J. W. (2014). Motivation to control prejudice predicts categorization of Multiracials. *Personality and Social Psychology Bulletin*, *40*, 590-603.

Chen, J. M., Pauker, K., Gaither, S. E., Hamilton, D. L., & Sherman, J. W. (2018). Black + White=Not White: A minority bias in categorizations of Black-White multiracials. *Journal of Experimental Social Psychology*, *78*, 43–54.

Chesley, G. L., & Wagner, W. G. (2003). Adults' attitudes toward multiracial children. *Journal of Black Psychology*, *29*(4), 463-480.

Colby, S. L., & Ortman, J. M. (2015). Projections of the size and composition of the US population: 2014 to 2060. *U.S. Census Bureau Current Population Reports* (P25-1143). Retrieved from https://pdfs.semanticscholar.org/09c9/ad858a60f9be2d6966ebd0bc267af5a76321.pdf.

Cummins, J., & De Houwer, J. (2021). The shape of belief: Developing a mousetracking-based relational implicit measure. *Social Psychological and Personality Science*, *12*(8), 1517-1526.

Freeman, J. B. (2018). Doing psychological science by hand. *Current directions in psychological science*, *27*(5), 315-323.

Freeman, J. B., & Ambady, N. (2009). Motions of the hand expose the partial and parallel activation of stereotypes. *Psychological Science*, *20*, 1183-1188.

Freeman, J. B., & Ambady, N. (2010). MouseTracker: Software for studying real-time mental processing using a computer mouse-tracking method. *Behavior Research Methods*, *42*, 226-241.

Freeman, J. B., & Ambady, N. (2011). A dynamic interactive theory of person construal. *Psychological Review*, *118*, 247-279.

Freeman, J. B., Ambady, N., Rule, N. O., & Johnson, K. L. (2008). Will a category cue attract you? Motor output reveals dynamic competition across person construal. *Journal of Experimental Psychology: General*, *137*, 673-690.

Freeman, J. B., & Dale, R. (2013). Assessing bimodality to detect the presence of a dual cognitive process. *Behavior research methods*, *45*, 83-97.

Freeman, J. B., & Johnson, K. L. (2016). More than meets the eye: Split-second social perception. *Trends in cognitive sciences*, *20*(5), 362-374.

Freeman, J. B., Pauker, K., Apfelbaum, E. P., & Ambady, N. (2010). Continuous dynamics in the real-time perception of race. *Journal of Experimental Social Psychology*, *46*, 179-185.

Freeman, J. B., Pauker, K., & Sanchez, D. T. (2016). A perceptual pathway to bias: Interracial exposure reduces abrupt shifts in real-time race perception that predict mixed-race bias. *Psychological Science*, *27*(4), 502-517.

Freeman, J. B., Stolier, R. M., & Brooks, J. A. (2020). Dynamic interactive theory as a domain-general account of social perception. In *Advances in experimental social psychology* (Vol. 61, pp. 237-287). Academic Press.

Gaither, S. E., Chen, J. M., Pauker, K., & Sommers, S. R. (2019). At face value: Psychological outcomes differ for real vs. computer-generated multiracial faces. The Journal of social psychology, 159(5), 592-610.

Garay, M. M., & Remedios, J. D. (2021). A review of White-centering practices in multiracial research in social psychology. Social and Personality Psychology Compass, 15(10), e12642.

Halberstadt, J., Sherman, S. J., & Sherman, J. W. (2011). Why Barack Obama is Black: A cognitive account of hypodescent. *Psychological Science*, *22*, 29-33.

Halberstadt, J., & Winkielman, P. (2014). Easy on the eyes, or hard to categorize: Classification difficulty decreases the appeal of facial blends. *Journal of Experimental Social Psychology*, *50*, 175-183.

Hester, N., Xie, S. Y., Bertin, J. A., & Hehman, E. (2023). Stereotypes shape response competition when forming impressions. *Group Processes & Intergroup Relations*, *26*(8), 1706-1725.

Ho, A. K., Sidanius, J., Levin, D. T., & Banaji, M. R. (2011). Evidence for hypodescent and racial hierarchy in the categorization and perception of biracial individuals. *Journal of Personality and Social Psychology*, *100*, 492-506.

Højsgaard, S., Halekoh, U., & Yan, J. (2006). The R package geepack for generalized estimating equations. *Journal of statistical software*, *15*, 1-11.

Iankilevitch, M., Cary, L. A., Remedios, J. D., & Chasteen, A. L. (2020). How do multiracial and monoracial people categorize multiracial faces?. Social Psychological and Personality Science, 11(5), 688-696.

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

Jackman, C. F., Wagner, W. G., & Johnson, J. T. (2001). The Attitudes Toward Multiracial Children Scale. *Journal of Black Psychology*, *27*, 86-99.

Johnson, K. L., Freeman, J. B., & Pauker, K. (2012). Race is gendered: How Covarying Phenotypes and Stereotypes Bias Sex Categorization. *Journal of personality and social psychology*, doi: 10.1037/a0025335.

Jones, N., Marks, R., Ramirez, R., & Ríos-Vargas, M. (2021, August 12). 2020 census illuminates racial and ethnic composition of the country. Census.gov. Retrieved January 9, 2023, from https://www.census.gov/library/stories/2021/08/improved-race-ethnicity-measures-reveal-united-states-population-much-more-multiracial.html

Korb, S., Mikus, N., Massaccesi, C., Grey, J., Duggirala, S. X., Kotz, S. A., & Mehu, M. (2023). EmoSex: Emotion prevails over sex in implicit judgments of faces and voices. *Emotion*, *23*(2), 569.

Lenth, R. (2022). emmeans: estimated marginal means, aka least-squares means. R package version 1.4. 7. 2020.

Ma, D. S., Correll, J., & Wittenbrink, B. (2015). The Chicago face database: A free stimulus set of faces and norming data. *Behavior Research Methods*, *47*, 1122-1135.

Macrae, C. N., & Bodenhausen, G. V. (2000). Social cognition: Thinking categorically about others. *Annual Review of Psychology*, *51*, 93-120.

Martens, M. A., Hasinski, A. E., Andridge, R. R., & Cunningham, W. A. (2012). Continuous cognitive dynamics of the evaluation of trustworthiness in Williams syndrome. *Frontiers in psychology*, *3*, 160.

Melnikoff, D. E., Mann, T. C., Stillman, P. E., Shen, X., & Ferguson, M. J. (2021). Tracking prejudice: A mouse-tracking measure of evaluative conflict predicts discriminatory behavior. *Social Psychological and Personality Science*, *12*(2), 266-272.

Nicolas, G., Skinner, A. L., & Dickter, C. L. (2019). Other than the sum: Hispanic and Middle Eastern categorizations of Black–White mixed-race faces. Social Psychological and Personality Science, 10(4), 532-541.

Oldfield, R. C., & Wingfield, A. (1965). Response latencies in naming objects. Quarterly Journal of Experimental Psychology, 17(4), 273-281

Pauker, K., Carpinella, C. M., Lick, D. J., Sanchez, D. T., & Johnson, K. L. (2018). Malleability in biracial categorizations: The impact of geographic context and targets' racial heritage. *Social Cognition*, *36*(5), 461-480.

Peery, D., & Bodenhausen, G. V. (2008). Black+ White=Black hypodescent in reflexive categorization of racially ambiguous faces. *Psychological Science*, *19*, 973-977.

Sanchez, D. T. (2010). How do forced-choice dilemmas affect multiracial people? The role of identity autonomy and public regard in depressive symptoms. Journal of Applied Social Psychology, 40(7), 1657-1677.

Sanchez, D. T., & Bonam, C. M. (2009). To disclose or not to disclose biracial identity: The effect of biracial disclosure on perceiver evaluations and target responses. *Journal of Social Issues*, *65*, 129-149.

Sanchez, D. T., Shih, M., & Garcia, J. A. (2009). Juggling multiple racial identities: malleable racial identification and psychological well-being. *Cultural Diversity and Ethnic Minority Psychology*, *15*, 243-254.

Sanchez, D. T., Young, D. M., & Pauker, K. (2015). Exposure to racial ambiguity influences lay theories of race. *Social Psychological and Personality Science*, *6*(4), 382-390.

Singmann, H., Bolker, B., Westfall, J., Aust, F., & Ben-Shachar, M. S. (2015). afex: Analysis of factorial experiments. R package version 0.13–145.

Smeding, A., Quinton, J. C., Lauer, K., Barca, L., & Pezzulo, G. (2016). Tracking and simulating dynamics of implicit stereotypes: A situated social cognition perspective. *Journal of Personality and Social Psychology*, *111*(6), 817.

Stillman, P. E., Shen, X., & Ferguson, M. J. (2018). How mouse-tracking can advance social cognitive theory. *Trends in cognitive sciences*, *22*(6), 531-543.

Tiddeman, B., Burt, D. M., & Perrett, D. (2001). Prototyping and transforming facial textures for perception research. *IEEE Computer Graphics and Applications, 21,* 42-50.

Townsend, S. S., Markus, H. R., & Bergsieker, H. B. (2009). My choice, your categories: The denial of Multiracial identities. *Journal of Social Issues*, *65*, 185-204.

Van der Biest, M., Cracco, E., Riva, P., & Valentini, E. (2023). Should I trust you? Investigating trustworthiness judgements of painful facial expressions. *Acta Psychologica*, *235*, 103893.

Willadsen-Jensen, E. C., & Ito, T. A. (2006). Ambiguity and the timecourse of racial perception. *Social Cognition*, *24*, 580-606.

Xie, S. Y., Flake, J. K., Stolier, R. M., Freeman, J. B., & Hehman, E. (2021). Facial impressions are predicted by the structure of group stereotypes. *Psychological Science, 32*(12), 1979-1993.

Yamauchi, T., & Xiao, K. (2018). Reading emotion from mouse cursor motions: Affective computing approach. *Cognitive science, 42*(3), 771-819.

Yu, Z., Wang, F., Wang, D., & Bastin, M. (2012). Beyond reaction times: Incorporating mouse-tracking measures into the implicit association test to examine its underlying process. *Social cognition*, *30*(3), 289-306.

Zarate, M. A., & Smith, E. R. (1990). Person categorization and stereotyping. *Social Cognition*, *8*(2), 161-185.

Zeger, S. L., & Liang, K. Y. (1986). Longitudinal data analysis for discrete and continuous outcomes. *Biometrics, 42*, 121-130.