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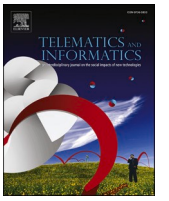

Are you what you emoji? How skin tone emojis and profile pictures shape attention and social inference processing

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ABSTRACT

Emojis can express emotions and some aspects of the sender's identity; however, only limited research has explored how the choice of skin tone in emojis influences the perceptions of the users. We examined the interaction between emoji skin tones and profile pictures in instant messaging, using self-reported and eye tracking measures. White participants viewed 14 screenshots of conversations (9 target and 5 fillers) where the sender used an emoji in a Darker or Lighter skin tone, or the default Yellow; alongside profile pictures displaying a Black or White individual, or a landscape as a neutral condition. Results showed that Black senders using Darker emojis were seen as warmer and closer to the receiver, but less competent, suggesting a dimensional compensation effect. Conversely, Black senders using Lighter emojis appeared more competent, but less warm. In the Neutral condition, Lighter emojis improved warmth and relationship quality, but reduced competence inferences, unlike Yellow and Darker emojis, suggesting a black sheep effect (in-group strictness). Yellow emojis were assumed to be sent by White individuals. Eye-tracking measures revealed an implicit bias towards White senders using Darker emojis, although such an impact was not observed for Black senders using Lighter emojis. Overall, findings indicate that skin tone emojis and profile pictures influence sender perception and challenge the neutrality of Yellow emojis.

1. Introduction

Emojis are graphic symbols that convey emotions and some aspects of the sender's identity (Robertson et al., 2021). Their use can influence the tone of a message and shape social attributions (for a review, see Bai et al., 2019). Initially, emojis representing human figures and body parts were uniformly yellow. However, in 2015, the introduction of five skin-tone options based on the Fitzpatrick scale (1988) provided a novel tool to express racialized nuances in digital identities. When a tone modifier is not deliberately selected, emojis automatically default to Yellow.

An analysis of 600 million tweets found that users selected a specific skin tone for 42 % of the 13 million tone-modifiable emojis

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tweeted (Robertson et al., 2018). Further research showed that senders who used the default yellow emoji, which does not represent any skin tone, were perceived as White by both self-identified Black and White users (Robertson et al., 2021). It was also revealed that users predominantly use skin-tone emojis similar to their own skin tone (Robertson et al., 2018, 2020). Additionally, darker-skinned users were more likely to use skin-tone emojis instead of the default yellow tone, compared to lighter-skinned users, even in predominantly darker-skinned populations (Robertson et al., 2020).

In real-world settings, skin tone emojis are often used alongside identity-representative images like profile pictures and avatars, which are pivotal for forming social inferences. Individuals make judgements about another person's competence and trustworthiness within just 100 ms of exposure to a photograph of their face, likely due to the adaptive value of quick judgement and response (Willis & Todorov, 2006). Moreover, a substantial body of research has demonstrated that racialized cues from facial photographs significantly impact person perception (for a review, see Molenberghs, 2013). Yet, to the best of our knowledge, the combined effects of social signals from both skin-tone emojis and profile pictures on social inference processing remain unexplored. This study aims to bridge this gap by experimentally examining the impact of the interaction between emojis skin tones and profile pictures on the perceptions of the sender's social attributes. Given the novelty of this investigation and its use of racialized cues, we applied eye tracking measures. By analyzing gaze patterns while participants read chat conversations, it is possible to gain insights into which visual information is prioritized and under what conditions. Understanding how skin tone emojis and profile pictures are used as racialized cues and their effects on users could shape digital communication strategies and influence the design decisions of social media platforms.

1.1. *Emojis and social perception*

Research suggests that some emojis can enhance perceptions of the sender's competence and warmth (Beattie et al., 2020; Boutet et al. 2021), depending on the context, quantity of emojis (Glikson et al., 2018; Koch, 2023), and congruency/incongruency with the accompanying written message (Hand et al., 2022). Evolutionary psychologists argue that, although the context of social interactions can influence first impressions, individuals fundamentally assess others based on two core dimensions: warmth and competence, reflecting others' intentions and abilities, respectively (Judd et al., 2005; Rosenberg et al., 1968). Remarkably, these dimensions can explain up to 80 % of the variance in social perception (Wojciszke et al., 1998).

The interpretation and usage of emojis vary with the relationship's closeness between the sender and receiver. When communicating with someone close, users tend to use different emojis and do so more frequently than when communicating with acquaintances (Thomson et al., 2018). Emojis also provide cues about the sender's relationship intentions (Rodrigues et al., 2022), but their use may be perceived as inadequate in communications with less close contacts (Cavalheiro et al., 2022). Thus, emojis not only convey information about the sender but also signal the interpersonal context of their relationship.

Emojis also impact cognitive processes. For instance, the congruence between emojis and verbal text can enhance information processing speed and comprehension, as evidenced by eye-tracking measures (Barach et al., 2021; Boutet et al., 2021; Robus et al., 2020). Therefore, we propose that the congruence between skin tone emojis and the racialized cues displayed in profile pictures might impact cognitive processes as well as social inferences.

1.2. *Profile pictures and digital identity*

Digital identity, especially when represented through profile pictures that reveal racialized cues, plays a crucial role in shaping impression formation. Research shows that in-group favoritism, a process where individuals favor those perceived as part of their own group over others, can be significantly influenced by cues like skin tones (Brewer, 1999; Tajfel et al., 1971). As a result, individuals often attribute more positive traits to in-group members compared to out-group members (e.g., Cadinu & Rothbart, 1996).

The Stereotype Content Model (Fiske et al., 2002, 2007) provides insight into the social inference process by mapping how social groups, including those differentiated by skin tone, are categorized based on perceived warmth and competence. This model indicates that groups can be perceived ambivalently, where they are seen as high in one dimension and low in the other, or in a univalent way, where they are viewed in both dimensions as high or low. Thus, groups are typified into distinct clusters: in-groups (high warmth, high competence), envied groups (low warmth, high competence), paternalized groups (high warmth, low competence), and derogated social groups (low warmth, low competence).

Assessing biases toward racialized cues requires both self-report and indirect measurements due to the implicit nature of these biases. Eye-tracking studies have shown that lighter-skinned participants observe darker-skinned faces for longer periods of time than lighter-skinned faces (Trawalter et al., 2008), especially among those with strong negative stereotypes about darker-skinned individuals (Donders et al., 2008). These negative stereotypes are intensified by low contact with out-group members (Dickter et al., 2014), right-wing political views (Richetin et al., 2012), and a strong self-identification with the in-group (Postmes et al., 2012).

1.3. *The present research*

Our purpose was to evaluate the combined effect of skin-tone emojis and profile pictures on impression formation. We aimed to assess perceptions of the sender's competence and warmth, as well as the relationship quality between interlocutors, while measuring indirect measures with eye-tracking. Participants, who self-reported as White, were shown screenshots of WhatsApp conversations in which the sender used an emoji in Darker or Lighter skin tones, or the default Yellow. The screenshots also featured the sender's profile picture that displayed a Black or White individual, or a landscape without racialized cues to serve as a neutral condition. The study followed a within-subjects 3×3 design.

Drawing from the aforementioned literature on in-group favoritism (e.g., Cadinu & Rothbart, 1996) and Stereotype Content Model (e.g., Fiske et al., 2007), we expected that senders from racialized/minoritized groups, such as Black senders, would be perceived as low in both warmth and competence by self-identified White participants. In contrast, we expected that White senders would be perceived as high in both attributes. Similarly, when using a Lighter emoji, senders would be perceived as more competent and warmer than when using a Darker emoji, regardless of the profile picture used. Drawing from the previous research (Robertson et al., 2021), we expected that, in the conditions where the profile picture was Neutral, senders using a Yellow emoji would be assumed as White individuals.

We also aimed to understand how the perceptions of the sender might be affected in incongruent conditions of emoji-profile pairings. Halverson (2021) suggested that the use of skin tone emojis is often seen as an indicator of a user's racialized identification, potentially leading to expectations of congruence between the emoji and profile picture. Previous literature, however, shows mixed results. For instance, Robertson et al. (2018) did not find any negative response to situations where the skin tone emoji and profile picture were mismatched, whereas Halverson (2021) reported opposite findings in a qualitative study. Therefore, using eye-tracking measures – previously unapplied to skin tone emojis – were valuable to explore how participants process these racialized digital cues (for a review, see Kawakami et al., 2018).

Our eye-tracking analyses focused on dwell time, which represents the total duration one's gaze lingers within an Area of Interest (AOI). Attention typically precedes eye movements to a new location within a scene, and in tasks with complex stimuli, the relation between eye movements and attention is tight (Rayner 1998). Building upon previous research (Barach et al., 2021; Boutet et al., 2021; Trawalter et al., 2008), we hypothesized that incongruencies between emojis and profile pictures would lead to participants spending more time viewing these cues compared to congruent pairings, as incongruent stimuli could create disruption in the gaze duration (Rayner, 2009). Additionally, in conditions where either the emoji or the profile provides limited information – like the Yellow emoji or the Neutral profile picture – we expected attention to gravitate towards the more informative of the two. This would be consistent with findings by Scott and Hand (2016), who demonstrated that viewer motivation influences which elements of a social networking site profile are attended to, with image content attracting more focus when the profile is viewed socially, and text content becoming more salient in a professional context. For instance, the Yellow emoji might draw more attention to the profile picture with racialized cues, while the Neutral profile picture might shift attention predominantly to the skin tone emojis.

2. Method

2.1. Participants

A power analysis was conducted with G*Power 3.1 (F tests, repeated measures ANOVA within factors, $1–\beta = 0.90$; $\alpha = 0.05$; effect size of 0.15; number of groups = 1; number of measurements = 9; correlation among repeated measures: 0.5; nonsphericity correction ε: 1; Faul et al., 2007) and revealed a total of 49 participants. However, anticipating constraints related to eye quality data and exclusion criteria, we recruited 80 participants. They predominantly self-identified as White, leading us to restrict our analysis to this demographic. After excluding four participants who self-identified as non-White, our final sample consisted of 76 White European Portuguese speakers (57 women, 18 men, one unreported), aged 18 to 64 years ($M = 24.22$, $SD = 10.24$). The majority were college students (94.74 %), with 45 volunteering and 31 receiving course credit. All participants reported using computer-mediated communication, and on average, they use it for 71.22 % ($SD = 27.21$ %) of their communication activities in a typical day. Among those who reported using emojis with skin tones ($M = 85.53$ %, $SD = 0.35$ %), 84.62 % mainly used the two lightest tones available (see Supplementary Information, Table S1 and S2). All participants provided written consent before taking part of the study. Ethical approval for this research was given by the Ethics Committee of ISCTE-IUL.

2.2. Materials

We created 14 WhatsApp screenshots, consisting of nine target conversations and five fillers, all discussing neutral university topics (e.g., planning to have lunch at school; see Supplementary Information, Table S3). Participants saw one target trial per condition. In the target conversations, a single emoji without text was placed into the third, fourth, or fifth message out of six to avoid influencing eye movements (Robus et al., 2020). Message lengths remained consistent across positions. Considering that women have been reported to use emojis more frequently (Prada et al., 2018), and the gender of the sender impacts emoji interpretation (Butterworth et al., 2019), all conversations featured a female sender.

For the emojis, we selected two skin tones, Darker [U+1F3FE] and Lighter [U+1F3FC], and the default Yellow, alongside three hand gestures (U+1F44D, U+1F44C, and U+270C) to avoid complex features like hair and eyes. We selected these emojis because they depicted unambiguous hand gestures (Koh et al., 2019), were the most frequently used (Unicode, n.d.), and were appropriate for the Portuguese context. For the profile pictures, we selected ten self-identified White and Black faces from the Chicago Face Database's closed-mouth smile category (Ma et al., 2015), all consistent in attractiveness, and perceived age. We only used faces with closed-mouth smiles because all our senders were female, and females are generally expected to smile (Plant et al., 2000; Portengen et al., 2023). The perceived racialized identity was also validated by Ma et al. (2015). In the neutral condition, we chose four landscape photos from Unsplash (2022), and manipulated them to reach similar luminosity, contrast, and complexity. We used three faces from each racialized group and three landscape photos for target conversations; for fillers, we used two faces from each racialized group and one landscape. All sender names had the same number of letters and were among the most frequently registered names in Portugal.

We created three counterbalancing versions of the experiment, making sure that, across participants, each emoji color appeared an

equal number of times with different profile pictures. Each target conversation included a fixed hand emoji. The three types of hand emoji always appeared three times in each counterbalancing list. The skin tone of the emoji was counterbalanced so that each target conversation depicted all three skin tones across the counterbalancing versions. Participants were randomly allocated to one of the versions, and the sequence in which they were exposed to all 14 conversations (for examples, see Fig. 1) was randomized.

2.3. Procedures and measures

Prospective volunteers were recruited by convenience sampling on campus and informal snowballing. Participants were told that the goal of this study was to understand how college students communicate on instant messaging with each other (see Supplemental Information, Table S4). Throughout the experiment, the participant's eye movements were recorded using an Eyelink Portable Duo system at a frequency of 1000 Hz and in a binocular setting. They were instructed to maintain minimal head movements while using the chin rest, which was set at 45 cm from the monitor. A 9-point calibration to both eyes was performed before the experiment began. Before each trial, drift correction was performed to ensure the system was consistently calibrated. The setup was programmed using SR Research's Experiment Builder and displayed on a 22-in ACER B223w monitor with a resolution of 1680 × 1050 pixels and a 60 Hz refresh rate. The conversations occupied an area of 430,276 pixels. A 9,764.07-pixel AOI was set around emojis and profile pictures. The size of the AOIs for emojis and profile pictures was the same.

In each trial, participants were presented with a conversation and instructed to press the space key once they were ready to proceed. They then rated the relationship quality between the sender and her colleague (1 = *Not close at all*, 7 = *Very close*; Rodrigues et al., 2018); the sender's competence (1 = *Incompetent*, 7 = *Competent*) and warmth (1 = *Cold*, 7 = *Warm*; Kotzur et al., 2020). To maintain the cover story, participants were prompted with filler questions to evaluate the receiver's competence and warmth, identify the interlocutor's academic field, recognize the conversation's topic, and recognize the featured emoji. For each conversation, participants also indicated how certain they were that the Sender was White, and how certain they were that the Sender was Black (2 items, 1 = *Definitely no,* 7 = *Definitely yes*).

At the end of the experiment, participants completed a Qualtrics survey to measure their text and emoji usage (Rodrigues et al., 2018), skin tone self-identification, self-ethnic/racialized categorization, social identity (Postmes et al., 2012), cross-group friendships (Turner et al., 2007), attitudes toward skin tone emojis, and related norms, usage, preferences, and frequencies, as well as political orientation, and demographic information (see Supplementary Information, Table S5 and S6). The sessions took an average of 30 min.

2.4. Data analytic plan

We extracted data from the right-eye, but for 10 participants, we used their left-eye data due to calibration constraints or the presence of artifacts (Hooge et al., 2018). We excluded two trials that exceeded a 2-minute read time, as these unreasonable durations might indicate issues with the task application. Although our preregistered plan (https://osf.io/yqanr?view_only=e073dafd4a7e4ca093377e7efc140955) was to use a repeated measures ANOVA,[2] we conducted generalized, linear, and ordinal mixed effects models instead because of their robustness in handling assumptions violations (e.g., Bono et al., 2021; Taylor et al., 2022), which we found in most models, and their prior use in studies related to perceptions of emojis (Hand et al., 2022; Robus et al., 2020). Also, variables with Gamma distribution, such as dwell time, are a poor fit for models that assume normally distributed residuals (Lo & Andrews, 2015). For multiple test control, we applied the Benjamini and Hochberg (2000)'s method. We incorporated emoji hand type and texting frequency into all models as fixed factors to account for variance (see Section 3.7). Since our main independent variables have three levels, the interaction effects will be further explored with interaction contrasts to capture patterns within the interactions (Abelson & Prentice, 1997). Zero duration dwell times over emoji's and profile picture's AOI were removed (11.25 % and 22.66 % of the data, respectively) to ensure that dwell time analysis was not contaminated by skippings (Horstmann et al., 2016). As per pre-registration, unreasonable values (±2 SD) based on the grand mean and standard deviation across all participants and conditions were removed from dwell times over emoji's and profile picture's AOI (2.80 % and 3.59 % of the data, respectively). The dwell time was computed by the EyeLink Data Viewer as the summation of the duration across all fixations on the AOI. The Generalized Linear Mixed Models automatically applied listwise deletion for trials with missing values in dwell time.

3. Results[3]

In our analysis, relying solely on conditional models to interpret main effects can be misleading because these effects are influenced

[2] We reported the results of the ANOVAs in the supplemental materials. The results from the ANOVAs were consistent with the models reported in results section, except that in the ANOVAs, we found a significant main effect for skin tone emojis over Relationship Quality Between Sender and Receiver, and a significant main effect for profile picture over Dwell Time on Profile Pictures' AOI that we did not find in the models reported in the results section. Also, the main effect of skin tone emojis over Dwell Time on Profile Pictures' AOI, which we found in the models reported in the results section, was not observed in the corresponding ANOVA. Caution should be used when interpreting these ANOVAs. The assumptions of normally distributed residuals were violated. Specifically, variables with Gamma distribution, such as dwell time, constitute a poor fit in models that assume normally distributed residuals (Lo & Andrews, 2015).

[3] We conducted mediation analyses with all dependent variables to assess whether certainty in perceptions of racialized identity was a significant mediator. All results indicated that this mediator was not significant. The results were reported in the supplemental materials.

Fig. 1. Mockup direct messages on WhatsApp (version 2.22.4) on Android platform (version 8; see the conversations translated in the Supplemental Information, Table S3).

by interaction terms and do not represent the independent contribution of each variable (Brambor et al., 2006). Therefore, we reported the unconditional for the main effects and the conditional models for the interaction effects.

3.1. *Effect of skin tone emoji and profile picture on perceived warmth regarding the sender*

While the main effects of skin tone emojis and profile pictures in the unconditional model did not significantly impact warmth perceptions ($ps > 0.294$), their interaction in the conditional model was significant, $\chi^2_{(df\ =\ 4)} = 20.73$, $p < 0.001$. Post hoc contrast tests revealed that the use of Yellow emojis with Neutral profile pictures significantly lowered warmth perceptions compared to Lighter emojis within this profile, $b = -1.03$, $SE = 0.31$, 95 % CI [-1.65, −0.41], $z = -3.25$, $p = 0.011$. Conversely, Darker emojis used with Black profile pictures significantly enhanced warmth perception compared to all other conditions combined, $b = 0.49$, $SE = 0.14$, 95 % CI [0.21, 0.78], $z = 3.40$, $p = 0.003$. Lighter emojis increased perceived warmth with Neutral profile pictures compared to all other conditions combined, $b = 0.49$, $SE = 0.15$, 95 % CI [0.20, 0.78], $z = 3.30$, $p = 0.003$. When a White profile picture was used, the display of different emojis did not impact warmth perceptions ($ps > 0.365$). The effect of the Yellow emoji was not significantly different from Darker emojis within the Black profile picture ($p = 0.053$). No significant differences in warmth perceptions were observed between congruent (Black profile picture with Darker emoji vs. White profile picture with Lighter emoji) and incongruent pairs (Black profile picture with Lighter emoji vs. White profile picture with Darker emoji; $ps > 0.080$; Fig. 2).

3.2. *Effect of skin tone emoji and profile picture on perceived competence regarding the sender*

The analysis revealed no significant main effects of skin tone emojis or profile pictures on perceived competence in the unconditional model ($ps > 0.751$). However, the interaction between them in the conditional model was significant, $\chi^2_{(df\ =\ 4)} = 16.85$, $p = 0.002$. Post hoc contrast analysis indicated that the use of Lighter emojis with Neutral profile pictures significantly decreased perceived competence compared to all other conditions combined, $b = -0.44$, $SE = 0.15$, 95 % CI [-0.74, −0.14], $z = -2.85$, $p = 0.019$. Lighter emoji increased competence perceptions with Black profile pictures compared to all other conditions combined, $b = 0.59$, $SE = 0.15$, 95 % CI [0.30, 0.89], $z = 3.90$, $p < 0.001$. With White profile picture, the different emojis did not impact competence perceptions ($ps > 0.404$). The effect of Yellow emoji was not significantly different from Darker emoji within Black profile pictures ($ps > 0.713$). Neither the congruent pair of Black profile pictures with Darker emojis versus White profile pictures with Lighter emoji, nor the incongruent pair of Black profile pictures with Lighter emojis versus White profile pictures with Darker emojis were significant ($ps > 0.235$; Fig. 2).

We compared perceptions of competence versus warmth and found that Lighter emojis with Black profile pictures elicited higher competence perceptions than warmth perceptions, $b = 0.61$, $SE = 0.14$, 95 % CI [0.33, 0.88], $z = 4.36$, $p < 0.001$. For Darker emojis with Black profile pictures, competence perceptions were lower than warmth perceptions, $b = -0.38$, $SE = 0.14$, 95 % CI [-0.66, −0.11], $z = -2.76$, $p = 0.026$. The response variable was standardized and the variable that identifies the response as competence or warmth rating was added as fixed effect part of the interaction term.

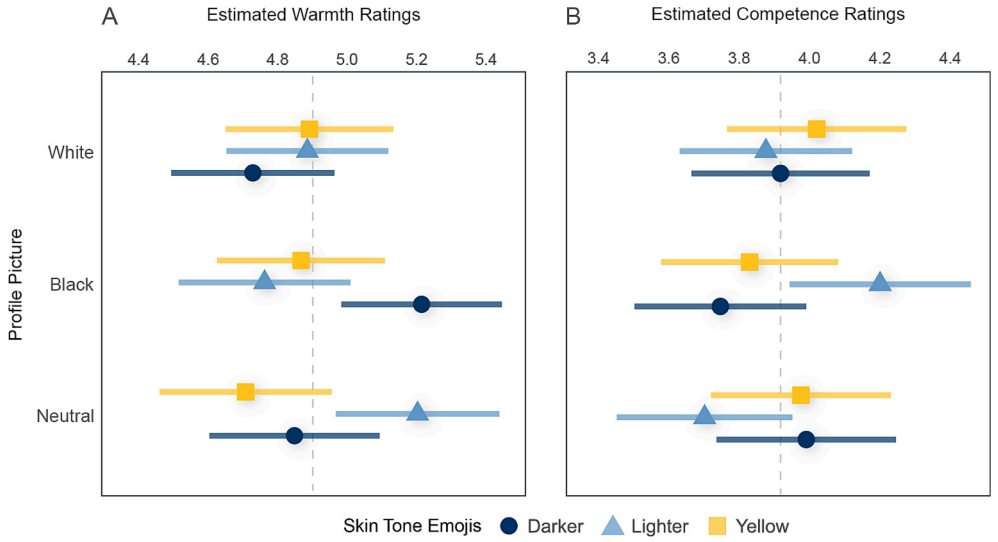

Fig. 2. Estimated marginal means of warmth (A) and competence (B) perceptions by emoji and profile picture, with 95% confidence intervals (CI). The dashed line indicates the general estimated mean.

3.3. *Effect of skin tone emoji and profile picture on perceived relationship quality between sender and receiver*

The main effects of both skin tone emojis and profile pictures did not significantly impact perceived relationship quality ($ps >$ 0.589). However, we observed a significant interaction between them in the conditional mode, $\chi^2_{(df\ =\ 4)} = 40.56$, $p < 0.001$. Post hoc contrasts analysis indicated that Darker emojis with Neutral profile pictures elicited diminished perceptions of relationship quality compared to Lighter emojis within this profile, b = -1.10, SE = 0.32, 95 % CI [-1.74, −0.47], z = -3.42, p = 0.002. Lighter emojis elicited diminished perceptions of relationship quality with Black profile pictures compared to the Darker emoji within this profile, b = -1.41, SE = 0.31, 95 % CI [-2.02, −0.81], z = -4.56, $p < 0.001$. The use of Darker emojis with White profile pictures resulted in lower perceptions of relationship quality compared to the other emojis combined within this profile, b = -0.39, SE = 0.17, 95 % CI [-0.73, −0.05], z = -2.24, p = 0.046. Lighter emojis increased relationship quality perceptions with Neutral profile pictures compared to all other conditions combined, $b = 0.56$, $SE = 0.15$, 95 % CI [0.27, 0.84], $z = 3.84$, $p < 0.001$. Darker emojis increased relationship quality perceptions with Black profile pictures compared to all other conditions combined, $b = 0.83$, $SE = 0.15$, 95 % CI [0.54, 1.12], $z = 5.62$, $p < 0.001$. The comparison between the congruent pairs, as well as between the incongruent pairs, were not significant ($ps > 0.077$; Fig. 3).

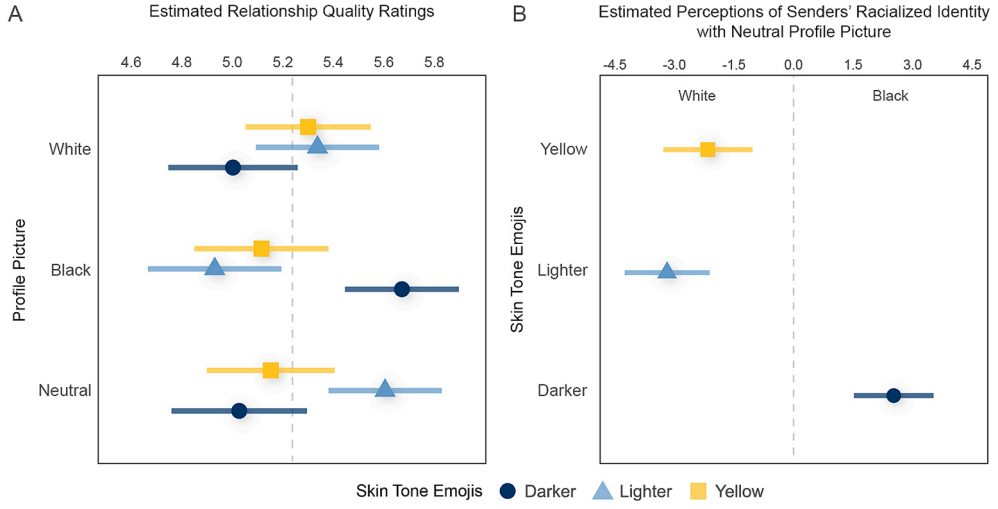

Fig. 3. (A) Estimated marginal means of the relationship quality perceptions by emojis and profile pictures, with 95% CI. The dashed line represents the general estimated mean. (B) Estimated marginal means of the perceptions of sender's racialized identity with Neutral profile picture. The dashed line indicates the midpoint of the index.

3.4. Effect of skin tone emoji on perceptions of Senders' racialized identity with Neutral profile picture

The index of participants' certainty about the Senders' racialized identity was calculated by subtracting their certainty in the Sender being White from their certainty in the Sender being Black. This index ranged from negative integers, indicating greater certainty that the Sender was White; to positive integers, indicating greater certainty that the Sender was Black; and zeros represented equal certainty for both racialized identities.

Due to zero-inflation and the presence of negative and positive integers, we first applied a binomial model treating zero values as 1 and non-zero values as 0 in order to discern any underlying pattern within the zero responses. The results showed a significant main effect for skin tone emojis, $\chi^2_{(df = 2)} = 9.32$, $p = 0.009$. Post hoc contrast analysis revealed no differences between Darker and Lighter emojis ($p = 0.361$), or between Yellow and Lighter emojis ($p = 0.105$). However, Yellow emojis received more zeros than Darker emojis, $b = 1.45$, $SE = 0.50$, 95 % CI [0.47, 2.44], $z = 2.89$, $p = 0.012$. Participants showed more equal certainty for both racialized identities when Yellow emojis were displayed compared to Darker emojis.

Next, a linear mixed-effects model analyzing only the non-zero responses (89 data points) showed a significant main effect for skin tone emojis, $\chi^2_{(df = 2)} = 60.03$, $p < 0.001$. Post hoc contrast analysis indicated no significant difference between Yellow and Lighter emojis ($p = 0.184$). This suggests that the certainty that the sender was White when participants saw a Lighter emoji did not differ from the certainty that the sender was White when participants saw a Yellow emoji. Furthermore, Yellow emojis received a lower certainty that the Sender was Black (or conversely, a higher certainty that the Sender was White) compared to Darker emojis, $b = -4.68$, $SE = 0.74$, 95 % CI [-6.17, −3.20], $t = -6.31$, $p < 0.001$. Darker emojis received more certainty that the sender was Black than Lighter emojis, $b = 5.71$, $SE = 0.81$, 95 % CI [4.08, 7.34], $t = 7.01$, $p < 0.001$; Fig. 3). We then conducted Wilcoxon signed-rank tests against 0, which indicates equal certainty for both racialized identities. We applied multiple testing corrections. The darker emojis was significantly greater than 0, $Mdn = 3$, $Z = 651$, $p < 0.001$. Lighter emojis was significantly less than 0, $Mdn = -3$, $Z = 19.5$, $p < 0.001$. Yellow emojis was significantly less than 0, $Mdn = -2$, $Z = 30$, $p = 0.003$.

3.5. Effect of skin tone emoji and profile picture on dwell time over skin tone Emoji's AOI

In the unconditional model, the main effect of profile picture was not significant ($p = 0.727$). However, the main effect of skin tone emojis was significant, $\chi^2_{(df = 2)} = 15.30$, $p < 0.001$. Post hoc contrast analysis indicated that Yellow emojis had shorter dwell times over emojis' AOI compared to Darker emojis, $b = -0.27$, $SE = 0.07$, 95 % CI [-0.41, −0.13], $z = -3.86$, $p < 0.001$, and Lighter emojis, $b = -0.17$, $SE = 0.07$, 95 % CI [-0.32, −0.03], $z = -2.38$, $p = 0.026$. The dwell times between Darker and Lighter emojis were not significantly different ($p = 0.188$).

In the conditional model, the interaction between skin tone emojis and profile pictures was significant, $\chi^2_{(df = 4)} = 20.23$, $p < 0.001$. Post hoc contrast analysis revealed that Lighter emojis with White profile pictures had shorter dwell times compared to when they were with Neutral and Black profile pictures combined, $b = -0.18$, $SE = 0.07$, 95 % CI [-0.31, −0.04], $z = -2.62$, $p = 0.039$. Darker emojis with Black profile pictures had shorter dwell times compared to when they were with White and Neutral profile pictures combined, $b = -0.17$, $SE = 0.07$, 95 % CI [-0.31, −0.03], $z = -2.44$, $p = 0.044$. Yellow emojis with Neutral profile pictures resulted in significantly shorter dwell times compared to other emojis combined in the same profile, $b = -0.18$, $SE = 0.07$, 95 % CI [-0.31, −0.06], $z = -2.80$, $p = 0.015$. Darker emojis with White profile pictures resulted in longer dwell times compared to all other conditions combined, $b = 0.21$,

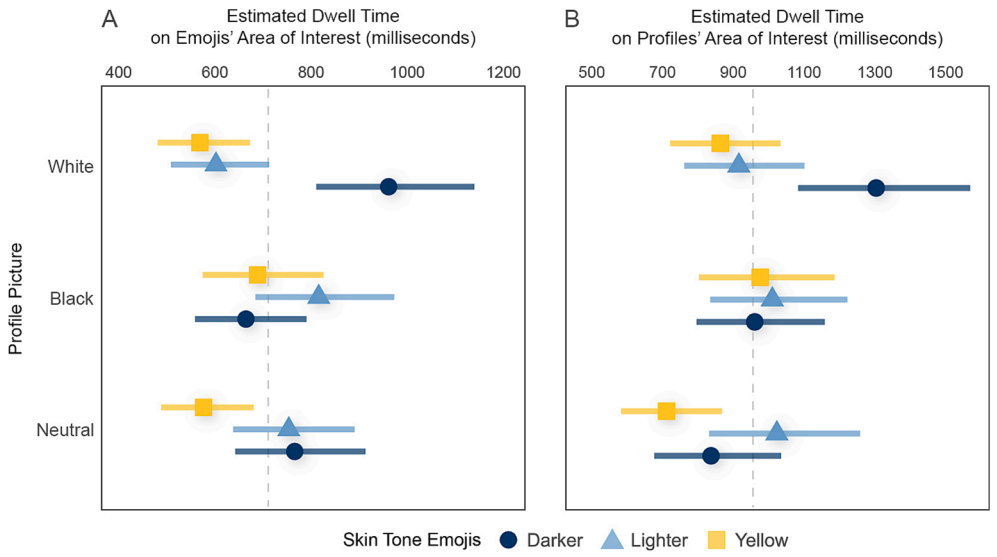

Fig. 4. Estimated marginal means of dwell time in milliseconds by emojis and profile pictures of the (A) emojis' AOI and (B) profile pictures' AOI, with 95% CI. The dashed line indicates the general estimated mean.

SE = 0.05, 95 % CI [0.11, 0. 32], $z = 3.89$, $p < 0.001$. When Black profile picture was used, the display of different emojis did not impact dwell time over emojis' AOI (*ps* > 0.156). The comparison between the congruent pairs, as well as between the incongruent pairs, were not significant (*ps* > 0.308; Fig. 4).

3.6. Effect of skin tone emoji and profile picture on dwell time over profile Picture's AOI

In the unconditional model, the main effect of profile picture was not significant ($p = 0.056$). However, the main effect of skin tone emojis was significant, $\chi^2_{(df = 2)} = 7.29$, $p = 0.026$. Post hoc contrast analysis indicated no significant differences between Darker and Lighter emojis or between Yellow and Lighter emojis (*ps* > 0.111). Yellow emojis had shorter dwell times over profile pictures' AOI compared to Darker emojis, $b = -0.20$, *SE* = 0.08, 95 % CI [-0.35, −0.05], $z = -2.63$, $p = 0.025$.

In the conditional model, the interaction between skin tone emojis and profile pictures was significant, $\chi^2_{(df = 4)} = 12.70$, $p = 0.013$. Post hoc contrast analysis revealed that Darker emoji elicited longer dwell times with White profile picture compared to all other conditions combined, $b = 0.18$, *SE* = 0.06, 95 % CI [0.06, 0. 30], $z = 3.03$, $p = 0.022$. The effect of Black profile pictures across emojis was not significant (*ps* > 0.936). Within Neutral profile pictures, Yellow emojis had shorter dwell times than Lighter emojis, $b = -0.36$, *SE* = 0.14, 95 % CI [-0.64, −0.09], $z = -2.60$, $p = 0.028$. Within White profile pictures, Yellow emojis were not significantly different from Lighter emojis ($p > 0.884$). The comparison between the congruent pairs, as well as between the incongruent pairs, were not significant (*ps* > 0.157; Fig. 4).

We compared the dwell times between the emojis' AOI and profile pictures' AOI, and we found a significant main effect of AOIs, $\chi^2_{(df = 1)} = 57.97$, $p < 0.001$. The interaction between AOI, skin tone emojis, and profile pictures was not significant ($p = 0.719$). Participants looked at profile pictures for longer than emojis, regardless of the condition, $b = 0.32$, *SE* = 0.04, 95 % CI [0.24, 0.40], $z = 7.61$, $p < 0.001$. We then filtered the data to only contain the yellow emoji and neutral profile picture conditions. We compared again the dwell times between the emojis' AOI and profile pictures' AOI, but we did not find a significant main effect of AOIs ($p = 0.063$). The variable that identifies the dwell time as either profile AOI or emoji AOI was added as a fixed effect in these models.

3.7. Covariates

Emoji hand type was a significant covariate for perceptions of warmth, $\chi^2_{(df = 2)} = 48.90$, $p < 0.001$, and relationship quality, $\chi^2_{(df = 2)} = 121.10$, $p < 0.001$. Thumbs up emojis were associated with higher warmth ratings than ok and peace emojis, $b = 1.03$, *SE* = 0.18, 95 % CI [0.67, 1.39], $z = 5.58$, $p < 0.001$, and $b = 1.21$, *SE* = 0.19, 95 % CI [0.84, 1.58], $z = 6.45$, $p < 0.001$, respectively. Ok and peace emojis were not significantly different ($p = 0.308$).

Additional scaled covariates were incorporated into the models, including sending and receiving emoji frequency, skin tone self-identification, social identity, cross-group contact, attitudes towards skin tone emojis, injunctive and descriptive norms toward skin tone emojis, skin tone emoji usage and preference, and political orientation. No significant differences were found between the original and updated models based on Chi-square tests (*ps* > 0.105), so the original models were retained for their parsimony.

4. Discussion

This study examined the combined effects of skin tone emojis and profile pictures on people's perception in digital settings. Using Darker, Lighter, and Yellow emojis with profile pictures of White individuals, Black individuals, or landscapes in WhatsApp conversations, we investigated how these combinations influence perceptions of the senders' warmth, competence, relationship quality, and gaze patterns over emojis and profile pictures. While previous research explored these factors separately, our study uniquely focuses on their interactions.

4.1. Compensation effect on Attribution of Warmth, Competence, and Relationship Quality

Based on the Stereotype Content Model (Fiske et al., 2007), we expected Black senders to receive low ratings in warmth and competence, and White senders to receive high ratings in both. Our findings partially support these hypotheses. Black senders using Darker emojis received low ratings in competence perceptions compared to other emojis, but were seen as warmer and as having a better relationship with the receiver. This pattern is consistent with paternalistic stereotypes (i.e., being perceived as high in warmth but low in competence; Fiske et al., 2002), where certain racialized out-groups, perhaps due to historical socio-economic factors, are seen as groups that are disrespected but pitied by their counterparts. The Dimensional Compensation Model (for a review, see Yzerbyt, 2018) builds on this notion by suggesting that there's a "compensation effect" where an increase in one dimension might be offset by a decrease in the other due to people's desire to present a balanced evaluation of the social targets being compared. Additionally, we did not observe a similar intensification of such negative stereotypes by low contact with out-group members (Dickter et al., 2014), right-wing political views (Richetin et al., 2012), or strong self-identification with the in-group (Postmes et al., 2012) in our dependent variables.

When White profile pictures were used, the display of different skin tone emojis did not impact warmth and competence perceptions, indicating a buffering effect of in-group favoritism (Cadinu & Rothbart, 1996).

4.2. Implicit positive skin tone bias for Lighter emojis

We hypothesized that senders using Lighter emojis would be perceived as more competent and warmer than those using Darker emojis, regardless of the profile picture. Our findings did not support a main effect of skin tone emojis. However, Black senders using Lighter emojis were perceived as highly competent compared to other emojis, but less warm. This might be rooted in perceptions where those who align closer with White group characteristics (by using Lighter emojis) are seen as more competitive (potentially due to proximity to the in-group) but less authentic by White participants. This result aligns with the findings of Gill and Lippmann (2024), where participants exhibited more positive implicit biases towards Lighter skin tone emojis than Darker ones. However, the authors found that the lighter the skin tone of the participant, the stronger their bias in favor of light skin tone emojis, which we were not able to replicate.

4.3. Black sheep effect for presumably White senders without profile pictures

In the neutral condition, where racialized cues from the profile picture were omitted, participants demonstrated greater certainty that the Neutral senders using Lighter emojis were White individuals. Therefore, we assume that participants may have perceived Neutral senders using Lighter emojis as part of their in-group, identifying them as White individuals. Furthermore, the use of Lighter emojis for Neutral senders improved warmth and relationship quality inferences compared to other conditions, but reduced competence perceptions. This pattern diverges from the effects we observed for Neutral senders using Darker emojis or Yellow emojis. This result might be explained by the Black Sheep Effect (Marques, et al., 1988), where members of an in-group (i.e., White participants) are harsher in their evaluations of other in-group members who deviate from the group's norms and expectations (i.e., Neutral senders using Lighter emojis that are presumably White individuals) compared to out-group members who exhibit the same behavior (i.e., Neutral senders using Darker emojis), as the deviant behavior is perceived as a threat to the group's identity.

4.4. Yellow emojis are not Neutral in the perceptions of Sender's racialized identity

We hypothesized that, in the conditions where the profile picture was Neutral, senders using a Yellow emoji would be assumed as White individuals. Our findings support this hypothesis. Participants were more likely to assume that the sender was a White individual when presented with a Yellow emoji and Neutral profile picture, as the amount of certainty that the sender was a White was not different between Lighter emojis and Yellow emojis, but both were different from Darker emojis. Furthermore, the level of certainty that the sender was a White individual for both Lighter emojis and Yellow emojis was different from 0, which was the middle point of the index, indicating equal certainty for both racialized identities. This pattern aligns with the findings of Robertson et al. (2021). These authors also observed a bias among White and Black participants where Yellow emojis were also perceived as being sent by White individuals, thereby questioning the neutrality of the Yellow emoji.

However, an alternative explanation that must be considered is the potential bias of the context. Participants were instructed that the conversations were between university students and the data collection took place in a setting with a predominant percentage of White students. It would be more likely to encounter a White sender in this context. Hence, the overall context might have influenced the presumptions when the conversation provided fewer clues.

4.5. Yellow emojis are not simple surrogates for skin tone emojis

Furthermore, the use of Yellow emojis did not differ from Darker emojis within Black profile pictures nor from Lighter emojis within White profile pictures in terms of warmth and competence perceptions. This suggests that congruent racialized cues and Yellow emojis were perceived similarly across these traits. The dwell times between these conditions were also not significantly different. However, Black senders using Yellow emoji received lower relationship quality ratings than Darker emojis, whereas White senders did not receive such negative impact. This suggests that Yellow emojis do not fully equate to surrogates of the congruent skin tone emoji, particularly for out-group members. One possible explanation is that perceptions of relationship quality are affected by ambiguous communication. When Black senders use Yellow emojis, it might be seen by White participants as lack of social interest or an attempt to hide information. This aligns with Wang and Ziano's (2023) findings, which show that people are less inclined to pursue relationships with those who appear to give ambiguous responses. On the other hand, White senders using Yellow emojis might be perceived as less ambiguous, as this emoji is associated with White senders.

Although no specific emojis were exclusively used by Black, White, or Neutral senders in our experiment, it is possible that, due to the cultural context surrounding the participants, a White sender using a Darker emoji could be perceived either as an ally to Black communities or as engaging in cultural appropriation. This, in turn, may have influenced the perceptions measured in this study, particularly those related to warmth.

4.6. Implicit negative bias towards incongruent use of skin tone emojis

We also aimed to understand how the perceptions of the sender might be affected in incongruent conditions of emoji-profile pairings. Our findings indicated no differences in warmth, competence, and relationship quality perceptions between the two incongruent pairs. In particular, for White senders, the warmth and competence perceptions were not affected by the use of the incongruent Darker emojis, as the ratings for this condition did not differ from when White senders used Lighter or Yellow emojis. Also,

the incongruent conditions of White senders using Darker emojis and Black senders using Lighter emojis did not differ in warmth ratings. This suggests that, in our sample, White senders using Darker emojis were not perceived as warmer due to the interpretation that they might be supporting the Black Lives Matter movement. Moreover, the topics of the conversations did not contain any political content.

The analysis of eye-tracking measures revealed that participants took longer to process the incongruent condition on both AOIs only for White senders, and not for Black senders. This attention bias suggests the existence of an implicit negative bias towards the use of Darker emojis by White senders. This may be because using an emoji that does not match one's racialized identity might be interpreted as cultural insensitivity or appropriation. This result also partially supports our hypothesis that incongruencies between emojis and profile pictures would lead to participants spending more time viewing these visual cues compared to congruent pairings.

Furthermore, both incongruent pairs were associated with decreased perceptions of relationship quality compared with the respective congruent pair. Black senders elicited diminished perceptions of relationship quality when they used Lighter emojis, and White senders elicited diminished perceptions of relationship quality when they used Darker emojis. This result suggests that when there is a mismatch between the racialized cues — without any context to justify it —, it might be perceived as inauthentic, thus affecting the perceived relationship quality, as authenticity is a rapport in interpersonal relationships (Wickham, 2013).

4.7. Informative value of skin tone emojis and profile pictures

We aimed to determine which stimuli were more informative: emojis or profile pictures. Specifically, we aimed to investigate whether, under neutral profile picture condition, the attention to the skin tone emojis' AOI would be higher compared to the attention to the profile pictures' AOI when the emoji was Yellow. Our findings indicated no significant difference between the attention allocated to both AOI. However, when we considered all our profile pictures and emojis, the findings indicated that participants looked at profile pictures' AOI for longer times than emojis' AOI, regardless of the condition. This suggests that in digital communication, while emojis are useful, they might act as supplementary to the context provided by the profile picture. Consequently, users should be aware that emojis alone may not convey the complete context and might entail specific impacts.

4.8. Limitations and future research

Our findings should be interpreted considering some limitations that may affect their generalizability. Our sample was predominantly composed of female participants. Furthermore, there are cross-cultural differences in emoji usage, such as some hand gesture emojis may be more commonly paired with specific skin tones in specific societies (e.g., Black fist up as a symbol for the Black Lives Matter movement; white OK hand emoji as a symbol of White supremacy). Finally, our sample was composed of White individuals, which limits the ability to generalize to culturally diverse populations.

Future studies should incorporate a broader array of hand emojis and skin tones to capture a more accurate representation of how different emojis are perceived. Also, more trials per condition should be included to increase generalizability and statistical power. Since emoji hand types were a significant covariate, future studies should include this variable in their counterbalancing scheme and measure their valence in conjunction with the text messages in order to explore further their effects in the sample. Also, future studies could include other facial expressions in the profile picture in order to explore the generalizability of the results. Furthermore, our research was conducted on a single computer-mediated communication platform, WhatsApp, which might influence the user's behavior and perceptions differently than other platforms. Future studies could extend this research across several digital platforms to discern any platform-specific biases or patterns.

4.9. Conclusion

In this study, we presented the first analysis of the combined effects of skin tone emojis and profile pictures on social inference processes. Our findings indicated that Black senders using Darker emojis were perceived as warmer, but less competent. In contrast, Black senders using Lighter emojis were seen as more competent, but less warm. White senders were less impacted by the skin tone emojis. However, when senders used a profile photo that did not show their face or their skin, such as a neutral landscape, then using Lighter emojis improved the perceptions of their warmth, but reduced competence perceptions. Neutral senders using Yellow emojis were more likely to be presumed as White individuals. Future studies should explore these effects with more diverse stimuli and in more diverse samples to further investigate these biases. We hope that by raising awareness of such biases our study can contribute to the development of new self-representational technologies in the future.

CRediT authorship contribution statement

Sofia Pelica: Writing – review & editing, Writing – original draft, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Visualization, Validation, Conceptualization. **Tiago Rôxo Aguiar:** Writing – review & editing, Writing – original draft, Software, Resources, Methodology, Investigation, Conceptualization. **Sofia Frade:** Writing – review & editing, Supervision, Software, Resources, Project administration, Methodology, Formal analysis, Data curation. **Rita Guerra:** Writing – review & editing, Supervision, Resources, Conceptualization. **Marília Prada:** Writing – review & editing, Supervision, Resources, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tele.2024.102207.

Data availability

The data, scripts, materials, and preregistration of this study are available on open access via the Open Science Framework at https://osf.io/4b7qs/?view_only=87e472488be344589da6b7fef5d94a4b

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