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ORIGINAL ARTICLE

Pain and satisfaction: healthcare providers' facial appearance matters

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Abstract
Trait inferences based solely on facial appearance affect many social decisions. Here we tested whether the effects of such inferences extend to the perception of physical sensations. In an actual clinical setting, we show that healthcare providers' facial appearance is a strong predictor of pain experienced by patients during a medical procedure. The effect was specific to familiarity: facial features of healthcare providers that convey feelings of familiarity were associated with a decrease in patients' perception of pain. In addition, caring appearance of the healthcare providers was significantly related to patients' satisfaction with the care they received. Besides indicating that rapid, unreflective trait inferences from facial appearance may affect important healthcare outcomes, these findings contribute to the understanding of the mechanisms underlying social modulation of pain perception.

Introduction

When interacting with strangers, an important source of information is their facial appearance. One hundred milliseconds exposure to an unfamiliar face is sufficient to trigger attributions of personality traits to the person based solely on their facial appearance (Todorov et al., 2015). These appearance-based attributions tend to be rapid and effortless (Montepare & Dobish, 2003; Todorov et al., 2015). In terms of their content, the attributions encompass a range of complex personality characteristics (e.g., trustworthiness, competence, and dominance) and predict both specific behaviors (e.g., memory for face identity and emotion recognition) (Rule, Slepian & Ambady, 2012; Mattarozzi et al., 2015a; Wendt et al., 2018; Colonnello, Mattarozzi & Russo, 2019), and social outcomes ranging from electoral and occupational success to economic (see Todorov et al., 2015 for a review) and healthcare decisions (Hadjistavropoulos, Ross & Von Baeyer, 1990; Aston-James & Nicholas, 2016; Schafer et al., 2016; Mattarozzi et al., 2017a). Here, we study whether facial-based trait inferences may predict sensory experience in the context of a mildly painful medical procedure.

Multiple studies consistently indicate that pain is modulated by the social context in which it is experienced (Krahé et al., 2013). Salient interpersonal interactions (e.g., passive or active presence of a romantic partner vs. a stranger) during painful experience seem to function as a social, predictive signal of contextual safety or threat, and as such influence the salience of noxious stimuli (Eisenberger et al., 2011; Goldstein et al., 2018; von Mohr et al., 2018). Here, we argue that inference from facial appearance alone may signal safety or threat and, consequently, may intervene in top-down processing of noxious stimuli. This is particularly likely to occur in the context of patient–healthcare provider interactions. Studies consistently find that physicians' supportive nonverbal behavior and communication skills are among the most relevant social variables that influence patients' pain and satisfaction with the care received (Benedetti, 2013; Ruben, 2015; Ruben et al., 2017). These patient–healthcare interactions are also related to the placebo and nocebo effects, which arise from the individual's positive or negative expectations, respectively, about treatments and clinical outcomes; and play a role in modulating pain perception throughout the descending pain pathways (Wager et al., 2011; Benedetti, 2013; Blasini et al., 2017). We study whether the healthcare providers' facial appearance alone

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can also predict patients' pain perception during a medical procedure and their satisfaction with the care received. To the extent that this is the case, healthcare providers' facial appearance could be an additional factor involved in top-down modulation of pain perception.

Using hierarchical linear modeling (HLM), we tested the hypothesis that positive trait inferences from healthcare providers' facial appearance (more trustworthy, familiar, caring, and competent looking)—as judged by an independent sample of participants—are associated with patients' reduced pain perception and an increased satisfaction with the care received during a simple but invasive clinical procedure (a venipuncture for a blood sample).

Methods

Participants

We recruited a total of 1096 patients (689 women, mean age ± SD 49.7 ± 16.3) and 25 nurses (all women; mean age ± SD: 49.5 ± 7.2; about 40 patients for each nurse). All participants were recruited at the outpatient phlebotomy services of two public Italian hospitals.

Procedure

Patients' variables

The patients underwent a venipuncture for a routine blood sampling procedure by 1 of 25 nurses. Immediately after the blood sampling procedure, the patients individually rated on 9-point (1 not at all, 9 extremely) scales their pain intensity and satisfaction with the care received. We also collected judgments of competence, trustworthiness, and caring of the nurse they interacted with. The questions were presented in a fixed order, with the rating of the main variables (pain and satisfaction) first. We excluded participants who reported that they were familiar with the nurses. The patient's ratings were collected outside the blood sample room by the same research assistant, and the nurse was not present when those ratings were made.

Facial appearance variables

To collect measures of trait inferences based solely on facial appearance (as opposed to factors related to the actual interaction), we asked an independent sample of 274 students (211 women, mean age 22.8 ± SD 5.45) from the University of Bologna, Italy, to rate the photos of the 25 nurses, who were all Caucasians. The students came from the same patients' community but from a neighboring urban area to avoid the possibility that they had already seen and interacted with the nurses.

The method to rate the faces by an independent sample of participants at zero acquaintance followed prior findings that people agree on their social judgments from faces and that the aggregated social judgments are predictive of important social outcomes (Todorov et al., 2015). Using these zero acquaintance ratings, we were able to focus on the specific and unique contribution of the facial features of the nurses to pain perception, independently from other factors such as the nurses' other aspects of physical appearance, facial expression, behavior, and the dynamic and complex nurse–patient interactions. We acknowledge that the two samples (i.e. students and patients) were different in age and gender. However, two things should be noted. First, studies show very high agreement between young and elderly participants in social judgments of faces (Cortes et al., 2019). Differences between these groups are typically confined to higher or lower judgments of attributes such as attractiveness, but not to the relative ordering of the faces on the specific judgment. That is, the judgments of the two groups (of the same faces) are highly correlated. The same observations are also valid for gender differences. Males' and females' social judgments of faces are highly correlated (Mattarozzi et al., 2015b; Oh et al., 2019), though they differ in other respects such as higher or lower judgments on specific attributes (Mattarozzi et al., 2015b) or the relationship between different judgments (Oh et al., 2019). Second, any differences between our samples (students vs. patients) should work against the hypothesis that measures of trait inferences derived from a student sample predict the experience of patients.

The nurses, displaying an emotionally neutral facial expression, were frontally photographed with a direct gaze and visible collar of a white t-shirt against a standard gray background. The full-color photographs (standard size of 15 cm width X 22 cm height) of the 25 nurses were individually presented to students at the center of a computer screen and the students were asked to judge each unfamiliar face for its perceived trustworthiness, competence, familiarity, and caring appearance. We choose these attributes, because of the nature of the setting and, specifically, the interaction between the healthcare provider and the patient. According to the literature, these attributes are related to the act of caring (Benedetti, 2013; Ruben, 2015; Ruben et al., 2017) and to signals of safety (Loewenstein et al., 2001; Zebrowitz, Bronstand, & Lee, 2007; Eisenberger et al., 2011; Goldstein et al., 2018; von Mohr et al., 2018).

Responses were collected using a 9-point (1 not at all, 9 extremely) scale. None of the students were familiar with the nurses. The students took about 20 min to rate all the nurses' faces. The judgments of all traits were highly reliable (Cronbach's alpha > 0.88).

All participants gave informed consent prior to the experiment and were fully debriefed at its completion in accordance with the policies of the University of Bologna Institutional Review Panel. The Ethical Committee on Human Research approved the study.

Statistical analyses

To assess the role of the nurses' facial appearance in affecting patients' pain perception and their reported satisfaction, we used two separate HLM regressions. HLM, which is a complex form of ordinary least squares regression, is used to analyze variance in the outcome variables when the predictor variables are at varying hierarchical levels (Raudenbush et al., 2004). A two-level analysis ("Level 1" and "Level 2") was conducted to investigate to what extent the dependent variable (i.e., pain or satisfaction) may be influenced by inferences from the nurses' facial appearance, as measured in an independent sample (see above). In particular, in "Level 1", we included the patients' ratings based on the interaction with the nurse (i.e., trustworthy, competent, and caring) and the patients' individual characteristics (i.e., age, gender, level of education) as independent variables (within nurses variables). In "Level 2", we included the traits inferred from the nurses' facial appearance (i.e., students' ratings of trustworthiness, competence, caring, and familiarity) controlling for two of the nurses' individual characteristics (i.e., age and years of work experience) as independent variables (between-nurses variables). The "Level 2" analysis was the one pertinent to our hypothesis, because it assessed the role of the between-nurses variance. Initially, a "null model" (with no predictors included) was calculated. In the "null model", the variability of the dependent variable is given by the sum of two components: variability between nurses and variability within nurses. The null model establishes an essential prerequisite for the HLM approach, providing the intraclass correlation (rho) information (i.e., an index indicating the hierarchical structure of the data). The rho is equal to the ratio of the variance between nurses and the total variance (variance between nurses + variance within nurses): $\rho = (\sigma^2_{u0} / (\sigma^2_{u0+} (\sigma^2)$. The null model was used as a reference point to determine how much variance may be explained by the subsequent model (i.e., the full model). In the next step, the null model was modified by introducing patient-level variables and nurse-level variables. This analysis allowed us to estimate the unique contribution of each predictor in explaining the variance within nurses and between nurses.

The calculation of the required sample size in HLM studies requires considering both the sample size at the individual level (the total number of participants) and the sample size at the group level (the number of groups). In this study, we recruited a total of 1096 patients (689 women, mean age ± SD 49.7 ± 16.29, range 18–90 years) at the individual level and 25 nurses (all women; mean age ± SD: 49.55 ± 7.16, range 32–64 years) at the group level (about 40 patients for each nurse). At the individual level, this sample size is in line with several studies in the social science literature using HLM methods (Nathans et al., 2012). With respect to the sample size at the group level, following Yu, Jiang, & Land, (2015), we estimated that, though the required sample size was about 30, the large sample size at the individual level would compensate the slightly reduced sample size at the group level.

The HLM analyses were performed using the software HLM 6.0.

Results

Pain perception

Patients reported mean (± SD) pain ratings of 3.16 (± 2.95). The intraclass coefficient (rho = 0.24) confirmed the hierarchical structure of the data. As shown in Fig. 1, there was high pain perception variability due to nurses' characteristics: the nurses' variables were responsible for about one-quarter of the variance of patients' perception of pain.

Table 1 shows the estimated effects on pain perception of the predictors included in the full model.

Not surprisingly, the results obtained at "Level 1" (within-nurses level) indicated that the patients' judgments of how caring and competent the nurse was during the interaction were significantly associated with their pain perception rating.

More importantly for our hypothesis, the variables included at "Level 2" (between nurses level) explained a substantial proportion (79%) of the variance between nurses. Specifically, the results obtained indicated that the nurses' facial-based apparent familiarity was a strong predictor ($\beta = -0.62$) of patients' perception of pain even after controlling for the nurses' years of work experience.

Satisfaction

Patients reported mean (± SD) satisfaction ratings of 7.84 (± 1.21). The intraclass coefficient (rho = 0.21) confirmed the hierarchical structure of the data.

Table 1 shows the estimated effects of the predictors included in the full model on patients' satisfaction. At the patient level, high perceptions of competence and caring inclination had a significant positive impact on patients' satisfaction. The variables included at the patient level explained a non-negligible proportion (27%) of the variance within nurses.

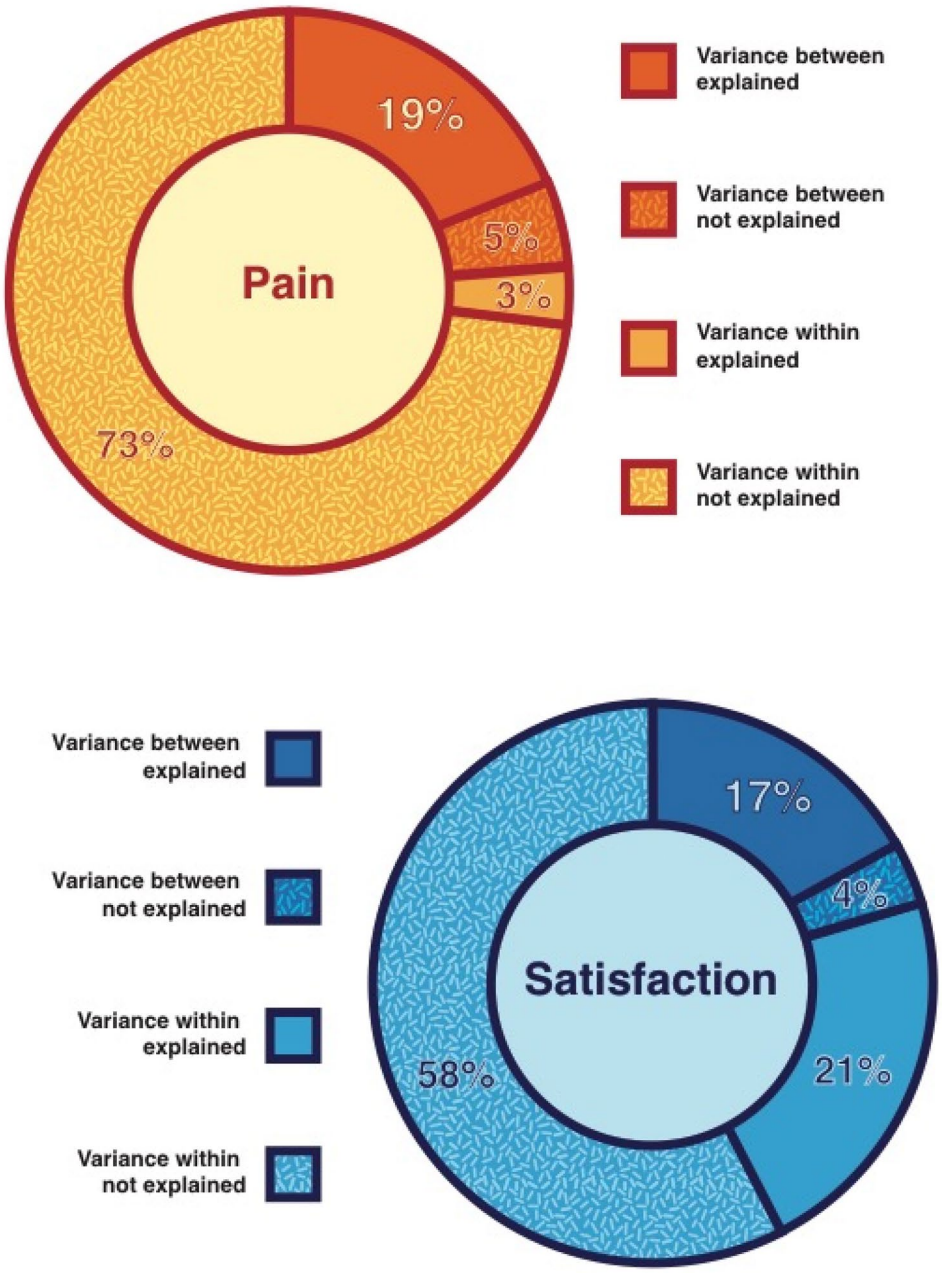

Fig. 1 Between- and within-nurses variances of patients' pain perception and satisfaction

More striking and relevant to the aims of the present study is the impact of the variables included at the nurse level (Fig. 1). In the full model, these variables explained 81% of the between-nurses variance (i.e., about 20% of the total variance). Importantly, the independent judgment of the nurses' faces as caring was the strongest (positive) predictor of satisfaction ($\beta = 0.36$).

Discussion

The present findings indicate that trait inferences from facial appearance predict a significant proportion of the variance of pain intensity resulting from a routine but invasive medical procedure. First impressions from

Table 1 Multilevel regression results: estimated effects on patients' pain perception and satisfaction

	Pain perception			Satisfaction		
	β	S.E	*p*	*β*	S.E	*p*
Within nurses variables ("Level 1")						
Trustworthiness	− 0.03	(0.02)	0.194	0.05	(0.08)	0.501
Competence	**− 0.13**	**(0.03)**	**< 0.001**	**0.24**	**(0.05)**	**< 0.001**
Caring	**− 0.12**	**(0.04)**	**< 0.001**	**0.39**	**(0.06)**	**< 0.001**
Patients' age	0.02	(0.03)	0.490	− 0.00	(0.02)	0.918
Patients' gender	0.02	(0.05)	0.755	− 0.07	(0.07)	0.275
Patients' level of education	0.01	(0.03)	0.787	− 0.03	(0.03)	0.364
Between nurses variables ("Level 2")						
Trustworthy looking	− 0.36	(0.60)	0.547	− 0.17	(0.46)	0.721
Competent looking	0.50	(0.33)	0.141	− 0.40	(0.30)	0.202
Caring looking	0.49	(0.33)	0.151	**0.36**	**(0.15)**	**< 0.001**
Familiar looking	**− 0.62**	**(0.14)**	**< 0.001**	− 0.17	(0.22)	0.429
Nurses' age	− 0.04	(0.06)	0.57	0.08	(0.6)	0.190
Nurses' work experience (years)	**0.23**	**(0.06)**	**0.01**	**− 0.28**	**(0.06)**	**0.01**

Statistically significant values ($p < 0.02$) are in bold

S.E. Standard error of the mean

nurses' faces were responsible for a large proportion of the between-nurses variability. Specifically, healthcare providers' facial physiognomy that conveys feelings of familiarity powerfully predicts patients' judgment of pain intensity: the greater the familiarity evoked by nurses' facial features, the lower the patients' perception of pain. Of note, the effect of familiarity judgment outweighed the effect of the nurses' actual work experience.

These findings are in line with a large body of research indicating that facial appearance-based evaluations influence real-life behaviors and decisions across a wide range of contexts (Todorov et al., 2015; Todorov, 2017) and add to the literature on the role of top-down processes and nonverbal communication in modulating pain perception. The observed effect of perceived face familiarity on pain perception in an actual clinical context resonates with previous laboratory-based studies demonstrating that the presence of a familiar person during an acute stressful experience reduces neuroendocrine stress responses and pain perception (Younger et al., 2010; Eisenberger et al., 2011; Goldstein et al., 2018; von Mohr et al., 2018); and with translational neuroscience studies demonstrating that the nociceptive threshold and related activation of the endogenous mu-opioid system is higher following contact with a familiar than with an unfamiliar individual (Panksepp, Biven, & Siegel 2014). Of note, physical similarity to familiar others has been found to influence impressions of others across a range of settings (Verosky, & Todorov, 2010, 2013). Furthermore, people continue to rely on physical similarity even as they learn relevant behavioral information about the person (Verosky, & Todorov, 2013). Adding to this literature, the present study demonstrates that even when familiarity is operationalized as a mere trait inference from physical features of unknown faces, it modulates pain perception, at least when pain levels are not severe, as in our case. Such an effect can be explained by the "familiar face overgeneralization" hypothesis that posits that responses to unknown individuals vary as a function of their resemblance to known individuals (Zebrowitz, & Montepare, 2008). Faces that have never been seen before but that resemble the majority of faces observed in one's environment are likely to produce biased perceptions of familiarity and positive affective reactions (Zebrowitz, Bronstand, & Lee, 2007; Dotsch, Hassin, & Todorov, 2016), probably due to associative learning processes. Although the precise mechanisms by which inferences of familiarity from facial appearance affect pain remain to be determined, it is plausible to hypothesize that seeing faces with features that evoke familiarity may automatically enhance feelings of safety, reduce fear and anxiety, and, in turn, reduce pain perception, similar to seeing an actually familiar face (Coan, Schaefer, & Davidson, 2006; Krahé, et al., 2013).

Facial-based trait impressions were also significantly related to the patients' evaluations of the healthcare service: patients were more satisfied after receiving care from nurses who appeared more caring. This result is in line with several studies indicating that physicians' caring attitude and patients' satisfaction are strongly related (Ruben, 2015), and that patients view physicians' interpersonal skills as an indicator of quality of care (Mattarozzi et al., 2017b). The literature concerning the impact of face-based social attributions (Todorov et al., 2015) indicates that the predictive power of a particular facial trait depends on its relevance to the domain in question. Consistently, we found that judgments of nurses' faces as

more caring predicted higher patients' satisfaction. Given that patients approach physicians with a variety of emotions and expectations and that their understanding and knowledge of technical aspects of the healthcare service remain limited (Ruben, 2015; Mattarozzi et al., 2017b), patients may tend to rely on their first impressions. This is in line with studies indicating that the less expert people are in a given field, the more they tend to base their decisions on limited information such as inferences from facial appearance (Olivola et al., 2012).

Several limitations of the study should be noted. First, the specificity of context and procedure limit the generalizability of the present results. An additional limitation is that the study focused on specific care-related inferences. Thus, it is not possible to disentangle, for example, the role of other factors, such as facial attractiveness, in possibly modulating pain perception. The latter hypothesis is consistent with studies showing that pleasant environmental stimuli affect pain perception by capturing attentional resources (De Tommaso et al., 2008; Villemure, & Bushnelle, 2002). Moreover, previous studies show that attractiveness increases the perceived familiarity of unfamiliar faces (Monin, 2003). Thus, it is possible that attractiveness is one of the determinants of perceived familiarity (but see Sofer et al., 2015). Finally, we did not measure the nurses' facial expressions during the actual dynamic interaction. Therefore, additional research is needed to explore how first impressions shape and are being shaped by the actual interaction.

Taken together, the present findings are consistent with previous evidence demonstrating the impact of first impressions on real-life behaviors and decisions (Todorov et al., 2015; Todorov, 2017). Interestingly, in the case of a bodily sensation such as pain, the only inference that mattered was familiarity. These findings contribute to our understanding of the mechanisms underlying social modulation of pain perception. In particular, they seem to suggest that the sense of familiarity conveyed merely by the facial appearance of the clinician may contribute to the top-down processing of noxious stimuli.

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Author contributions KM. developed the study concept. KM and AT contributed to the study design. Testing and data collection were performed by EF and MBEC and PMR performed the data analysis. KM, VC, and PMR drafted the manuscript, and AT provided critical revisions. All authors approved the final version of the manuscript for submission.

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Compliance with ethical standards

Conflict of interest All co-authors declare no conflict of interest to report.

Ethical approval All procedures performed in studies were in accordance with the ethical standards of the institutional research committee (University of Bologna Ethical Committee) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. All participants were fully informed about the procedure of the study and gave their formal consent to participate.

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