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Unmasking smiles: the influence of culture and intensity on interpretations of smiling expressions

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Abstract A smile can communicate many things: happiness, affiliative intent, or a person's social status. This means that perceivers need to interpret what a given smile might mean. In the current study, we hypothesized that the interpretation of smiles is influenced by the culture of both the person smiling and of the perceiver, as well as by the intensity of the smile. Chinese and Dutch perceivers rated positivity, negativity, authenticity, and politeness for isolated (Experiment 1) and minimal-context (Experiment 2) low- and high-intensity smiles produced by Chinese and Dutch expressers. Largely consistent with our hypotheses, the culture of the expresser and the intensity of the smile consistently influenced smile interpretation: Dutch smiles were interpreted as more positive and authentic, and as less negative and polite, than were Chinese smiles; high-intensity smiles were interpreted as more positive and authentic, and less negative and polite, than were low-intensity smiles.

However, contrary to our predictions, we did not find a systematic effect of the culture of the perceiver on smile interpretation. Together, these findings provide new evidence for the impact of culture and smile intensity on the interpretation of the social and affective meaning of smiles.

Keywords Culture · Smile perception · Authenticity · Politeness

Introduction

The smile is a ubiquitous facial expression in daily life (Calvo et al. 2014). Although it is a simple and highly recognizable configuration (Ekman 2003; Sauter 2010), the information carried by the smile is manifold, complex, and often ambiguous (Hess et al. 2002; Matsumoto and Kudoh 1993; Niedenthal et al. 2010; Rychlowska et al. 2017). People often smile when they feel pleasure (e.g., Ekman 1972; Elfenbein and Ambady 2002). However, people have reported also smiling in the absence of pleasant feelings to signal affiliative intent (Niedenthal et al. 2010; Rychlowska et al. 2017). In an emotion production study, people were found to display smiling behavior even during negative emotional experiences (embarrassment; Keltner 1995). Interpreting others' smiles accurately is important, as misinterpretation may lead to a

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misjudgment of what a given social interaction affords.

In the present research, we develop and test the idea that the interpretation of smiles is influenced by characteristics of the smiling expression as well as by characteristics of the perceiver. Specifically, we propose that, when interpreting smiles, perceivers draw on their own cultural background (perceiver characteristics), as well as on the smiling person's cultural background and the intensity of the smile (expression characteristics). Given that smiles do not only reflect the affective state of the expresser, but also signal social information directed at others (Fridlund 1994; Van Kleef 2016), we sought to investigate the influence of expresser and perceiver culture and smile intensity on both affective and social interpretations of smiles. In particular, we examined the effects of culture and smile intensity on perceived positivity and negativity (capturing inferences related to the smiling person's private affective state) as well as perceived authenticity and politeness (capturing inferences related to social implications) of smiles.

Cultural influences on smile interpretations

Prior research has found great cultural variability in display rules for the encoding of smiles, that is, cultural norms that dictate how, when, and to whom people should smile (Ekman 1972; Friesen 1972; Klineberg 1938; Sun 2010). There is anecdotal evidence that Eastern Asians (henceforth Easterners) engage in more social smiling than Americans and West Europeans (henceforth Westerners; Klineberg, as cited by LaBarre 1947). In an early observational study, American and Japanese participants' facial expressions were coded while they watched a show with the experimenter. The results showed that Japanese people were more likely than Americans to cover their negative feelings with a smile in the presence of the experimenter (Friesen 1972). It has been argued that Japanese people often suppress their negative emotional expressions because of the potential of such expressions to threaten interpersonal relationships; negative expressions are therefore "masked" with smiles to smoothen interpersonal tensions (e.g., Ekman 1972; Matsumoto 1990). A more recent study from linguistics also suggests that there is a large array of phrases relating to smiles that

are used for different reasons in Chinese culture, and that smiling to cover negative emotions or to simulate positive ones is regarded as socially normative in China (Sun 2010). It is thus likely that smiles are related to etiquette among Easterners. By contrast, Westerners reported that they smile more often because they feel pleasure, as they tend to be encouraged to openly express what they feel (Matsumoto et al. 2008; Tsai et al. 2002). This suggests that Easterners use smiles more frequently than Westerners for reasons of social appropriateness, and relatively less frequently than Westerners to express true feelings of pleasure.

Research has also shown that people from different cultures differ in their beliefs about why people smile (Rychlowska et al. 2015). Specifically, participants in nine countries rated the extent to which 15 possible emotional and motivational states cause people to smile in their culture. The results showed that people from homogenous cultures (represented by many Eastern cultures), where the current population descended from migrants from only a few source countries over a long period of time, differed from people from heterogeneous countries (represented by many Western cultures), where the current population descended from migrants from numerous countries over a long period of time, in their judgments about the motivation for smiling. People from homogeneous cultures believed that feelings and states related to hierarchy management were more likely to cause smiling, whereas people from heterogeneous countries believed that affiliative intentions were more likely to cause smiling. In general, it seems that the motivation for smiling in Western cultures (being affiliative) relates more to positive affect than the motivation for smiling in Eastern cultures (managing hierarchies).

Based on the existing evidence, we propose that Easterners and Westerners *interpret* smiles in line with differences in their display rules of smiles as well as their motivations for smiling. Specifically, we expected that Westerners would perceive smiles as signaling more positive affect than Easterners, whereas Easterners would be more likely to interpret smiles as indicative of polite behavior than Westerners. In addition, we expected that Easterners would perceive smiles as signaling more negative affect than Westerners, whereas Westerners would perceive smiles as more authentic than Easterners. The reason for including negativity ratings is that perceived

positivity and negativity of smiles do not necessarily lie on opposite ends of a single dimension, especially for Easterners. Previous research has shown that Easterners are higher on dialectical thinking—less troubled by apparent contradictions in their own and others' thoughts, emotions, and behaviors—than Westerners (Hideg and Van Kleef 2017; Peng and Nisbett 1999; Peng et al. 2006; Spencer-Rodgers et al. 2004). As a result, Easterners may infer both positive and negative affect from smiles, whereas Westerners tend to endorse primarily positive affect from smiles. The inclusion of perceived negativity of smiles may thus provide additional, rather than redundant, information for understanding smiles across cultures. Likewise, although previous research has argued that authentic and polite smiles are two major classes of smiles (Heerey and Crossley 2013), these two attributes of smiles may not necessarily lie on opposite ends of a single dimension for Easterners. We thus also examined the effect of culture on perceived authenticity of smiles.

At the same time, perceivers may interpret the other person's expression differently depending on the culture of the expresser (Hess et al. 2000; Matsumoto 1999; Matsumoto and Kudoh 1993). The expresser's ethnicity conveys information about the expresser's group membership, which may prime potential knowledge or stereotypes about that group in the perceiver. Suggestive evidence that the expresser's ethnicity can indeed influence the perception of emotional expressions comes from a recent study by Kommattam et al. (2017). They found that White participants preferentially interpreted expressions of embarrassment in Whites as signs of embarrassment, whereas they interpreted the same expressions when displayed by Arabs as signs of disinterest. These patterns of emotion perception aligned with White participants' stereotypes about Whites' and Arabs' emotional lives, suggesting that such stereotypes can color perceivers' interpretation of (at least some) emotional expressions of people from different cultural backgrounds.

Easterners and Westerners represent two broad, salient cultural groups (Markus and Kitayama 1991). Research has shown that people from these different cultural backgrounds are aware of certain emotion norms not only in their own cultural group, but also in other cultural groups (Pittam et al. 1995). If Easterners and Westerners have knowledge of the norms

surrounding smiles in each culture (Westerners smiling more often out of pleasure and Easterners smiling more often out of politeness), smiles by Western expressers may be more likely to be interpreted as expressions of true happiness, and less likely to be interpreted as reflecting politeness, as compared to smiles by Eastern expressers. Complementarily, smiles by Eastern expressers may be perceived as more negative and less authentic than smiles by Western expressers.

Interpreting smiles with different intensities

A wealth of research on the perception of smiles demonstrates that people who are smiling are perceived more positively than non-smiling people, in terms of both affective states and personality traits (e.g., Harker and Keltner 2001; Hess et al. 2002; Scharlemann et al. 2001). Previous research has relied almost exclusively on high-intensity smiles, despite the fact that smiles in real life vary in intensity (Abel and Kruger 2010; Harker and Keltner 2001). This bias in the smile literature reflects a bias in the wider research community to employ highly prototypical facial expressions as research stimuli (Reisenzein et al. 2013). To our knowledge, only one study has used varying intensities of Duchenne smiles (involving both the zygomatic major muscles around the mouth [Action Unit 12] and the orbicularis oculi muscles around the eyes [AU6]) to show that more intense Duchenne smiles were judged as more amused than Duchenne smiles of low intensity (Krumhuber and Manstead 2009). More research has investigated intensity from the perspective of smile encoding, pointing to a positive relation between smile intensity and the intensity of the expresser's emotional experience (Hess et al. 1995; Jakobs et al. 1999). For example, participants displayed more intense smiles when experiencing strong feelings of happiness and being in the company of friends (Hess et al. 1995). Based on this work, we expected that smile intensity would influence how perceivers interpret the emotional experiences of the expresser. Specifically, high-intensity smiles should be interpreted as signaling more positive affect and less negative affect than low-intensity smiles.

Little research has examined relations between smile intensity and the interpretation of the social

implications of smiles with respect to authenticity and politeness. Research has shown that, in addition to the Duchenne marker (AU6; de Duchenne Bologne 1862/1990; Ekman and Friesen 1982), Westerners also use smile intensity (indicated by the intensity of AU12) to infer the authenticity of a smile, with more intense smiles being judged as more authentic than less intense smiles (Gunnery and Ruben 2016; Gunnery et al. 2013; Thibault et al. 2012). Compared to the Duchenne marker, smile intensity has been found to be a stronger indicator of smile authenticity (Gunnery et al. 2013) that is also used in other cultures such as China and Gabon (Mai et al. 2011; Thibault et al. 2012). It seems plausible, therefore, that smile intensity serves as a universal marker of smile authenticity, with high-intensity smiles being judged as more authentic than low-intensity smiles.

Complementarily, we expected that low-intensity smiles would be judged as indicating more politeness than high-intensity smiles. Indeed, research on smile encoding suggests a link between smile intensity and politeness: When people intend to be polite, they are less likely to produce high-intensity smiles (Ambadar et al. 2009). Based on these theoretical arguments and suggestive findings, we predicted that smile intensity would be positively correlated with perceived authenticity, and negatively correlated with perceived politeness.

Interaction between culture of perceiver/expresser and smile intensity

Finally, we considered the possibility that smile intensity and (perceiver and/or expresser) culture may interact with each other. Recent findings have shown cultural differences in the valuation of positive states (ideal affect), with European Americans valuing high-arousal positive states more than Chinese (Park et al. 2016; Tsai et al. 2016). This cultural difference has been further found to predict leaders' smiles in each nation: the more nations value high-arousal positive states, the more their leaders show excited smiles in their official photos; similarly, the more nations value low-arousal positive states, the more their leaders show calm smiles in their official photos. However, European Americans and Chinese do not differ in how they actually feel across different positive states, and there is also no consistent evidence

that the valuation of high- versus low-arousal positive states influences behavioral responses to high- versus low-intensity smiles (Park et al. 2016). It is thus not clear whether cultural differences in the valuation of high-versus low-arousal positive states (ideal affect) would cause the perception of high- versus low-intensity smiles to vary across cultures.

Although previous theorizing and empirical evidence do not provide a strong basis for formulating clear predictions, it is conceivable that high-intensity smiles are interpreted as signaling happy feelings across cultures, given that high-intensity smiles often occur when people feel amused (Ambadar et al. 2009). The interpretation of low-intensity smiles, however, may be influenced by culture to a greater extent. Preliminary evidence from an evolutionary framework suggests that Duchenne laughter is well established in the hominid bio-behavioral repertoire, whereas non-Duchenne laughter involves more learning processes (Gervais and Wilson 2005). Given the association between smile intensity and authenticity, it is possible that low-intensity smiles (comparable to non-Duchenne laughter) are influenced by culture to a greater degree than high-intensity smiles (comparable to Duchenne laughter). We thus examined in an exploratory fashion whether cultural differences would be more pronounced for low- as compared to high-intensity smiles.

The present research

Chinese and Dutch expressers and perceivers were employed in two studies to represent Eastern and Western cultures, respectively. Our goal was to test the effects of culture of perceiver, culture of expresser, smile intensity, and the potential interactions between these factors, on smile interpretation (perceived positivity, negativity, authenticity, and politeness). Isolated smiles (photographs of smiling facial expressions) were used in Experiment 1. Minimal-context smiles (photographs of smiling facial expressions paired with sentences describing neutral situations of daily life such as “this person is in a train station”) were used in Experiment 2, which sought to test whether the effects found for de-contextualized smiles in Experiment 1 would replicate in the context of smiles presented as occurring in daily-life situations.

In sum, we tested three sets of hypotheses regarding culture of perceiver, culture of expresser, and smile intensity, respectively. First, we predicted that Western perceivers would infer more positive affect and authenticity from smiles than Eastern perceivers, whereas Eastern perceivers would infer more negative affect and politeness from smiles than Western perceivers. Second, mirroring the effect of culture of perceiver on smile interpretation, we predicted that smiles by Western expressers would be interpreted as more positive and authentic than smiles by Eastern expressers, whereas smiles by Eastern expressers would be interpreted as more negative and polite than smiles by Western expressers. Third, we hypothesized a main effect of smile intensity on smile interpretation. Specifically, we predicted that high-intensity smiles would be perceived as more positive and authentic than low-intensity smiles, whereas low-intensity smiles would be perceived as more negative and polite than high-intensity smiles. In addition, we examined in an exploratory fashion whether cultural differences on smile interpretation would be more pronounced for low- as compared to high-intensity smiles.

Pilot study: development of stimuli

We selected four Chinese models (two women, two men) posing low- and high-intensity smiles from the Taiwan Facial Expression Image Database (TFEID; Chen and Yen 2007). Next we selected four Dutch models (two women, two men) from the Amsterdam Dynamic Facial Expression Set (ADFES; Van Der Schalk et al. 2011) that matched the Chinese models in terms of gender and approximate age based on one-to-one correspondence. Both facial expression databases were created using instructions based on the facial action coding system (FACS; Ekman et al. 2002). Specifically, models in both face databases were asked to (a) push up the cheeks, gathers the skin under the eye, narrow the eye aperture, and (b) pull the corners of lips up.

The ADFES consists of dynamic expressions changing from a neutral expression to a specific emotional state. To ensure a match of intensity between the Dutch and Chinese stimuli, we conducted a pilot study to select the frame of each ADFES stimulus that best matched the intensity of the

corresponding Chinese stimulus. Twenty Dutch participants ($M_{\text{age}} = 23.71$; 6 men) and 20 Chinese participants ($M_{\text{age}} = 27.60$; 12 men) were recruited. We extracted 150 frames from each original clip of the Dutch models (ranging from 6 to 6.5 s) and combined them into new stimulus sequences. The number of frames was calculated by multiplying 24 fps (the common frame rate used in films) by 6.25 (the mean of 6 and 6.5). A photograph of one of the Chinese facial expressions was presented on the left side of the screen, while the corresponding sequential Dutch facial expressions were presented on the right side of the screen. Participants were asked to drag the slider bar underneath the clip to choose the frame that was most similar in terms of intensity to the Chinese stimulus on the left side. Each comparison between a Chinese stimulus and a Dutch stimulus included two trials with different initial positions of the slider bar, with one starting from the first frame of the clip and the other one starting from the last frame of the clip. In total, each participant completed 16 trials (4 model pairs \times 2 intensity levels [low and high intensity smiles] \times 2 initial positions of the slider bar) in a random order. We conducted an independent-samples *t* test comparing Chinese participants' and Dutch participants' selected frames for each Dutch stimulus (matched with a particular Chinese stimulus), and found no significant differences between the two groups of perceivers (see Table S1). We therefore used the average frame across all participants as the final stimulus for each model to operationalize smile intensity in the Dutch stimulus set. The resultant sets of Chinese and Dutch facial expression stimuli were thus matched both in terms of activated action units (mainly in the activation of AU6 and AU12) and intensity (see Supplementary Table S2 for AU activation and intensity for each stimulus based on coding according to the FACS; the stimuli are available from the first author upon request).

Experiment 1

The first experiment examined perceived positivity, negativity, authenticity, and politeness of still photographs of Chinese and Dutch smiling facial expressions with two different levels of intensity (high- and low-intensity smiles), as judged by Chinese and Dutch participants.

Methods

Participants

To ensure that participants from China and the Netherlands have similar age and socioeconomic and education backgrounds, we recruited mainly student samples from the two countries. Seventy-five Dutch participants ($M_{\text{age}} = 20.03$, $SD = 1.72$; 56 women) were recruited from the University of Amsterdam subject pool, and 95 Chinese participants ($M_{\text{age}} = 25.97$, $SD = 5.10$; 63 women) living in Mainland China (mainly University students) were recruited via personal networks. Dutch participants received 0.25 course credit for participation; Chinese participants did not receive compensation. All participants provided written informed consent, and the ethics committee of the University of Amsterdam approved the experiment.

Stimuli

The stimuli consisted of 16 still photographs of smiles obtained from the pilot study, with four Chinese models (two women, two men) and four Dutch models (two women, two men) displaying both low- and high-intensity smiles.

Procedure

The experiment was administered via Qualtrics online survey software (<http://www.qualtrics.com>). Participants were told that they would see a series of faces, with each one appearing for only 2 s. Immediately after each face, participants were asked to rate the expressions on one of the four dimensions: positivity (“How positive does the person feel?”), negativity (“How negative does the person feel?”), authenticity (“How authentic is the expression?”), and politeness (“Is the expression out of politeness?”). Ratings were made by moving a slider ranging from 0 (*not at all*) to 100 (*extremely*). The order of faces and judgments was random for each participant. Participants completed 4 practice trials, followed by 64 trials (16 photographs \times 4 judgments) divided into two blocks. The task took about 15 min. Instructions were translated into Chinese and Dutch by means of the standard translation/back-translation procedure.

Results and discussion

We used R (version 3.6.0; R Core Team 2017) with the lme4 (version 1.1–21; Bates et al. 2015) to perform a linear mixed effects analysis for each dependent measure (positivity, negativity, authenticity, and politeness ratings; correlations of all measures can be found in Supplementary Table S4). As fixed effects, we entered smile intensity, perceiver culture, expresser culture, and their interactions into the model. As random effects, we had intercepts for subjects and model pairs. The lmerTest package was used for testing significance (version 3.0.1; Kuznetsova et al. 2017). The emmeans package (version 1.3.4; Lenth 2019) was used for post hoc comparisons. A complete overview of effects can be found in Supplementary Table S5.

Perceived positivity

As expected, high-intensity smiles were judged as more positive than low-intensity smiles, $b = 10.71$, $CI_{95} (10.04, 11.38)$, $t (2546.91) = 31.25$, $p < 0.001$. The main effect of culture of perceiver was significant, $b = -1.50$, $CI_{95} (-2.84, -0.15)$, $t (169.31) = -2.18$, $p = 0.031$. This effect was further qualified by the two-way interaction of culture of perceiver and smile intensity, $b = 1.05$, $CI_{95} (0.38, 1.73)$, $t (2546.91) = 3.08$, $p = 0.002$ (see Fig. 1 for interactions). Post-hoc comparisons showed that Dutch participants judged low-intensity smiles as more positive than Chinese participants, while there was no difference for high-intensity smiles (see Table 1 for means and standard deviations). The main effect of culture of expresser was also significant, $b = -0.81$, $CI_{95} (-1.48, -0.14)$, $t (2546.91) = -2.37$, $p = 0.018$, and it did not interact with smile intensity, $b = 0.58$, $CI_{95} (-0.09, 1.25)$, $t (2546.91) = 1.69$, $p = 0.091$, suggesting that Dutch smiles were judged as more positive than Chinese smiles (see Table 2 for means and standard deviations). In sum, the expected cultural difference on perceived positivity was found for expressers with both smile intensities, but among perceivers judging low-intensity smiles only.

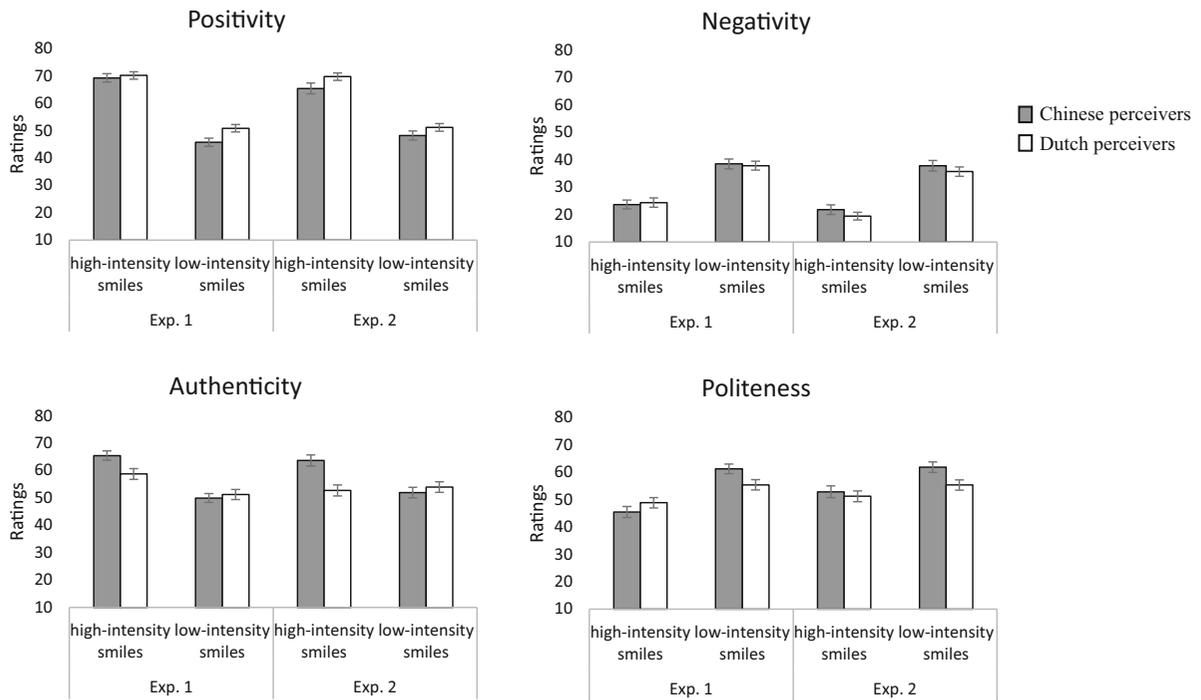


Fig. 1 Interactions of perceiver culture and smile intensity on positivity, negativity, authenticity, and politeness ratings. Error bars indicate 95% confidence intervals

Table 1 Means and standard deviations of ratings on positivity, negativity, authenticity, and politeness as a function of perceiver culture and smile intensity

Ratings	Smile intensity	Experiment 1				Experiment 2			
		Chinese perceivers		Dutch perceivers		Chinese perceivers		Dutch perceivers	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Positivity	Low-intensity smiles	45.74	20.73	50.84	17.19	48.22	21.75	51.15	18.54
	High-intensity smiles	69.26	21.93	70.15	17.19	65.39	25.54	69.72	18.17
Negativity	Low-intensity smiles	38.51	25.05	37.86	20.47	37.82	25.55	35.69	22.80
	High-intensity smiles	23.66	23.02	24.35	21.40	21.77	22.96	19.42	18.06
Authenticity	Low-intensity smiles	49.97	23.05	51.28	23.01	51.98	25.38	53.94	25.34
	High-intensity smiles	65.49	23.92	58.76	24.82	63.70	26.09	52.70	26.39
Politeness	Low-intensity smiles	61.25	24.60	55.41	23.38	61.87	25.37	55.34	25.09
	High-intensity smiles	45.47	28.07	48.85	23.31	52.85	28.22	51.24	25.96

Perceived negativity

As expected, low-intensity smiles were judged as more negative than high-intensity smiles, $b = - 7.09$, $CI_{95} (- 7.82, - 6.36)$, $t (2547) = - 19.06$, $p < 0.001$. The main effect of culture of perceiver was not significant, $b = - 0.01$, $CI_{95} (- 1.89, 1.87)$,

$t (169.4) = - 0.01$, $p = 0.99$, nor the interaction between culture of perceiver and smile intensity, $b = - 0.33$, $CI_{95} (- 1.06, 0.40)$, $t (2547) = - 0.89$, $p = 0.37$ (see Table 1 for means and standard deviations). The main effect of culture of expresser was significant, $b = 1.83$, $CI_{95} (1.10, 2.55)$, $t (2547) = 4.91$, $p < 0.001$, and it did not interact

Table 2 Means and standard deviations of ratings on positivity, negativity, authenticity, and politeness as a function of expresser culture and smile intensity

Ratings	Smile intensity	Experiment 1				Experiment 2			
		Chinese expressers		Dutch expressers		Chinese expressers		Dutch expressers	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Positivity	Low-intensity smiles	46.73	18.62	49.25	20.09	47.44	21.75	51.93	18.54
	High-intensity smiles	69.40	21.02	69.91	18.90	66.55	25.54	68.56	18.17
Negativity	Low-intensity smiles	40.70	23.37	35.74	22.65	39.44	24.73	34.08	23.43
	High-intensity smiles	25.12	23.92	22.81	20.54	21.32	21.29	19.87	20.05
Authenticity	Low-intensity smiles	49.56	22.94	51.54	23.11	53.11	26.50	52.80	24.20
	High-intensity smiles	59.16	26.33	65.89	22.13	55.05	28.75	61.36	24.32
Politeness	Low-intensity smiles	59.61	24.61	57.74	23.84	59.02	26.34	58.19	24.50
	High-intensity smiles	49.12	27.55	44.80	24.44	53.98	27.46	50.10	26.65

with smile intensity, $b = -0.66$, $CI_{95} (-1.39, 0.07)$, $t(2547) = -1.77$, $p = 0.08$, suggesting that Chinese smiles were judged as more negative than Dutch smiles (see Table 2 for means and standard deviations). In sum, the expected cultural difference on perceived negativity was found for expressers, but not for perceivers.

Perceived authenticity

As expected, high-intensity smiles were judged as more authentic than low-intensity smiles, $b = 5.75$, $CI_{95} (4.94, 6.56)$, $t(2546.87) = 13.93$, $p < 0.001$. The main effect of culture of perceiver was not significant, $b = 1.35$, $CI_{95} (-0.28, 2.99)$, $t(169.42) = 1.62$, $p = 0.11$, but there was a significant interaction with smile intensity, $b = 2.01$, $CI_{95} (1.20, 2.82)$, $t(2546.87) = 4.87$, $p < 0.001$ (see Fig. 1 for interactions). Post-hoc comparisons revealed that Chinese participants judged high-intensity smiles as more authentic than Dutch participants, while there was no difference for low-intensity smiles (see Table 1 for means and standard deviations). The main effect of culture of expresser was significant, $b = -2.19$, $CI_{95} (-3.00, -1.38)$, $t(2546.87) = -5.30$, $p < 0.001$, and it was qualified by the two-way interaction of culture of expresser and smile intensity, $b = -1.27$, $CI_{95} (-2.08, -0.47)$, $t(2546.87) = -3.09$, $p = 0.002$ (see Fig. 2 for interactions). Post-hoc comparisons revealed that high-intensity smiles displayed by Dutch models were judged as more

authentic than high-intensity smiles displayed by Chinese models, but there was no difference for low-intensity smiles (see Table 2 for means and standard deviations). In sum, the expected cultural difference on perceived authenticity was found for expressers showing high-intensity smiles, but not for perceivers.

Perceived politeness

As expected, low-intensity smiles were judged as more polite than high-intensity smiles, $b = -5.59$, $CI_{95} (-6.45, -4.72)$, $t(2546.81) = -12.70$, $p < 0.001$. The main effect of culture of perceiver was not significant, $b = 0.62$, $CI_{95} (-1.14, 2.37)$, $t(169.59) = 0.69$, $p = 0.492$, but there was an interaction with smile intensity, $b = -2.30$, $CI_{95} (-3.17, -1.44)$, $t(2546.81) = -5.24$, $p < 0.001$ (see Fig. 1 for interactions). Post-hoc comparisons showed that Chinese participants judged low-intensity smiles as more polite than Dutch participants, but there was no cultural difference for high-intensity smiles (see Table 1 for means and standard deviations). The main effect of culture of expresser was significant, $b = 1.55$, $CI_{95} (0.69, 2.41)$, $t(2546.81) = 3.52$, $p < 0.001$, and it did not interact with smile intensity, $b = 0.67$, $CI_{95} (-0.20, 1.53)$, $t(2546.81) = 1.52$, $p = 0.130$. Chinese smiles were judged as more polite than Dutch smiles (see Table 2 for means and standard deviations). In sum, the expected cultural difference on perceived politeness was found for expressers with both smile

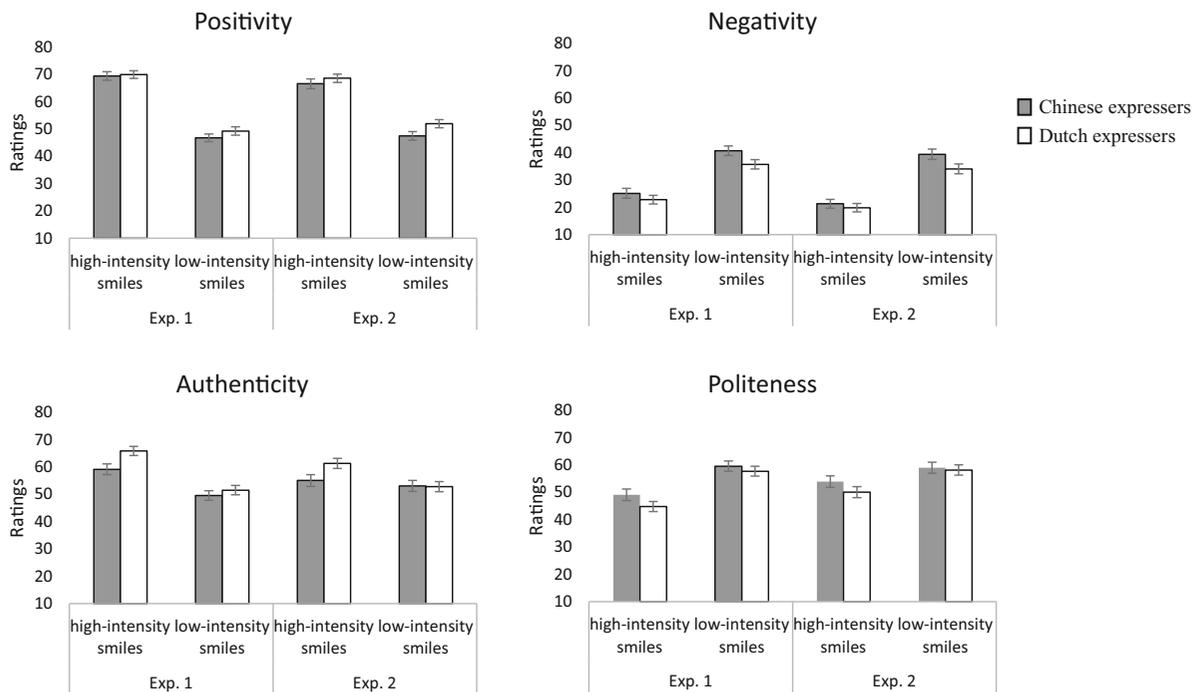


Fig. 2 Interactions of expresser culture and smile intensity on positivity, negativity, authenticity, and politeness ratings. Error bars indicate 95% confidence intervals

intensities, but among perceivers viewing low-intensity smiles only.

In general, high-intensity smiles were perceived as more positive and authentic, and as less negative and polite than low-intensity smiles. Largely consistent with our hypotheses regarding expressers, Dutch smiles were judged as more positive and authentic, and less negative and polite than Chinese smiles. We did not find that the low-intensity smiles shown by Chinese and Dutch expressers were perceived as different in authenticity. In contrast, the expected cultural difference regarding perceivers was only found for positivity and politeness ratings of low-intensity smiles. Contrary to what we predicted, Chinese perceivers rated high-intensity smiles as more authentic than Dutch perceivers. No other cultural differences regarding perceivers were found. Failure to find a systematic difference between Chinese and Dutch perceivers is surprising given that people from these two cultures differ in their norms about smiles. We considered that this may be due to the fact that the smile stimuli in Experiment 1 were presented in isolation from any social context. Such de-contextualized smiles may not have provided participants with

sufficient information to associate the smile stimuli with the smiles that they came across in daily life. Therefore, in Experiment 2 we provided participants with some contextual information within which to judge the smiles.

Experiment 2

Experiment 2 aimed to examine perceived positivity, negativity, authenticity, and politeness of low- and high-intensity smiles paired with minimal daily-life contexts. Again, Chinese and Dutch participants were recruited to judge both Chinese and Dutch stimuli.

Methods

Participants

As in Experiment 1, we recruited mainly students from the two cultures to ensure that the samples would be similar in terms of age, socioeconomic background, and education levels. In addition, we also recruited similar proportions of women/men in both cultures.

Eighty-three Dutch participants ($M_{\text{age}} = 20.53$, $SD = 2.35$; 62 women) were recruited from the University of Amsterdam subject pool, and 83 Chinese participants ($M_{\text{age}} = 20.60$, $SD = 3.78$; 59 women) living in Mainland China (mainly University students) were recruited via personal networks. Dutch participants received 0.25 course credit, and Chinese participants received 7 yuan (about €1) for participation. All participants provided written informed consent, and the ethics committee of the University of Amsterdam approved the experiment.

Stimuli

The facial stimuli were identical to those used in Experiment 1. In addition, we selected eight sentences describing neutral daily-life situations common in both cultures to accompany the facial expressions (e.g., this person is at a train station; see Supplementary Table S3 for details).

Procedure

The experiment was administered via Qualtrics online survey software (<http://www.qualtrics.com>). The procedure was identical to Experiment 1, except that a sentence describing a daily-life situation was presented for 2 s preceding the presentation of the face. Smile stimuli and situations were randomly paired for each participant. Participants completed 4 practice trials, followed by 64 trials (16 photographs \times 4 judgments). The task took about 15 min.

Results and discussion

The analytical approach was identical to Experiment 1. A complete overview of effects can be found in Supplementary Table S6.

Perceived positivity

As expected, high-intensity smiles were judged as more positive than low-intensity smiles, $b = 8.94$, $CI_{95} (8.22, 9.66)$, $t (2486.86) = 24.28$, $p < 0.001$. The main effect of culture of perceiver was significant, $b = -1.81$, $CI_{95} (-3.36, -0.27)$, $t (165.50) = -2.30$, $p = 0.022$, and it did not interact with smile intensity, $b = -0.35$, $CI_{95} (-1.07, 0.37)$, $t (2486.86) = -0.95$, $p = 0.343$, suggesting that

Dutch participants judged smiles as more positive than Chinese participants (see Table 1 for means and standard deviations). The main effect of culture of expresser was also significant, $b = -1.62$, $CI_{95} (-2.35, -0.90)$, $t (2486.86) = -4.41$, $p < 0.001$, and it did not interact with smile intensity, $b = 0.62$, $CI_{95} (-0.10, 1.34)$, $t (2486.86) = 1.68$, $p = 0.093$, suggesting that Dutch smiles were judged as more positive than Chinese smiles (see Table 2 for means and standard deviations). In sum, the expected cultural difference on perceived positivity was found for both perceivers and expressers.

Perceived negativity

As expected, low-intensity smiles were judged as more negative than high-intensity smiles, $b = -8.08$, $CI_{95} (-8.82, -7.35)$, $t (2486.89) = -21.56$, $p < 0.001$. The main effect of culture of perceiver was not significant, $b = 1.12$, $CI_{95} (-0.71, 2.95)$, $t (165.53) = 1.20$, $p = 0.232$, nor was the interaction of culture of perceiver and smile intensity, $b = 0.06$, $CI_{95} (-0.68, 0.79)$, $t (2486.89) = 0.15$, $p = 0.883$. The main effect of culture of expresser was significant, $b = 1.70$, $CI_{95} (0.97, 2.44)$, $t (2486.89) = 4.54$, $p < 0.001$, and it was qualified by the two-way interaction effect of culture of expresser and smile intensity, $b = -0.98$, $CI_{95} (-1.71, -0.24)$, $t (2486.89) = -2.61$, $p = 0.009$ (see Fig. 2 for interactions). Post-hoc comparisons showed that low-intensity smiles displayed by Chinese models were judged as more negative than low-intensity smiles displayed by Dutch models, but there was no difference for high-intensity smiles (see Table 2 for means and standard deviations). In sum, the expected cultural difference on perceived negativity was found for expressers with low-intensity smiles, but not for perceivers.

Perceived authenticity

As expected, high-intensity smiles were judged as more authentic than low-intensity smiles, $b = 2.62$, $CI_{95} (1.73, 3.52)$, $t (2486.63) = 5.77$, $p < 0.001$. The main effect of culture of perceiver was significant, $b = 2.26$, $CI_{95} (0.44, 4.08)$, $t (165.88) = 2.43$, $p = 0.016$, further qualified by the two-way interaction of culture of perceiver and smile intensity, $b = 3.24$, $CI_{95} (2.35, 4.13)$, $t (2486.63) = 7.12$, $p < 0.001$ (see

Fig. 1 for interactions). Contrary to our predictions, Chinese participants judged high-intensity smiles as more authentic than Dutch participants, but no difference was found for low-intensity smiles (see Table 1 for means and standard deviations). The main effect of culture of expresser was also significant, $b = -1.50$, $CI_{95} (-2.39, -0.61)$, $t(2486.63) = -3.29$, $p = 0.001$, and it was further qualified by the two-way interaction of culture of expresser and smile intensity, $b = -1.65$, $CI_{95} (-2.54, -0.76)$, $t(2486.63) = -3.63$, $p < 0.001$ (see Fig. 2 for interactions). Results showed that high-intensity smiles displayed by Dutch models were judged as more authentic than high-intensity smiles displayed by Chinese models, but no difference emerged for low-intensity smiles (see Table 2 for means and standard deviations). In sum, the expected cultural difference on perceived authenticity was found for expressers with high-intensity smiles, but not for perceivers.

Perceived politeness

As expected, low-intensity smiles were judged as more polite than high-intensity smiles, $b = -3.28$, $CI_{95} (-4.19, -2.37)$, $t(2486.83) = -7.06$, $p < 0.001$. The main effect of culture of perceiver was significant, $b = 2.03$, $CI_{95} (0.27, 3.80)$, $t(165.51) = 2.26$, $p = 0.025$, qualified by the two-way interaction of culture of perceiver and smile intensity, $b = -1.23$, $CI_{95} (-2.14, -0.32)$, $t(2486.83) = -2.64$, $p = 0.008$ (see Fig. 1 for interactions). Post-hoc comparisons showed that Chinese participants judged low-intensity smiles as more polite than Dutch participants, but we found no difference for high-intensity smiles (see Table 1 for means and standard deviations). The main effect of culture of expresser was significant, $b = 1.18$, $CI_{95} (0.27, 2.09)$, $t(2486.83) = 2.53$, $p = 0.011$, and it did not interact with smile intensity, $b = 0.76$, $CI_{95} (-0.15, 1.67)$, $t(2486.83) = 1.64$, $p = 0.102$. Chinese smiles were judged as more polite than Dutch smiles (see Table 2 for means and standard deviations). In sum, the expected cultural difference on perceived politeness was found for expressers with both smile intensities, but for perceivers viewing low-intensity smiles only.

In sum, Experiment 2 tested the perception of minimal-context smiles (i.e., smiles mapped to neutral daily-life situations) across cultures. Replicating Experiment 1, high-intensity smiles were perceived

as more positive and authentic, and as less negative and polite than low-intensity smiles. We again found that Dutch smiles were judged as more positive and authentic, and as less negative and polite than Chinese smiles. However, consistent with Experiment 1, the low-intensity smiles of Chinese and Dutch expressers were not judged differently on authenticity. Furthermore, Experiment 2 revealed that the high-intensity smiles of Chinese and Dutch expressers were judged similarly on negativity. Cultural differences pertaining to perceivers were again scattered: Dutch participants judged smiles as more positive than Chinese participants, whereas Chinese participants rated low-intensity smiles as more polite than Dutch participants. Contrary to what we predicted, Chinese participants again rated high-intensity smiles as more authentic than Dutch participants. No other cultural differences regarding perceivers were found.

General discussion

In two experiments we examined Chinese and Dutch perceivers' interpretations of low- and high-intensity smiles depicted by expressers from both cultures. Isolated smiles were used in Experiment 1, and minimal-context smiles in Experiment 2. We consistently found that high-intensity smiles were interpreted as more positive and authentic, and as less negative and polite than low-intensity smiles. Regarding the effect of culture of expresser, largely consistent with our hypotheses, Dutch smiles were perceived as more positive and authentic, and as less negative and polite than Chinese smiles. There was one non-significant difference occurring in both experiments, namely that the low-intensity smiles of Chinese and Dutch expressers were rated similarly on authenticity. In contrast to the generally consistent effect of expresser culture, we only found effects of perceiver culture on perceived positivity of smiles (but not on high-intensity smiles in Experiment 1) and perceived politeness of low-intensity smiles. Contrary to what we predicted, Chinese participants perceived high-intensity smiles as more authentic than Dutch participants. No other cultural differences were found relating to perceiver cultures. We discuss these findings in turn.

Theoretical implications and contributions

We consistently found a main effect of *expresser culture* on smile perception. Dutch smiles were seen as reflecting more positive affect and authenticity, whereas Chinese smiles were seen as reflecting more negative affect and politeness. Importantly, the Chinese and Dutch facial expression stimuli employed in the present research were both produced using instructions based on how the expressers should move their faces (using the FACS protocol), ensuring that they were matched in terms of the activated facial AUs. The Chinese and Dutch stimuli were also matched for perceived intensity, as judged by a cross-cultural sample. These precautions rule out the possibility that the effect of culture of expresser was caused by the differences in activated facial muscles or expression intensities between the two groups of stimuli (Chinese and Dutch). Our findings thus support that the cultural background of expressers influences how their smiles are interpreted by others.

These findings align with previous research implying that expressions of, for example, anger, shown by people with a northern accent are perceived as indicating a more intense emotional state than expressions of anger shown by people with a southern accent (Kirouac and Hess 1999). This is because many people hold the stereotype that Northerners are less emotional than Southerners across multiple countries (Pennebaker et al. 1996). People's conceptual knowledge and stereotypes about emotions may be especially important for interpretations of facial expressions whose meaning is ambiguous, such as smiles (Halberstadt and Niedenthal 2001; Hess et al. 2002). Such stereotypes may be automatically activated in both Easterners and Westerners in encounter with members of a social category are encountered (Bargh et al. 1996; Devine 1989). Thus, participants in the current research may have relied on automatically-activated conceptual emotion knowledge about the cultural group of the expresser when interpreting other's smiles. We propose that the reason smiles shown by Westerners are interpreted as indicating more positive affect and authenticity and less negative affect and politeness than smiles shown by Easterners is the conceptual knowledge, held by both Easterners and Westerners, that Easterners' smiles may not reflect true happiness, whereas Westerners more often smile out of pleasure (Lai and Linden 1993).

In contrast, the effect of perceiver culture on smile interpretation was inconsistent. Specifically, Dutch participants perceived smiles as more positive than Chinese participants (except high-intensity smiles in Experiment 1), but they did not differ on perceived negativity of smiles. Chinese participants perceived low-intensity smiles as more polite than Dutch participants, but they did not differ on perceived politeness of high-intensity smiles or perceived authenticity of low-intensity smiles. Contrary to what we predicted, Chinese participants even perceived high-intensity smiles as more authentic than Dutch participants. This mixed pattern of results indicates that perceiver culture did not play a consistent role in smile interpretation, with the majority of effects of perceiver culture being nonsignificant or even opposite to what we expected.

This seems to contradict to common notions that Easterners and Westerners differ in their norms about smiles (Ekman 1972; Sun 2010; Matsumoto 1990). A study by Tsai et al. (2002), however, yielded evidence consistent with our findings. Examining facial behaviors during relived emotion episodes, European Americans and Hmong Americans showed more cultural similarities than differences. For smiling in particular, no differences were found in the frequencies of non-Duchenne smiles during pride or love, or in the occurrence of Duchenne smiles during happiness. The only significant difference was found in the occurrence of non-Duchenne smiles during happiness, with European Americans producing more non-Duchenne smiles than Hmong Americans. This result suggests that norms about smiles may not necessarily have a direct impact on how people actually express smiles across contexts in daily life. Notably, this is different from the finding that American and Chinese leaders differ in how they smile in their official photos (Tsai et al. 2016), which likely reflects ideal affect of the culture rather than actual smiling behavior in daily life in that culture. In our research, we directly compared perceived positivity, negativity, authenticity, and politeness of smiles between Easterners and Westerners. The non-significant effects of perceiver culture in most cases suggest that norms about smiles play only a weak role in how people perceive smiles.

Across two studies, high-intensity smiles were consistently interpreted as expressing more positive and less negative affect than low-intensity smiles. This finding complements previous research showing that

smile intensity is linked with expresser's own emotional experiences, such that high-intensity smiles are more likely to be produced during high levels of felt positive affect (Hess et al. 1995; but see Kraut and Johnston 1979). Together, this suggests that expression intensity can be a reliable indicator of expressers' emotional experiences that perceivers are sensitive to.

We also found a link between smile intensity and the perceived authenticity and politeness of smiles. Specifically, high-intensity smiles were judged as more authentic and less likely to reflect politeness than were low-intensity smiles. The fact that this occurred across both cultural groups may seem to contradict to recent findings showing that Chinese value low-arousal positive states over high-arousal positive states to a greater degree than European Americans (Park et al. 2016; Tsai et al. 2016). However, the valuation for affect was assessed in those studies by participants rating "how often you would ideally like to have that feeling over the course of a typical week" for a series of emotional states (ideal affect). Additionally, participants were asked to rate "how often you actually have that feeling over the course of a typical week" for the same emotional states (actual affect). The results showed that Chinese and European Americans differed in their ideal affect (i.e., valuations) but not in their actual affect regarding different positive states. This suggests that how people ideally want to feel may not influence how people actually feel. In the present research, we examined perceptions of actual smiles, and no systematic differences were found between Chinese and Dutch perceivers. This finding suggests that how people ideally want to feel for different positive states may not necessarily relate to how people perceive expressions of these positive states in others.

On the other hand, valuation for different kinds of smiles may not map onto how authentic or polite those smiles are perceived to be in a straightforward fashion. Westerners tend to respond more favorably to authentic rather than inauthentic emotions (Côté et al. 2013), but this may not be the case for Easterners. In Eastern cultures, suppressing emotional expressions in order to follow social norms is more appreciated than expressing authentic feelings (e.g., Masuda et al. 2008). As a result, despite Chinese participants perceiving high-intensity smiles as more authentic than low-intensity smiles, they may still *value* low-intensity smiles over high-intensity smiles.

Overall, these findings indicate that the expression's characteristics—the cultural background of the smiling person and the intensity of the smile—provide reliable cues that guide perceivers' interpretations of smiles. Regarding expresser culture, for instance, smiles shown by Chinese people are more likely to be interpreted as them being polite compared to smiles shown by Dutch people. Regarding expression intensity, a high-intensity smile is perceived as indicating a stronger positive emotional state than a low-intensity smile. In contrast, perceivers across cultures seem to interpret smiles in largely similar ways. Thus, our data suggests that, compared to perceiver characteristics, characteristics of the expressions play a stronger and more reliable role in shaping how people interpret smiles.

We found no consistent evidence that the effects of culture were more pronounced for low-intensity smiles than for high-intensity smiles or vice versa. In Experiment 1, the difference between Chinese and Dutch perceivers' ratings of politeness was more pronounced for low-intensity smiles than for high-intensity smiles. However, the effect of culture on perceived authenticity was more pronounced for high-intensity than for low-intensity smiles. In Experiment 2, we again only found interactions of culture of perceiver/expresser and smile intensity on authenticity ratings, and the cultural difference was more pronounced for high-intensity than for low-intensity smiles. Thus we obtained no evidence of systematic moderating effects of smile intensity on the effects of culture on smile perception, and we can therefore not draw definitive conclusions regarding the interaction of these factors.

Limitations and future directions

Two limitations of the present study should be acknowledged. First, in order to establish a fundamental and generic effect of culture of perceiver/expresser on low- and high-intensity smile interpretation, the smiles in the current study were examined with no or minimal contextual information (isolated smiles in Experiment 1 and daily-life-context smiles in Experiment 2). This does not allow for conclusions about how perceivers make sense of others' smiles in real-life interactions across different social contexts. Beliefs about the causes of smiles as

well as knowledge about the expresser and the situation may also play a significant role in determining how perceivers interpret smiles. Such contextual information is likely integrated with the information provided by the expression itself to decipher the inherently ambiguous meaning of a smile. For instance, a recent study found that intense expressions of happiness were perceived by customers as less trustworthy than mild expressions of happiness in the context of a sales interaction (Cheshin et al. 2018). This suggests that the interpretation of smiles is shaped not only by culture and smile intensity, but also by the social context within which the smiles are shown (see also Glikson et al. 2018). Future research could attempt to establish whether these factors interact, and even greater ecological validity would be gained by examining smiles occurring in ongoing interactions.

Second, it is noteworthy that we used the Chinese stimuli as the standard instead of Dutch stimuli or counterbalancing when developing the current stimuli. This is because the intensities of the final states of dynamic Dutch smiles were always higher than the Chinese high-intensity smiles, and it was thus possible for participants to choose a Dutch stimulus matched to the corresponding Chinese stimulus in terms of intensity but not the other way around. Although we did not expect that any difference would occur based on whether Chinese or Dutch stimuli were used as the standard, a more rigorous control would be obtained if participants in future research can choose frames from Chinese dynamic facial expressions (once such stimuli are created) to match the Dutch stimuli. Relatedly, although we took great care to match Chinese and Dutch stimuli on crucial dimensions that may influence smile interpretation (gender, age, AUs, and intensity of AUs) other than the cultural background of the expresser, it is still possible that other factors (e.g., physiognomy, hair style and color) contributed to differences in smile interpretation. Although we see no theoretical basis for expectations about why and how such factors could have influenced the interpretation of smiles other than through suggesting different cultural backgrounds, this limitation could be addressed in future research by using avatars to manipulate specific facial features.

Conclusion

Ubiquitous as they may be, smiles are often ambiguous. Across two experiments, we demonstrated that perceivers use cues derived from the expression itself—the culture of the expresser and the intensity of the smile—to disambiguate the interpretation of affective (positivity and negativity) as well as social (authenticity and politeness) aspects of smiles. In contrast, we found no systematic evidence that the culture of the perceiver influences smile interpretation. Together, these studies suggest that features of the smile itself, more than characteristics of the perceiver, inform what we see when we see a smile.

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Data availability The datasets analysed for the current study can be found at <https://osf.io/utfw5/>.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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