Personality and Social Psychology Bulletin
1–19

DOI: 10.1177/0146167216651851
pspb.sagepub.com

Signal and Noise in the Perception of Facial Emotion Expressions: From Labs to Life

Ursula Hess[1], Konstantinos Kafetsios[2], Heidi Mauersberger[1], Christophe Blaison[1], and Carolin-Louisa Kessler[1]

Abstract

Human interactions are replete with emotional exchanges, and hence, the ability to decode others' emotional expressions is of great importance. The present research distinguishes between the emotional signal (the intended emotion) and noise (perception of secondary emotions) in social emotion perception and investigates whether these predict the quality of social interactions. In three studies, participants completed laboratory-based assessments of emotion recognition ability and later reported their perceptions of naturally occurring social interactions. Overall, noise perception in the recognition task was associated with perceiving more negative emotions in others and perceiving interactions more negatively. Conversely, signal perception of facial emotion expressions was associated with higher quality in social interactions. These effects were moderated by relationship closeness in Greece but not in Germany. These findings suggest that emotion recognition as assessed in the laboratory is a valid predictor of social interaction quality. Thus, emotion recognition generalizes from the laboratory to everyday life.

Keywords

emotion perception, social perception, social interaction, diary study, culture

Received May 7, 2014; revision accepted May 5, 2016

In everyday life, we are surrounded by people who experience and express emotions. May this be the angry disappointment of someone who misses his or her bus, the friendly smile of the shopkeeper who recognizes a frequent customer, or the fearful expression of someone seeing a large dog approach, we are constantly required to understand and appropriately react to these signals, when directed at us, or as in the examples above, at others.

Being able to accurately assess other people's emotional expressions is crucial for the regulation of relationships and for social functioning more generally (Fischer & Manstead, 2008). Emotional expressions have developed to communicate information that allows perceivers to infer targets' intentions and to take appropriate action (Darwin, 1872/1965; Matsumoto, Keltner, Shiota, O'Sullivan, & Frank, 2008), and the expressive behavior of conspecifics is an important source of information regarding the expresser's internal state. This information may additionally be filtered through knowledge of display rules (see also Matsumoto & Ekman, 1989) and augmented by information about the context of the interaction (Barrett & Kensinger, 2010; Kirouac & Hess, 1999).

The accurate perception of emotion displays and emotional states helps to coordinate and facilitate interpersonal interaction and communication (Keltner & Haidt, 2001; Niedenthal & Brauer, 2012) and provides the necessary "affective glue" between individuals (Feldman, Philippot, & Custrini, 1991). Nevertheless, many times, people are inaccurate in their assessments of others' emotion expressions (and in turn of their emotional state), and this can have adverse consequences for social interactions (Elfenbein, Foo, White, Tan, & Aik, 2007).

In this context, it is important to reflect on the meaning of accuracy and inaccuracy for the perception of facial emotion expressions. Most research on emotion recognition ability has used standardized tests (i.e., the Japanese and Caucasian Brief Affect Recognition Test, Matsumoto et al., 2000; or parts of the Profile of Nonverbal Sensitivity, Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979), where participants decode a given expression by selecting from a list of labels

[1]Humboldt University of Berlin, Germany
[2]University of Crete, Rethymnon, Greece

Corresponding Author:
Ursula Hess, Department of Psychology, Humboldt University of Berlin, Rudower Chaussee 18, 12489 Berlin, Germany.
Email: Ursula.Hess@hu-berlin.de

the focal emotion, that is, the emotion label that best describes a given facial expression. In this case, an accurate judgment is one where the decoder chooses the intended emotion label and any other judgment is inaccurate. That is, any judgment is either completely accurate or completely inaccurate.

However, this approach does not truly reflect the full range of the emotion perception process as it occurs in everyday life. In fact, there is evidence that people often perceive emotions as mixed even when only a "pure" emotion prototype is shown (Russell & Fehr, 1987; Yrizarry, Matsumoto, & Wilson-Cohn, 1998). Thus, rather than perceiving an expression as only angry or only sad, people can perceive an emotion expression as *both* sad and angry to different degrees. To the degree that the expresser was indeed angry and not sad, the additionally perceived sadness would constitute a misperception. This misperception, when acted on, then can lead to misunderstandings in the interaction. In this case, the terms "accuracy" and "inaccuracy" are not mere flip sides of each other. Rather, a person can correctly infer the intended emotion displayed in the expression—the signal—but also at the same time inaccurately infer additional, secondary emotions that are not part of the emotional message—which are in fact noise.

This form of misperception may be due to the observer's personality, for example, individuals higher on insecure attachment tend to over-attribute negative affect to peoples' facial displays (Magai, Hunziker, Mesias, & Culver, 2000), or to the observer's beliefs about the emotionality of the expresser based on the observed behavior. For example, two boys fighting are perceived as less aggressive than two girls fighting, due to the beliefs about the emotionality of boys and girls (Condry & Ross, 1985).

The perception of noise due to personality traits but also a susceptibility to be influenced by situational cues that are irrelevant to the specific emotion decoding task should entrain a fairly stable cognitive bias, which affects everyday life social interactions. If noise perception is indeed stable, then it should also be evident in a suitable laboratory task.

We therefore propose a distinction between signal perception, the correct ratings of the focal emotion that corresponds to the expresser's state, and noise perception, the incorrect ratings of additional emotions that were not intended to be expressed. Obviously, it can be argued that if an observer assumes, and hence perceives, the presence of additional emotions for whatever reason, this judgment must not be ipso facto incorrect. It could be that the decoder uses personal knowledge to infer more than what can be seen (Kirouac & Hess, 1999). However, the focus of the present research was on the perceptual style that an observer brings to the emotion decoding process, not on the wider theory of mind processes that may be brought to bear in some contexts as well.

Few studies have separately assessed and distinguished these two facets of emotion perception (Zaki & Ochsner, 2011), and even fewer examined their respective consequences for the quality of social interactions. This relative lack of research on the role of signal and noise perception in the decoding of emotion expressions for social interactions is a curious oversight, and one that this research aims to redress. We predicted that signal and noise perception in facial emotion expression decoding has separate effects in face-to-face social interactions. The tendency to perceive noise should be associated with lower quality naturally occurring social interactions, whereas signal perception should be associated with higher quality social interactions.

Signal and Noise in Emotion Perception

Emotion perception is based on several sources of information (e.g., Hess & Hareli, 2015). These include at least the actual expression shown, the contextual characteristics of the encoding stimulus, and the decoders' social schemas. Emotion perception in real life rarely operates devoid of context (Barrett & Kensinger, 2010; Hess & Hareli, in press), yet, emotion perception research has typically used context-free facial expressions as stimuli. Interestingly, one of the most common situational aspects of everyday emotion expression—the presence of other people—has rarely been considered, and if, then with a cross-cultural focus (e.g., Masuda et al., 2008). Accordingly, the present study places expressers into the context of other people.

Noise is expected to be an issue in any complex situation where there are opportunities for the social perception of emotion. This is especially the case in naturally occurring social interactions where people are likely to exhibit subtle expressions that are open to different interpretations (Ekman, 2003). Signal and noise in emotion perception—contrary to the mislabeling of emotions in a forced choice task—do not necessarily result in a trade-off such that better signal perception automatically entrains less noise perception. In fact, the tendency to inaccurately perceive noise, that is, "secondary" emotions, is, arguably, theoretically independent of the accurate perception of the signal, that is, the target emotion (West & Kenny, 2011), and both can have independent meaningful implications for interpersonal interactions (Kenny & Acitelli, 2001). For example, a person who is low in signal perception (that is, a person who does not accurately perceive the target emotion) would tend to misperceive the other's emotional state by, for example, seeing sadness instead of anger and reacting accordingly, which would likely result in great irritation by the angry other (Crawford, Clippax, Onyx, Gault, & Benton, 1992). By contrast, a person who is high in both signal perception and noise perception would correctly perceive the anger but would also see it attenuated by one or more additional emotions, such as sadness or disgust. In this case, the reaction may only be slightly "off" and may not result in a corrective reaction by the interaction partner but rather in a somewhat strained and uncomfortable interaction.

From this view, the inaccuracy that leads to noise perception is not the mere opposite of accurate judgments of the signal. Rather biased noise perception and accurate signal perception can be thought of as two dimensions that can simultaneously exist and influence the emotion perception process (Kenny, 2011; West & Kenny, 2011). The recently suggested Truth and Bias model (West & Kenny, 2011), which considers issues of accuracy and bias, makes further points relevant to our research beyond disentangling truth and bias. According to this model, bias results from systematic factors that influence perception, which can be empirically tested, and both bias and truth have social functionality. Yet, empirical work that considers those aspects of emotion perception and especially their social function is scarce.

Signal and Noise in the Perception of Emotions in Social Interactions

In a recent review, Niedenthal and Brauer (2012) showed that facial expressions are an important regulator of social interactions in that they provide information not only on emotional states but also on the behavioral intentions of the expresser (see also Hareli & Hess, 2010). They conclude that "when perceived accurately, facial expressions generate appropriate social intentions in the perceiver" (p. 262). Indeed, evidence converges to suggest that accuracy in decoding facial emotion expressions is generally associated with self and others' ratings of *social functioning* (Hall, Andrzejewski, & Yopchick, 2009). Thus, individuals who are accurate in judging others' facial expressions, that is, individuals who correctly perceive the signal, also report higher satisfaction in close relationships on questionnaire measures of relationship satisfaction (Carton, Kessler, & Pape, 1999; see also Brackett, Warner, & Bosco, 2005; Noller, 1980). Furthermore, emotion decoding accuracy predicts job performance for professional groups for whom interpersonal interaction is key, including counselors, physicians, teachers, human service workers, and managers (Elfenbein et al., 2007).

However, most of the prior research on emotion perception and social functioning has relied on self-report measures of social functioning. This raises concerns about external validity. Common-method variance associated with the exclusive reliance on self-report questionnaires and the likelihood that participants lack awareness of the causes of their behavior (Nisbett & Wilson, 1977) may also distort findings. In fact, some studies of naturalistic social interaction have disproved findings about the interpersonal effects of constructs at the trait level (Ickes, Holloway, Stinson, & Hoodenpyle, 2006; Kafetsios & Nezlek, 2012; Pietromonaco & Barrett, 1997).

In sum, one of the basic functions of emotion expressions is the communication of emotional states to an observer who uses them to infer the emotional states (Buck, 1984; Darwin, 1872/1965) and behavioral intentions (Hareli & Hess, 2010) of the expresser and to consequently adopt appropriate behavioral intentions himself or herself (Niedenthal & Brauer, 2012). Hence, accurate emotional signal perception should typically entrain a more appropriate assessment of the emotional state of the other and thereby more adequate reactions to interactants' emotion expressions and related behaviors. By contrast, noise perception in the decoding of emotion displays should "muddle" the emotional inference and thereby result in imbalanced social interactions, which in turn reduce the quality of the ensuing interactions. We expect the perceptual processes that underlie signal and noise perception respectively to be relatively stable across domains.

However, as discussed above, noise perception need not be ipso facto "wrong"—in particular, there may be culturally shared tendencies toward perceiving additional emotions as well as the signal as hinted at by Masuda et al. (2008; see also Hareli, Kafetsios, & Hess, 2015). The "Faces" section of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT; Mayer, Salovey, Caruso, & Sitarenios, 2003) requires participants to affix an emotion label to relatively weak, ambiguous facial expressions; the resulting rating can then be consensus scored, that is, the individual rating is assessed with regard to its correspondence with a cultural consensus or norm. As such, this measure assesses to what degree participants' imputation of expressions onto almost neutral targets is shared rather than idiosyncratic. We therefore included the faces part of the MSCEIT as a control for a type of noise perception that can be considered typical for a given socio-cultural context rather than the idiosyncratic inaccuracy we have discussed above. This form of noise perception was not expected to have the same negative effect described above, precisely because it corresponds to a culturally normative perception.

In sum, we predicted that participants who correctly judge the intended emotion in a laboratory decoding task experience overall more satisfactory social interactions in everyday life. Conversely, individuals who have a higher tendency toward noise perception, that is, individuals who inaccurately perceive additional emotions besides the intended signal, experience overall less satisfactory everyday social interactions. Because of the validity issues mentioned above, we opted for a field assessment of everyday interactions rather than the more common retrospective summary self-reports of interaction quality.

Intimacy and Emotion Perception

To assess the quality of social interactions, participants reported on their significant daily interactions ranging from interactions with acquaintances to interactions with partners and family members. It can be expected that the influence of emotion perception accuracy varies across different types of relationships.

Emotion perception accuracy itself varies with the intimacy of the interaction such that higher accuracy for facial emotion expressions is observed within more intimate relational contexts (Ma-Kellams & Blascovich, 2012; Sternglanz

& Depaulo, 2004). Hence, it has been posited (Zaki, Bolger, & Ochsner, 2008) that emotion perception accuracy has a higher functionality for more intimate relationships as the result of the emotional properties and interpersonal dynamics of intimate situations. Namely, interpersonal situations with more intimate interaction partners also involve more emotion expression from interactants, hence affording more opportunity for emotion perception and the interpersonal outcomes of emotion perception accuracy and inaccuracy.

Therefore, we expected that intimacy with the interaction partner moderates the effects of signal and noise perception on interaction quality. This effect should be more pronounced in a collectivistic culture (such as Greece, Studies 1 and 2) than in a more individualistic culture (Germany, Study 3) as it has been recently suggested that interpersonal accuracy may be more effective in more intimate relationships in collectivistic cultures (Ma-Kellams & Blascovich, 2012).

Overview and Hypotheses

We assessed our hypotheses in three studies. We expected the tendency toward signal and noise perception to be relatively stable and therefore independent of any specifics of the stimulus material used. We therefore replicated our first study using different stimulus materials for the laboratory task and more focused questions to assess everyday social interactions in Studies 2 and 3. Furthermore, we replicated the basic findings across two cultures differing in levels of individualism and collectivism, showing pertinent overlap but also specific differences in line with the basic cultural differences between the countries. More specifically, we predicted the following:

Hypothesis 1: Signal perception in decoding facial emotion expressions will be positively associated with indices of positive social interaction quality.
Hypothesis 2: Noise perception will result in less balanced and more negative social interactions and is therefore associated with indices that reflect negative interaction quality. We do not expect the same effects for noise perception when measured via the MSCEIT. We did not have specific expectations as to whether signal or noise would generally be more influential.
Hypothesis 3: Interactions with more intimate interaction partners will be characterized by higher affective quality. Furthermore, we expected signal and noise perception in Greece to be more strongly related to social interaction quality indices in relationships of higher, in comparison with lower, intimacy. The same effect was not expected for a more individualistic country (Germany).

In terms of securing power, we followed suggestions regarding sample sizes at individual and social interaction levels for random coefficient models (Nezlek, 2011). We additionally estimated power based on an ordinary least square (OLS) power analysis calculator, according to which power for a small effect ($f^2 = .15$) with three predictors, $N = 98$, and alpha = .05 would be .90. In each study, we present the proportion of variance within persons (the converse of intraclass correlation [ICC]) as indicative of power for detecting cross-level interaction effects. Lower ICCs favor the power for social interaction direct effects, whereas higher ICCs favor the power for cross-level direct effects (Mathieu, Aguinis, Culpepper, & Chen, 2012).

Study 1

Study 1 was conducted in Greece, a culture relatively higher in collectivism. We first assessed emotion decoding ability in terms of signal and noise perception in a laboratory task. In a second phase, we conducted a diary study to access facets of social interaction that have been found to be important determinants of social interaction quality: (a) own positive and negative affect (e.g., Kafetsios & Nezlek, 2012; Nezlek, Kafetsios, & Smith, 2008), (b) perception of interaction partner's positive and negative emotions and attending to others' emotions (e.g., Kafetsios & Nezlek, 2002; Laurenceau, Barrett, & Pietromonaco, 1998), (c) emotion suppression (Butler et al., 2003; Lopes, Salovey, Côté, & Beers, 2005), and (d) overall subjective satisfaction with the encounter.

Method

Participants. Thirty-seven men and 128 women with a mean age of 24 years ($SD = 6$) from a large state University in Southern Greece participated individually for extra course credit. A further 49 participants took part in the laboratory study, but returned their diary incompletely or not at all.

Procedure. On arrival at the laboratory, participants were informed about the general procedure of the study and that anonymity was guaranteed. After providing informed consent, they completed the individual difference measures, followed by the emotion perception test. They were then briefed on the use of the diary. They kept the diary for 7 days and returned it to the laboratory.

Emotion perception task—ACE-cartoons. Emotion recognition was assessed using the Assessment of Contextualized Emotions–Cartoons (ACE-cartoons), which followed the approach by Masuda et al. (2008) who utilized cartoons showing facial expressions within groups. In Study 1, we used cartoons to assure the presence of highly standardized "pure" emotions. The use of "pure" emotions makes it easy to meaningfully define the signal, but, as mentioned above, such pure expressions are rare in nature. As in Masuda et al. (2008), the central character's facial expression was either congruent or incongruent with the expressions shown by the surrounding group. All possible combinations between the three emotions and neutral were included.

Figure 1. Example stimuli from the ACE-cartoons.
Note. ACE-cartoons = Assessment of Contextualized Emotions–Cartoons.

The group was shown either facing the central character or facing the observer. This resulted in a total of 4 (target emotion expression: happiness, sadness, anger, neutral) × 4 (group emotion expression: happiness, sadness, anger, neutral) × 2 (group orientation) = 32 stimuli. Figure 1 shows an example for congruent anger for the two types of group orientation. No difference emerged as a function of group orientation, and the following analyses are based on the combined data.

Stimulus presentation. Participants rated the central character's emotion expressions on each of the following 7-point scales anchored with *not at all* and *very much*: calm, fear, anger, surprise, disgust, sad, happy, and other. Signal perception was defined as the rating on the scale corresponding to the focal emotion shown by the central character (i.e., anger for a character showing an angry expression). The mean of the ratings on all other emotion scales (representing emotions not shown by the central character) represented the level of perceived noise. The ACE-cartoons contains three focal emotion expressions for the central character: happiness, anger, and sadness; hence, three signal measures (for happiness, sadness, and anger) and three measures of noise (for happy targets, sad targets, and angry targets) were computed. The three measures for signal perception as well as the three measures for noise perception correlated substantially and were combined into one signal ($\alpha = .63$) and one noise scale ($\alpha = .83$), respectively.

Event sampling (social interaction diary) task. Participants were instructed to use a Social Interaction Record (see Nezlek et al., 2008) to describe for 7 days every meaningful social interaction they had that lasted 10 min or longer. A meaningful interaction was defined as any encounter in which the participant and their interaction partner attended to one another and adjusted their behavior in response to one another. They were instructed to complete the forms as soon as possible following the interaction. For each interaction, participants reported their relationship with the other person(s) on a 6-point scale reflecting ordinal-scaled levels of intimacy with the interaction partner, ranging from acquaintance to family member. Our rationale followed Reis, Clark, and Holmes's (2004) proposal that different types of relationships in a person's social network can be arranged into a hierarchy of perceived intimacy depending on rules of perceived intimacy associated with each relationship type. In total, participants described 2,589 interactions with acquaintances (16.6%), friends (17.7%), good friends (16.1%), best friends (19.3%), and partners (13.8%) as well as family members (16.5%; M = 2.29, SD = 1.18 per day). They then described their own emotions and their perception of the emotions of the interaction partner on 7-point scales (see below), anchored with 1 = *not at all* and 7 = *very much*. Analyses were based on 2104 interactions, excluding interactions with more than three persons (group interactions).

Own emotional reactions. Participants described their own positive (happy, enthusiastic, interested, elated, calm, relaxed, satisfied, secure, $\alpha = .80$) and negative (angry, stressed, nervous, sad, bored, tired, rejected, ashamed, $\alpha = .67$) affect during the social interaction, their general satisfaction with the interaction, and the degree to which they avoided showing their own emotions.

The interaction partner's reactions. Participants reported their perception of the degree to which their interaction partner showed positive and negative emotions. They further described the degree to which they attended to the interaction partner's emotions and were satisfied with the interaction as a whole.

Individual difference measures. The present research adopts a correlational design, which relates perceptions of facial emotion expressions tested at Time 1 to interpersonal events in the following week. This design protects from reverse causality, but still allows for third variables to mediate the observed effects. We therefore included a number of such

Table 1. Mean Signal and Noise Ratings as a Function of ACE Emotion Expression.

	Study 1		Study 2		Study 3	
	Signal	Noise	Signal	Noise	Signal	Noise
Happiness	6.17 (.86)	1.68 (.38)	6.33 (.80)	1.88 (.43)	6.03 (.70)	1.95 (.24)
Anger	6.26 (.68)	2.23 (.73)	4.45 (1.03)	2.63 (.76)	4.74 (.83)	2.43 (.59)
Sadness	5.67 (.72)	2.00 (.65)	5.10 (.95)	2.38 (.43)	4.36 (.99)	2.48 (.54)
Disgust			5.94 (.89)	2.29 (.69)	5.25 (.92)	2.39 (.54)

Note. ACE = Assessment of Contextualized Emotions.

potential variables as statistical controls. In particular, participants completed the *Brief Fear of Negative Evaluation Scale* (BFNE; Leary, 1983) and the *Experiences in Close Relationships Scale–Revised*, a global attachment scale (G-ECR-R; Tsagarakis, Kafetsios, & Stalikas, 2007) that assesses avoidant and anxious attachment orientations. The *Positive and Negative Affect Scale* (Watson, Clark, & Tellegen, 1988) was completed at the end of four different days. Extraversion and emotional stability were measured with a short version of the Big Five Inventory, the Ten Item Personality Measure (*TIPI*), which has high test–retest reliability and good validity (Gosling, Rentfrow, & Swann, 2003).[1] Furthermore, participants completed the "Faces" section of the MSCEIT (Mayer et al., 2003; 20 items, α = .82).

Faces section of the MSCEIT. In this section of the MSCEIT, participants report on the emotional content of each subtly emotional face by rating the degree of happiness, fear, surprise, disgust, and excitement on a 5-point scale (1 = *no emotion* and 5 = *extreme amount of emotion*). Ratings were consensus scored using an available large culture-specific Greek database.

Results

Manipulation check. Table 1, first panel, shows the mean ratings for signal and noise perception for each of the three types of emotional expressions across all presentation conditions. For all three expressions, the emotion corresponding to the focal expression (signal) was rated with higher intensity than the secondary emotions (noise), showing that although participants recognized the expressions as intended, they perceived, to a lesser degree, other—secondary—emotions as well.

Relationships between ACE signal and noise perception and social interaction quality (Hypotheses 1 and 2). We calculated two-level random coefficient models in which social interactions were the Level 1 units of analysis, and individuals were the Level 2 units. The top panel of Table 2 presents descriptive statistics from unconditional models: the means, the within-subject (the social interaction–level), and between-subject (person-level) variances of the outcome variables. Inspection of the means suggests that overall, and in line with previous research (e.g., Nezlek et al., 2008), participants reported experiencing positive emotions rather than negative emotions during the interactions.

To assess the influence of signal (H1) and noise (H2) perception on the social interaction quality indices, we used the following model that also included level of intimacy with the interaction partner as a moderator (H3). Level of intimacy was centered on each participant's average degree of intimacy across his or her social interactions, and signal and noise were grand mean centered.

Level 1:

$$y_{ij} = \beta_{0j} + \beta_{1j}\left(\text{Intimacy}\right) + r_{ij}.$$

Level 2:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\left(\text{Signal}\right) + \gamma_{02}\left(\text{Noise}\right) + u_{0j}.$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}\left(\text{Signal}\right) + \gamma_{12}\left(\text{Noise}\right) + u_{1j}. \quad (1)$$

The results from the conditional models (that include predictors at L1 and L2) are presented in the middle and bottom panels of Table 2. The γ_{00}, γ_{01}, and γ_{02} coefficients describe what can be considered main effects. Across all levels of intimacy, ACE noise was significantly related to perceiving the interaction partner as showing more negative emotions and reporting more negative emotions themselves, thereby supporting Hypothesis 2. Noise perception was positively related not only to self-reported negative affect but also to self-reported positive affect, suggesting that participants who have this tendency may approach social interactions in a more volatile emotional frame and hence may tend to feel generally more intense emotions, depending on the specifics of the interactions. There was no evidence that signal perception was associated with interaction quality across all types of social interactions (Hypothesis 1).

The moderating effect of intimacy (Hypothesis 3). To test the moderating effect of intimacy with the interaction partner, the slopes from the Level 1 model were analyzed at Level 2 as a function of signal and noise perception scores. This analysis examines whether intimacy moderates the relationship between perceived signal and noise and interaction quality.

Table 2. Results—Study 1.

	Own positive affect	Own negative affect	Satisfaction with the interaction	Avoided expressing emotions	Other positive emotions	Other negative emotions	Attending to others' emotions
Multilevel summary statistics							
M	4.52	1.98	5.13	2.83	5.41	2.11	5.37
Within-person variance	0.34	0.31	0.34	0.67	0.29	0.60	0.50
Between-person variance	0.90	0.62	2.11	2.80	1.76	1.81	1.57
Proportion of variance within persons (%)	73	66	86	81	86	75	76
Relationships between laboratory-measured signal and noise with social interaction–level outcomes taking into account level of intimacy							
Intercept β_{00}							
Intercept, γ_{00}	4.52*** (.05)	1.98*** (.045)	5.13*** (.06)	2.83*** (.08)	5.42*** (.05)	2.11*** (.07)	5.37*** (.06)
Signal, γ_{01}	.14 (.08)	.03 (.07)	.03 (.09)	.03 (.13)	.09 (.08)	.13 (.10)	.07 (.10)
Noise, γ_{02}	.19* (.09)	.40*** (.09)	−.02 (.13)	.23 (.14)	.02 (.10)	.40** (.13)	.19 (.12)
Intimacy slope							
Intimacy intercept, γ_{10}	.16*** (.02)	−.035* (.01)	.21*** (.03)	−.25*** (.03)	.15*** (.03)	−.07** (.03)	0.15*** (.03)
Signal, γ_{11}	.10** (.035)	−.04 (.025)	.095* (.045)	−.001 (.06)	.10* (.045)	−.09* (.04)	.09* (.04)
Noise, γ_{12}	−.01 (.04)	−.02 (.02)	−.04 (.06)	.21** (.06)	−.09 (.05)	−.02 (.05)	.01 (.05)

Note. Standard error is reported in the parentheses. Intimacy is a Level 1, within-subjects predictor. The multilevel summary statistics report results from unconditional models.
‡p = .08. *p < .05. **p < .01. ***p < .001.

The first line of the top panel of Table 2 (γ_{10} coefficients) presents the "main effect" of levels of intimacy. Higher levels of intimacy with the interaction partner were associated with a description of interaction partners as expressing more positive emotion, showing more attention to the other's emotions, and experiencing more own positive emotions during the interaction. For higher levels of intimacy, interaction partners were also described as expressing less negative affect and the participants reported experiencing less negative affect and less emotion suppression during the interaction. Thus, overall interactions with more intimately related interaction partners were described more positively in keeping with Hypothesis 3.

The lower two lines of the bottom panel of Table 2 (γ_{11}, γ_{12} coefficients) describe the moderation of ACE signal and noise respectively by intimacy level. This effect was significant for perceived positive and negative affect of the interaction partner, attending to the others' emotion, and self-reported positive affect. We calculated predicted slope values for observations (in our case, social interactions) that are ±1 *SD* on the measures that interact.

As expected, in more intimate as opposed to more casual relationships, better signal perception was associated with perceiving the interaction partner as expressing more positive affect (predicted value +1 *SD* = .25 vs. −1 *SD* = .05) and less negative affect (predicted value +1 *SD* = .02 vs. −1 *SD* = −.16). Signal perception was further associated with attending more to the interaction partner's emotions (predicted value +1 *SD* = .24 vs. −1 *SD* = .06) and higher self-reported positive affect (predicted value +1 *SD* = .26 vs. −1 *SD* = .06) as well as reporting to be overall more satisfied with the interaction (predicted value +1 *SD* = .305 vs. −1 *SD* = .115). By contrast, more noise perception in more intimate relationships was associated with avoiding expressing emotion (predicted value +1 *SD* = −.04 vs. −1 *SD* = −.46). These interactions are illustrated in Figure 2, which depicts simple slopes as a function of intimacy for all significant interactions.[2]

Overall, the tendency to perceive noise was associated with a more negative self-reported interaction experience in social interactions in general, whereas more accurate signal perception resulted in more positive self-reported interaction experiences in intimate relationships. Thus, signal and noise had separate effects on different dependent variables.

Relationships between the "Faces" section of the MSCEIT and social interaction quality. We first assessed the zero-order correlation between the ACE and the MSCEIT. ACE noise was inversely related to MSCEIT faces perception scores (r = −.44, $p < .01$), and ACE signal was unrelated to the MSCEIT scores. This confirms the notion that the MSCEIT measures socially shared biases related to, but not congruent with, the noise perception measured by the ACE noise score. In the next step, we entered the MSCEIT together with ACE signal and noise scores into all the analyses reported above. Again as expected, in none of the analyses was MSCEIT emotion perception accuracy a significant predictor of social interaction outcomes (see Online Appendix Table 1a).

Individual-level correlates of signal and noise. Signal perception was not correlated with any of the measured control variables. Noise perception correlated weakly positively with negative affect after 4 days and weakly negatively with extraversion. To control for the possible influence of individual differences known to be associated with the outcome variables, we examined multilevel models with these variables as person-level predictors in a multilevel model that also included levels of intimacy at the first level. Although most individual difference variables tended to influence one or the other outcome variables in expected ways, none of these potential moderating variables had a consistent effect on either the perception of the interaction or the participants' self-reported emotion during the interaction. Importantly, ACE signal and noise effects remained significant in all cases (see Online Appendix Tables 1b-1e).

Discussion

The findings support the prediction that signal and noise perception as measured in the laboratory predict distinguishable aspects of social interactions in everyday life. Specifically, whereas more noise perception was related to self-reports of more negative emotions in others and of a more negative interaction experience in social interactions across different levels of intimacy, better signal perception resulted in self-reports of more positive emotion in others and more positive interaction experiences, especially in more intimate relationships. Notably, only idiosyncratic but not socially shared noise perception was found to be negatively related to the overall self-reported quality of social interactions. As predicted for a collectivistic culture, emotion perception effects on social interactions were moderated by the intimacy of the relationship with the interaction partner, such that signal perception was more effective in more intimate relationships (Ma-Kellams & Blascovich, 2012).

This is one of the first studies that brings forward evidence for social interaction–level associations with the perception of signal and noise in facial emotion expressions. The present study clearly suggests that emotion decoding has different facets, which differently predict perceptive, affective, and behavioral aspects of social interaction.

However, although the findings from Study 1 are strong and persuasive, there are some limitations. First, to increase control, we used cartoons for the emotion perception task. However, the findings from Study 1 showed that the ACE-cartoons test was unnecessarily complex. Specifically, we did not find significant and consistent differential effects for faces shown in different group facial orientations nor for congruent versus incongruent expressions. Hence, a simpler set of stimuli could be constructed with one type of head

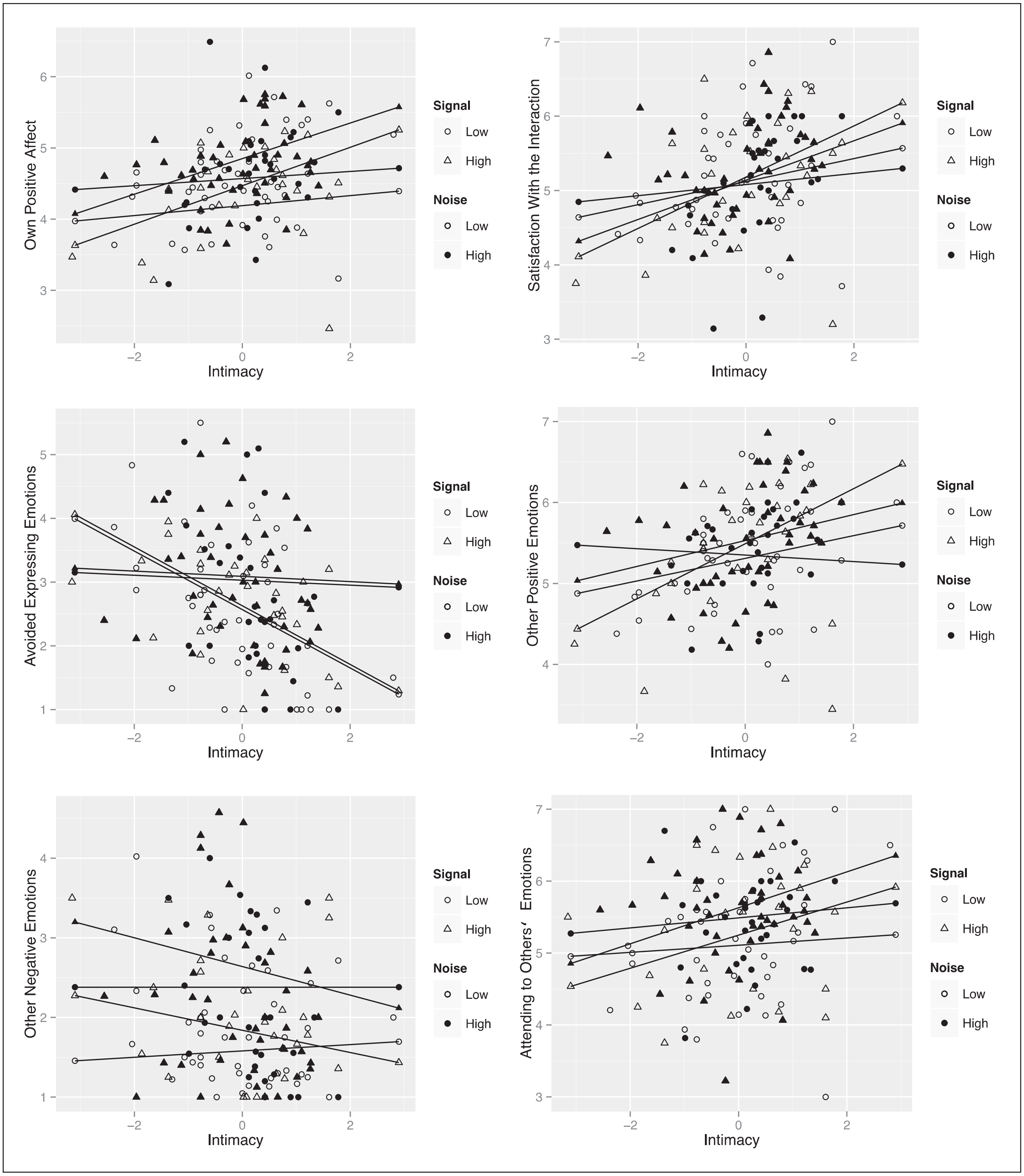

Figure 2. Interaction effects—Study 1.

orientation where either all actors show the same emotion or only the central person shows an emotion and the others show a neutral expression. This was done in Study 2. Furthermore, we predicted and found that the majority of effects of signal perception were moderated by intimacy with the interaction partner because Greece is a collectivistic culture. The corollary of this assumption is that in a less collectivistic culture, we would find main effects of signal and noise perception independent of intimacy levels. This assumption was tested in Study 3, which completely replicated Study 2, but was conducted in Germany (a less collectivistic culture).

Study 2

Study 2 was carried out to replicate and extend findings from Study 1. We tested the same three Hypotheses and used the same overall method and procedure as in Study 1 but with a new set of facial expressive stimuli—the ACE-faces. In addition, we simplified the interaction record for the diary study and added questions tapping more specific aspects of interactions related to feeling understood and accepted by the interaction partner, which have been shown to affect quality of social interaction and well-being (Lun, Kesebir, & Oishi, 2008).

Method

Participants. Ninety-one participants (21 men, one gender unknown) were recruited from a large state University in Southern Greece and from the community using posters and small advertisements. University students participated for course credit, and the rest of the participants were given a book of their choice. The data from 19 participants were excluded because they returned the diaries incomplete or not at all.[3] Age ranged from 18 to 49 years (M = 22.69, SD = 4.94), and the sample was balanced between students and the community.

Procedure. The procedure corresponds to the procedure of Study 1.

Emotion perception task—ACE-faces. To provide a more ecologically valid test of emotion recognition, we created a set of spontaneous facial expressions similar to those that occur during social encounters, using the relived emotion task, which has been shown to be an effective technique to elicit emotional expressions (e.g., Levenson, Carstensen, Friesen, & Ekman, 1991; Tsai, Chentsova-Dutton, Freire-Bebeau, & Przymus, 2002). For this, three people were arranged in an open semi-circle, and the central person in this group was instructed to remember a time when he or she had felt happiness, sadness, disgust, and anger and to then recount the events as vividly as possible to the other two. Apex expressions from these interactions were shown in randomized order to 26 raters who rated each picture on 7-point scales anchored with not at all and very much with regard to the degree that the central figure expressed calm, happiness, sadness, anger, surprise, fear, disgust, and other. Frequency distributions of the number of responses on the scale with the highest rating were computed for each photo. The photo was considered to be representative of the target emotion if at least 50% (chance accuracy = 12.5%) of the raters rated the expression highest on the target scale. All of our final stimuli passed that criterion. Figure 3 shows an example for male anger.

Figure 3. Example stimulus from the ACE-faces.
Note. ACE = Assessment of Contextualized Emotions.

Stimulus presentation. Participants rated the central person's emotion expressions on each of the following 7-point scales anchored with *not at all* and *very much*: calm, fear, anger, surprise, disgust, sad, and happy.[4] Signal and noise were calculated as for Study 1. The ACE-faces includes four emotion expressions for the central person—disgust, happiness, anger, and sadness—and three congruency levels—congruent (everyone shows the same emotion), non-congruent (only the central person shows an emotion), and alone. Thus, 12 signal and noise measures respectively were computed, three for each emotion. The 12 signal as well as the 12 noise measures correlated substantially and, as for Study 1, were collapsed into global signal (α = .88) and noise scores (α = .97), respectively.

Event sampling (social interaction diary) task. The same overall procedure was used for the diary task as in Study 1. The diary had three subsections.

Description of the interaction. For each social interaction, participants reported the length of the interaction, the sex of the other person, and their relationship status with the interaction partner. In total, participants described 1,128 interactions with acquaintances (17.5%), friends (19.1%), good friends (15.7%), best friends (19.8%), and partners (15.1%) as well as family members (12.4%; M = 2.13, SD = 1.15 per day). As in Study 1, we excluded interactions in which participants reported being in a group larger than three, basing our analyses on 1,057 interactions.

Own emotional reactions. Participants described on 7-point rating scales their general satisfaction with the interaction and rated the degree to which they felt understood, accepted, supported, and comfortable expressing their emotions. Furthermore, they reported their own negative and positive feelings during the interaction.

The interaction partner's reactions. Participants described on 7-point scales their perception of the degree to which their interaction partner showed positive and negative emotions and the extent to which they perceived the other person as expressive and well-intentioned.

Individual difference measures. As a control, we again used the consensus scored "Faces" section of the MSCEIT (Mayer et al., 2003; 20 items, α = .73). We further included the G-ECR-R (Tsagarakis et al., 2007) that assesses avoidant and anxious attachment orientations, the *Positive and Negative Affect Scale* (Watson et al., 1988), and extraversion and emotional stability measured with the Big Five Inventory short version (*BFI-10*; Rammstedt & John, 2007).[5]

Results

Manipulation check. Table 1, second panel, shows the mean signal and noise scores for each type of emotion expression across all presentation conditions. For all four expressions, the emotion corresponding to the focal expression was rated with higher intensity than the secondary emotions, showing that participants recognized the expressions as intended. However, as expected, they perceived, to a lesser degree, other—secondary—emotions as well. The levels of signal perception ($M = 5.56$, $SD = .76$) and noise perception ($M = 2.29$, $SD = .60$) were correlated, $r = .43$, $p < .001$.

Relationships between signal and noise perception and social interaction quality (Hypotheses 1 and 2). Data were analyzed using multilevel models in which social interactions were nested within individuals. Means, within-subject variances, and between-subject variances are presented in the top panel of Table 3. Like in Study 1, social interactions were overall perceived as positive rather than negative.

To assess the influence of signal (H1) and noise perception (H2) on the social interaction quality indices, we used the model described in Equation 1, which also includes level of intimacy with the interaction partner as a social interaction–level (within-subjects) moderator and signal and noise as grand mean centered between-subjects predictors (H3; see middle panel of Table 3).

Noise perception was significantly negatively related to both the self-reported positive feelings during the interaction and the perceived positive feelings of the interaction partner. Furthermore, noise was negatively associated with the degree to which participants reported feeling understood, accepted, supported, and overall satisfied with the interaction, and with the degree to which the other was perceived as open in their expression and expressing positive emotions. These findings again support Hypothesis 2. However, as in Study 1, there was no evidence in support of Hypothesis 1 (signal perception is associated with interaction quality across all types of social interactions).

The moderating effect of intimacy (Hypothesis 3). As in Study 1, signal and noise perception interacted with level of intimacy with the interaction partner and intimacy itself had an effect on interaction quality. Higher levels of intimacy with the interaction partner were associated with reporting to express more positive emotion and to perceive more positive emotion in the other, as well as with the degree to which participants reported feeling understood, accepted, supported, comfortable expressing their emotions, and overall satisfied with the interaction, as well as with the degree to which the other was perceived as well-intentioned and open in his or her expression. Thus, overall, interactions with more intimately related interaction partners were described more positively in keeping with Hypothesis 3.

The bottom part of Table 3 depicts relationships between signal and noise perception and social interaction quality as a function of the level of intimacy with the interaction partner. There were significant or nearly significant interactions between signal/noise and level of intimacy for self-reports of own negative affect, satisfaction, oneself openly expressing emotion, and perceiving the other as expressing emotions openly and being well-intentioned. To follow up on these effects, we calculated predicted slope values that are ±1 SD on the measures that interact. As expected, in more intimate as opposed to more casual relationships, better signal perception was associated with less self-reported negative affect (predicted value +1 $SD = -.20$ vs. −1 $SD = .18$) and with higher satisfaction with the interaction (predicted value +1 $SD = .24$ vs. −1 $SD = .02$), as well as with participants' self-reports of openly expressing their own emotions (predicted value +1 $SD = .53$ vs. −1 $SD = .13$), perceiving the other as expressing his or her emotions openly (predicted value +1 $SD = .43$ vs. −1 $SD = .25$) and being well-intentioned (predicted value +1 $SD = .28$ vs. −1 $SD = .02$). By contrast, and in addition to signal perception effects, more noise perception in more intimate relationships was associated with higher self-reported own negative affect (predicted value +1 $SD = .17$ vs. −1 $SD = -.19$). As in Study 1, these findings are in line with Hypothesis 3. Figure 4 depicts simple slopes as a function of intimacy for all significant interactions.[6]

Relationships between the "Faces" section of the MSCEIT and social interaction quality. ACE noise (but not signal) was negatively correlated to emotion perception accuracy as measured by the MSCEIT, $r(84) = -.50$, $p < .001$. As for Study 1, we entered the MSCEIT together with ACE signal and noise scores into all the analyses reported above. The MSCEIT did not have a main effect on interaction quality and did not affect the significant associations with signal perception; however, MSCEIT scores had a suppressor effect on main effect relationships between noise and the social interaction

Table 3. Results—Study 2.

	Own positive affect	Own negative affect	Satisfaction with the interaction	Felt understood	Openly expressed emotion	Felt accepted	Felt supported	Other expressed emotion openly	Other positive emotions	Other negative emotions	Other well-meant
Multilevel summary statistics											
M	5.31	2.18	5.28	5.27	5.30	5.55	5.14	5.22	5.34	1.93	5.61
Within-person variance	0.42	0.48	0.23	0.24	0.27	0.24	0.33	0.45	0.37	0.30	0.35
Between-person variance	1.44	1.63	1.56	1.43	1.82	1.19	1.77	1.70	1.55	1.44	1.12
Proportion of variance within persons (%)	77	86	87	85	87	83	84	79	85	83	76
Relationships between laboratory-measured signal and noise with social interaction–level outcomes taking into account level of intimacy											
Intercept β_{00}											
Intercept, γ_{00}	5.31*** (.09)	2.19*** (.10)	5.28*** (.07)	5.27*** (.07)	5.30*** (.08)	5.55*** (.07)	5.14*** (.09)	5.21*** (.09)	5.34*** (.09)	1.93*** (.08)	5.62*** (.08)
Signal, γ_{01}	−.02 (.14)	−.10 (.18)	.12 (.10)	.01 (.17)	.002 (.09)	−.02 (.09)	.04 (.11)	.18 (.11)	.07 (.10)	.17 (.10)	−.06 (.10)
Noise, γ_{02}	−.32† (.15)	.26 (.19)	−.26* (.11)	−.33* (.12)	−.23* (.14)	−.25** (.12)	−.25 (.14)	−.33* (.19)	−.33† (.17)	−.11 (.12)	−.27 (.16)
Intimacy slope											
Intimacy intercept, γ_{10}	.17*** (.04)	−.01 (.03)	.13* (.04)	.10* (.04)	.33*** (.04)	.17*** (.04)	.25*** (.04)	.34*** (.03)	.19*** (.04)	.04 (.03)	.15*** (.03)
Signal, γ_{11}	.02 (.05)	−.19** (.06)	.11† (.06)	.05 (.05)	.20** (.05)	.10 (.08)	.07 (.07)	.09* (.04)	.05 (.06)	−.07 (.05)	.13* (.05)
Noise, γ_{12}	−.05 (.09)	.18** (.06)	−.11 (.09)	−.07 (.09)	−.13 (.07)	−.12 (.10)	−.07 (.11)	−.10 (.05)	.02 (.08)	−.08 (.08)	−.14 (.08)

Note. Standard error is reported in the parentheses. Intimacy is a Level 1, within-subjects predictor. The multilevel summary statistics report results from unconditional models.
†$p = .05$. *$p < .05$. **$p < .01$. ***$p < .001$.

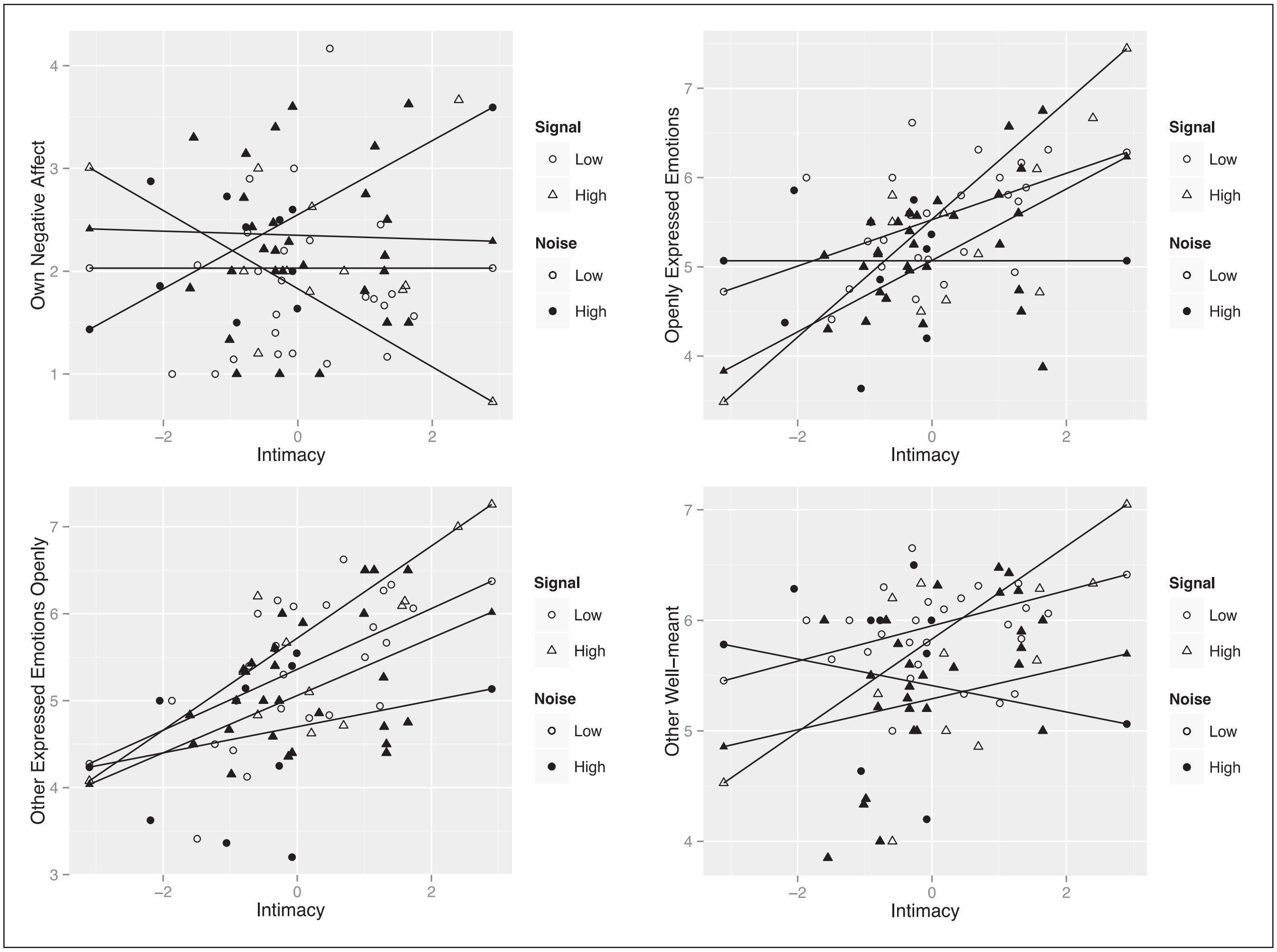

Figure 4. Interaction effects—Study 2.

outcomes (see Online Appendix Table 2a). This again confirms the notion that culturally shared noise perception does not have a negative effect on interaction quality and explains variance separate from idiosyncratic biases as assessed by the ACE noise.

Individual-level correlates of signal and noise. Signal and noise perception were unrelated to the big five, negative affect, or attachment orientations. Entering these variables in the multilevel models did not meaningfully affect the results of the above-reported analyses (see Online Appendix Tables 2b-2e).

Discussion

Study 2 was conducted using a more ecologically valid, simplified set of facial expressive stimuli for the laboratory assessment of facial expression recognition ability and a more focused set of questions on interaction quality for the diary task. Overall, the results closely replicated Study 1. We again found noise perception to be negatively related to self-reported interaction quality across all types of interactions. As in Study 1, we found the type of relationship to strongly determine interaction quality, such that intimate relationships were perceived as more satisfactory in all regards. Also as in Study 1, we found that relationship type interacted with signal and noise perception to predict interaction quality.

As in Study 1, signal and noise perception predicted different social interaction outcomes. Again, signal perception had a more pervasive effect in intimate relationships and noise perception a more pervasive effect across all relationships. This suggests that all types of interactions can be disrupted by emotional misunderstandings, but a high quality of understanding improves interactions specifically with close others, suggesting that emotional understanding is valued more when exhibited by someone who is close.

In sum, Study 2 adds further evidence to the notion that signal and noise perception in a laboratory task can predict perceptive, affective, and behavioral aspects of social interaction. In both Studies 1 and 2, we observed a strong effect of the type of relationship with the interaction partner as well as an interaction between relationship type and perception style. We had predicted this effect because Greece is a relatively collectivistic culture in which the closeness of relationships should play a more determining role than in an individualistic culture. We therefore conducted Study 3 in Germany, a more individualistic culture, to (a) replicate the basic effect that emotion perception style as measured in the laboratory predicts interaction quality, but expected that (b) this effect would not be moderated by relationship type.

Study 3

Study 3 used the identical method and procedure as Study 2, and data were collected over the same time period.

Method

Participants. One hundred twenty-two participants (30 men) were recruited from a large state university in Germany. A further 40 persons participated in the laboratory study, but did not return their diaries or had to be excluded due to equipment malfunction. Participants received a small gift (wellness products, chocolates, etc.) in recognition. Participant age ranged from 18 to 40 years ($M = 25.87$, $SD = 5.04$).

Emotion perception task—ACE-faces. The ACE-faces was used. Signal and noise scores were calculated as for Study 2.

Event sampling (social interaction diary) task. In total, participants described 3,724 interactions with acquaintances (23.1%), friends (17.5%), good friends (17.3%), best friends (9.8%), and partners (17.2%) as well as family members (15.1%; $M = 3.32$, $SD = 1.87$ per day). Again, we excluded interactions in which participants reported being in a group larger than three people, basing our analyses on 3,231 interactions.

Results and Discussion

Manipulation check. Table 1, third panel, shows the mean signal and noise scores for each type of emotion expression across all presentation conditions. For all four expressions, the emotion corresponding to the focal expression was rated with higher intensity than the secondary emotions, showing that participants recognized the expressions as intended. However, as expected, they perceived, to a lesser degree, other—secondary—emotions as well. Signal ($M = 5.09$, $SD = .64$) and noise ($M = 2.31$, $SD = .46$) scores were correlated, $r = .38$, $p < .001$.

Relationships between signal and noise perception and social interaction quality (Hypotheses 1 and 2). The data were analyzed in the same way as in Study 1. The means, and within-subject and between-subject variances are presented in the top panel of Table 4. We tested models that included level of intimacy with the interaction partner as a Level 1 predictor to test for associations between signal and noise perception and the social interaction variables as a function of varied degrees of intimacy. Like in the previous studies, more intimacy was generally associated with higher social interaction quality indicators. However, in this study in Germany, level of intimacy with the interaction partner did not moderate the relationship between signal and noise perception and social interaction outcomes (see Table 4 bottom panel).

Supporting Hypothesis 1, across all levels of intimacy (see Table 4 middle panel), signal perception was positively associated with indices of higher social interaction quality for all self-reported social interaction quality indices, except for reports of own positive affect, experiencing the interaction partner as expressing their emotions openly, and being expressive of positive affect. Furthermore, across all levels of intimacy, noise perception was negatively related to self-reports of higher interaction quality and positively related to indices of lower interaction quality, thereby supporting Hypothesis 2.

Relationships between the "Faces" section of the MSCEIT and social interaction quality. Only ACE noise was negatively correlated with emotion perception accuracy as measured by the MSCEIT, $r(122) = -.48$, $p < .001$. As for Studies 1 and 2, we entered the MSCEIT together with ACE signal and noise scores into all the analyses reported above. In none of the analyses was MSCEIT emotion perception accuracy a significant predictor of perceptions of the interaction partner's emotions or of own emotions during the social interaction. That is, it is the part of the variance in ACE noise that is not socially shared that accounts for its negative effects on social interactions (see Online Appendix Table 3a).

Individual-level correlates of signal and noise. Among the control variables, signal perception was negatively correlated with anxious attachment, $r(122) = -.18$, $p < .05$, and noise perception was significantly correlated with avoidant attachment, $r(122) = .26$, $p < .01$, and negative affect, $r(122) = .32$, $p < .001$, as well as inversely related to extraversion, $r(122) = -.18$, $p < .05$. No other significant correlations were found. Including positive or negative affect, the BFI, and avoidant attachment orientations together or the in separate analyses did not alter the above-reported findings significantly or meaningfully (see Online Appendix Tables 3b-3e).

General Discussion

The present research provides, to our knowledge, the first empirical evidence for the importance to consider the accurate perception of the emotional signal versus the inaccurate perception of secondary emotions (noise) as two potent, largely independent indices of the quality of social interactions both in the laboratory and in everyday life. Typically,

Table 4. Results—Study 3.

	Own positive affect	Own negative affect	Satisfaction with the interaction	Felt understood	Openly expressed emotions	Felt accepted	Felt supported	Other expressed emotion openly	Other positive emotions	Other negative emotions	Other well-meant
Multilevel summary statistics											
M	4.82	2.52	5.29	5.28	5.12	5.61	5.26	4.98	4.83	2.83	5.70
Within-person variance	0.57	0.77	0.71	0.76	0.91	0.88	0.76	0.38	0.54	0.68	0.73
Between-person variance	1.83	1.83	1.86	1.74	2.03	1.34	2.00	1.46	1.78	2.10	1.20
Proportion of variance within persons (%)	76	70	72	70	69	60	72	79	77	76	62
Relationships between laboratory-measured signal and noise with social interaction–level outcomes taking into account level of intimacy											
Intercept β_{00}											
Intercept, γ_{00}	4.83*** (.07)	2.52*** (.08)	5.29*** (.08)	5.29*** (.08)	5.13*** (.08)	5.62*** (.08)	5.26*** (.08)	4.98*** (.06)	4.83*** (.07)	2.84*** (.08)	5.71*** (.08)
Signal, γ_{01}	.22 (.13)	−.30* (.13)	.24† (.12)	.38** (.13)	.42** (.13)	.39** (.13)	.31* (.13)	.13 (.10)	.15 (.12)	−.22† (.13)	.33** (.13)
Noise, γ_{02}	−.52** (.17)	.75*** (.17)	−.74*** (.17)	−.75** (.19)	−.86*** (.19)	−.82*** (.20)	−.60** (.19)	−.33* (.15)	−.38* (.17)	.50** (.18)	−.60** (.19)
Intimacy slope											
Intercept, γ_{10}	.13*** (.02)	−.02 (.02)	.07** (.02)	.14*** (.02)	.32*** (.02)	.15*** (.02)	.19*** (.03)	.13*** (.02)	.08*** (.02)	.04 (.02)	.12*** (.02)
Signal, γ_{11}	.03 (.04)	−.02 (.04)	.03 (.04)	−.01 (.04)	.04 (.04)	.03 (.04)	.08 (.05)	−.07 (.04)	−.02 (.05)	−.06 (.04)	.04 (.04)
Noise, γ_{12}	−.08 (.05)	.04 (.05)	−.004 (.06)	.004 (.06)	−.05 (.06)	−.02 (.05)	−.08 (.06)	.006 (.05)	−.05 (.06)	.05 (.05)	−.06 (.05)

Note. Standard error is reported in the parentheses. Intimacy is a Level 1, within-subjects predictor. The multilevel summary statistics report results from unconditional models.
†$p = .05$. *$p < .05$. **$p < .01$. ***$p < .001$.

emotion perception research considers accuracy and inaccuracy as two sides of the same coin. Yet, research on mixed emotion (e.g., Russell & Fehr, 1987; Yrizarry et al., 1998) clearly suggests the possibility that the accurate perception of the emotional signal and the additional perception of noise are not mutually exclusive dimensions in emotion perception. The present studies show that they also have different correlates.

Specifically, across three studies and two cultures, signal and noise perceptions, as assessed in a laboratory emotion recognition task, were meaningfully associated with perceptions of daily social interactions reported in a diary during the days following the laboratory task. Overall, better signal perception was positively associated with indices of higher interaction quality and more noise perception was positively associated with indices of lower interaction quality as well as negatively associated with some indices of higher interaction quality.

Recently, the potential regulatory functions of emotion perception have been highlighted (Niedenthal & Brauer, 2012); yet the evidence base is thin. The present research shows that accurately perceiving other persons' emotions in facial expressions is associated with higher social interaction quality, whereas the inaccurate perception of secondary emotions (noise) is associated with lower quality of day to day social encounters. This general trend is moderated by culture. In the more collectivistic Greek culture, noise perception showed this effect across all types of relationships, but signal perception was a strong predictor only for intimate relationships. In the less collectivistic German culture, both signal and noise perception were independent predictors across all relationship types. Although the present research cannot provide a causal analysis (this remains a formidable task for future research), the results corroborate the notion that emotion perception can serve a regulatory function in daily interactions.

Importantly, the results from the three studies point to the advantage of assessing not only hit rates in emotion recognition but also the more subtle perceptive distortions, which may reflect a lack of attunement that can still grate on an interaction. Namely, as mentioned above, signal and noise perception predicted interaction quality at different levels in the two Greek samples.

This further suggests an important difference in interactions between the two cultures. Whereas in Greece the results reflect a situation where perceiving noise is always harmful to an interaction, but accurate signal perception only improves intimate ones, in Germany, it seems that both factors are equally important for all levels of intimacy. One way to look at this is to conclude that in Greece, interactions in intimate relationships have different standards of expectations for close as opposed to distant relationships. This seems not to be the case in Germany.

This observation may be related to the different meaning of relationship closeness in collectivistic versus individualistic cultures. Collectivistic cultures are characterized by lower relational mobility (Yuki & Schug, 2012), as many friendships are determined by the individual's social role, and family ties cannot be easily ignored. This may make it more important for the Greek participants to be alert to the emotional signals of their close relationship partners and create an environment where being accurate in detecting these signals becomes a basis for positive interactions with close others. Misunderstandings, however, are harmful to the quality of all interactions.

This argument, however, comes with a caveat. Low relationship mobility is also usually associated with a more ambiguous view of close others (e.g., Adams & Plaut, 2003). However, in the two Greek samples, interactions were systematically described more positively to the degree that they were closer. Yet, it should be noted that Greece, although clearly more collectivistic than Germany, is considerably less so than Ghana, which was studied by Adams and Plaut (2003). Thus, it may be that Greece strikes a fortunate middle ground in which close relationships are sufficiently stable to warrant investment in terms of emotional attention, but not so stable that they cannot be escaped when they become noxious. This is a question for future research.

In sum, both signal and noise perception as assessed in the laboratory task were related to self-reported indices of social interaction quality. This relationship was stronger than the relationship with individual difference measures and individual-level affect, which are less proximally related to emotion decoding ability. That is, the ability to decode the facial emotions of others is relatively specific and has specific interpersonal consequences, which are not tapped by more general measures related to behavior in social interactions, such as social anxiety, insecure attachment orientation, or positive or negative affectivity. Importantly, noise perception as assessed in this context cannot be considered to represent a complete misunderstanding of the emotion signal, but rather should be considered a tendency to perceive less clearly—or more noisily. Yet, this suggests that even subtle "defects" in emotion perception can have far-reaching effects on social interactions in everyday life.

Interestingly, we found that in all three studies, signal and noise account for variance not captured by the MSCEIT Perceiving Others' Emotion Branch. The MSCEIT places emphasis on the perception of relatively subtle expressions, less on the decoding of overt expressions in a social context. Moreover, there is evidence that the MSCEIT facial emotion perception section is more closely related to intrapersonal cognitive abilities (Farrelly & Austin, 2007) and hence may not assess the same proximal emotion decoding ability relevant for social interaction contexts as does our test. Importantly, because the MSCEIT may reflect culturally shared biases, our results suggest that the negative impact of perceiving more noise on interaction quality is not due to biases that are shared within one culture, but rather due to individual perceptive styles.

Conclusion

We found that signal and noise perception in the decoding of facial emotion expressions has different effects on the quality of naturally occurring social interactions. This pattern of results supports the usefulness of assessing signal and noise as separate processes. As such, the research contributes to an increasing zeitgeist on studying the social regulatory functions of emotion perception (Niedenthal & Brauer, 2012; Parkinson, 2011). The present data suggest that emotion perception ability is both specific—that is, it cannot be measured via other abilities or personality traits, and a generalized skill—that is, the same process that is used in the laboratory is also relevant for emotion perception in everyday life. The present research therefore underlines the predictive validity of laboratory tasks for our understanding of everyday interactions.

Acknowledgments

The authors thank D.Kokorikou, D. Makri, L. Karagiannopoulos, P. Grigorakaki, F.Lykomitrou, and I. Vergou, for help with data collection.

Authors' Note

Ursula Hess and Konstantinos Kafetsios initiated the study and design, analyzed data, interpreted data, and drafted the manuscript. Heidi Mauersberger and Carolin-Louisa Kessler developed stimulus materials and collected data. Christophe Blaison developed stimulus materials and supervised data collection. All authors provided comments and approved the manuscript.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The research was supported by a Basic Research Grant [KA 2756] to Dr. Kafetsios and Professor Hess by the University of Crete and Grant 50774769 from the PPP Program of the Idryma Kratikon Ypotrofion - Deutscher Akademischer Austauschdienst (IKY-DAAD) program to Kafetsios and Hess.

Notes

1. Participants completed additional questionnaires listed in the supplemental materials file.
2. Note that for ease of presentation, the means across interactions are shown in the graphs instead of the individual values on which the analyses were based.
3. Data collection ended prematurely due to upheaval related to political events in spring 2012.
4. Each presentation was interrupted 12 times with a short emotion contagion questionnaire.
5. Participants completed additional questionnaires listed in the supplemental materials file.
6. Note that for ease of presentation, the means across interactions are shown in the graphs instead of the individual values on which the analyses were based.

Supplemental Material

The online supplemental material is available at http://pspb.sagepub.com/supplemental

References

Adams, G., & Plaut, V. C. (2003). The cultural grounding of personal relationship: Friendship in North American and West African worlds. *Personal Relationships*, *10*, 333-347.

Barrett, L. F., & Kensinger, E. A. (2010). Context is routinely encoded during emotion perception. *Psychological Science*, *21*, 595-599.

Brackett, M. A., Warner, R. M., & Bosco, J. S. (2005). Emotional intelligence and relationship quality among couples. *Personal Relationships*, *12*, 197-212.

Buck, R. (1984). *The communication of emotion*. New York, NY: Guilford Press.

Butler, E. A., Egloff, B., Wlhelm, F. H., Smith, N. C., Erickson, E. A., & Gross, J. J. (2003). The social consequences of expressive suppression. *Emotion*, *3*, 48-67.

Carton, J., Kessler, E., & Pape, C. (1999). Nonverbal decoding skills and relationship well-being in adults. *Journal of Nonverbal Behavior*, *23*, 91-100.

Condry, J. C., & Ross, D. F. (1985). Sex and aggression: The influence of gender label on the perception of aggression in children. *Child Development*, *56*, 225-233.

Crawford, J., Clippax, S., Onyx, J., Gault, U., & Benton, P. (1992). *Emotion and gender: Constructing meaning from memory*. London, England: SAGE.

Darwin, C. (1965). *The expression of the emotions in man and animals*. Chicago, IL: The University of Chicago Press. (Original work published 1872)

Ekman, P. (2003). *Emotions revealed: Recognizing faces and feelings to improve communication and emotional life*. New York, NY: Times Books.

Elfenbein, H. A., Foo, M. D., White, J., Tan, H. H., & Aik, V. C. (2007). Reading your counterpart: The benefit of emotion recognition accuracy for effectiveness in negotiation. *Journal of Nonverbal Behavior*, *31*, 205-223.

Farrelly, D., & Austin, E. J. (2007). Ability EI as an intelligence? Associations of the MSCEIT with performance on emotion processing and social tasks and with cognitive ability. *Cognition and Emotion*, *21*, 1043-1063.

Feldman, R. S., Philippot, P., & Custrini, R. J. (1991). Social competence and nonverbal behavior. In R. S. Feldman & B. Rime (Eds.), *Fundamentals of nonverbal behavior* (pp. 319-350). New York, NY: Cambridge University Press.

Fischer, A., & Manstead, A. S. R. (2008). The social function of emotions. In M. Lewis, J. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (Vol. 3, pp. 456-468). New York, NY: Guilford Press.

Gosling, S. D., Rentfrow, P. J., & Swann, W. B., Jr. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality*, *37*, 504-528.

Hall, J. A., Andrzejewski, S. A., & Yopchick, J. E. (2009). Psychosocial correlates of interpersonal sensitivity: A meta-analysis. *Journal of Nonverbal Behavior*, *33*, 149-180.

Hareli, S., & Hess, U. (2010). What emotional reactions can tell us about the nature of others: An appraisal perspective on person perception. *Cognition and Emotion*, *24*, 128-140.

Hareli, S., Kafetsios, K., & Hess, U. (2015). A cross-cultural study on emotion expression and the learning of social norms. *Frontiers in Psychology*, *6*, Article 1501. doi:10.3389/fpsyg.2015.01501

Hess, U., & Hareli, S. (2015). The role of social context for the interpretation of emotional facial expressions. In M. K. Mandal & A. Awasthi (Eds.), *Understanding Facial Expressions in Communication* (pp. 119-141). New York: Springer.

Hess, U., & Hareli, S. (in press). The impact of context on the perception of emotions. In C. Abell & J. Smith (Eds.), *The Expression of Emotion: Philosophical, Psychological, and Legal Perspectives*. Cambridge, UK: Cambridge University Press.

Ickes, W., Holloway, R., Stinson, L. L., & Hoodenpyle, T. G. (2006). Self-monitoring in social interaction: The centrality of self-affect. *Journal of Personality*, *74*, 659-684.

Kafetsios, K., & Nezlek, J. B. (2002). Attachment styles in everyday social interaction. *European Journal of Social Psychology*, *32*, 719-735.

Kafetsios, K., & Nezlek, J. B. (2012). Emotion and support perceptions in everyday social interaction: Testing the "less is more hypothesis" in two different cultures. *Journal of Social and Personal Relationships*, *29*, 65-184.

Keltner, D., & Haidt, J. (2001). Social functions of emotions. In T. J. Mayne & G. A. Bonanno (Eds.), *Emotions and social behavior: Emotions: Current issues and future directions* (pp. 192-213). New York, NY: Guilford Press.

Kenny, D. A. (2011). History, Dialectics, and Dynamics. *Psychological Inquiry*, *22*, 207-209.

Kenny, D. A., & Acitelli, L. K. (2001). Accuracy and bias in the perception of the partner in a close relationship. *Journal of Personality and Social Psychology*, *80*, 439-448.

Kirouac, G., & Hess, U. (1999). Group membership and the decoding of nonverbal behavior. In P. Philippot, R. Feldman, & E. Coats (Eds.), *The social context of nonverbal behavior* (pp. 182-210). Cambridge, UK: Cambridge University Press.

Laurenceau, J.-P., Barrett, L. F., & Pietromonaco, P. R. (1998). Intimacy as an interpersonal process: The importance of self-disclosure, partner disclosure, and perceived partner responsiveness in interpersonal exchanges. *Journal of Personality and Social Psychology*, *74*, 1238-1251.

Leary, M. R. (1983). A brief version of the Fear of Negative Evaluation Scale. *Personality and Social Psychology Bulletin*, *9*, 371-375.

Levenson, R. W., Carstensen, L. L., Friesen, W. V., & Ekman, P. (1991). Emotion, physiology, and expression in old age. *Psychology and Aging*, *6*, 28-35.

Lopes, P. N., Salovey, P., Côté, S., & Beers, M. (2005). Emotion regulation abilities and the quality of social interaction. *Emotion*, *5*, 113-118.

Lun, J., Kesebir, S., & Oishi, S. (2008). On feeling understood and feeling well: The role of interdependence. *Journal of Research in Personality*, *42*, 1623-1628.

Magai, C., Hunziker, J., Mesias, W., & Culver, L. C. (2000). Adult attachment styles and emotional biases. *International Journal of Behavioral Development*, *24*, 301-309.

Ma-Kellams, C., & Blascovich, J. (2012). Inferring the emotions of friends versus strangers: The role of culture and self-construal. *Personality and Social Psychology Bulletin*, *38*, 933-945.

Masuda, T., Ellsworth, P. C., Mesquita, B., Leu, J., Tanida, S., & Van de Veerdonk, E. (2008). Placing the face in context: Cultural differences in the perception of facial emotion. *Journal of Personality and Social Psychology*, *94*, 365-381.

Mathieu, J. E., Aguinis, H., Culpepper, S. A., & Chen, G. (2012). Understanding and estimating the power to detect cross-level interaction effects in multilevel modeling. *Journal of Applied Psychology*, *97*, 951.

Matsumoto, D., & Ekman, P. (1989). American-Japanese cultural differences in intensity ratings of facial expressions of emotion. *Motivation and Emotion*, *13*, 143-157.

Matsumoto, D., Keltner, D., Shiota, M. N., O'Sullivan, M., & Frank, M. (2008). Facial expressions of emotion. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 211-234). New York, NY: Guilford Press.

Matsumoto, D., LeRoux, J., Wilson-Cohn, C., Raroque, J., Kooken, K., Ekman, P., . . . Goh, A. (2000). A new test to measure emotion recognition ability: Matsumoto and Ekman's Japanese and Caucasian Brief Affect Recognition Test (JACBERT). *Journal of Nonverbal behavior*, *24*, 179-209.

Mayer, J. D., Salovey, P., Caruso, D. R., & Sitarenios, G. (2003). Measuring emotional intelligence with the MSCEIT V2.0. *Emotion*, *3*, 97-105.

Nezlek, J. B. (2011). *Multilevel modeling for social and personality psychology*. London: Sage Publications.

Nezlek, J., Kafetsios, K., & Smith, V. (2008). Emotions in everyday social encounters: Correspondence between culture and self-construal. *Journal of Cross Cultural Psychology*, *39*, 366-372.

Niedenthal, P. M., & Brauer, M. (2012). Social functionality of human emotion. *Annual Review of Psychology*, *63*, 259-285.

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, *84*, 231-259.

Noller, P. (1980). Misunderstandings in marital communication: A study of couples' nonverbal communication. *Journal of Personality and Social Psychology*, *39*, 1135-1148.

Parkinson, B. (2011). How social is the social psychology of emotion? *British Journal of Social Psychology*, *50*, 405-413.

Pietromonaco, P. R., & Barrett, L. F. (1997). Working models of attachment and daily social interactions. *Journal of Personality and Social Psychology*, *73*, 1409-1423.

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal of Research in Personality*, *41*, 203-212.

Reis, H. T., Clark, M. S., & Holmes, J. G. (2004). Perceived partner responsiveness as an organizing construct in the study of intimacy and closeness. In D. Matcher & A. Aron (Eds), *Handbook of closeness and intimacy* (pp. 201-225). Mahwah, NJ: Lawrence Erlbaum Associates.

Rosenthal, R., Hall, J. A., DiMatteo, M. R., Rogers, P. L., & Archer, D. (1979). *Sensitivity to nonverbal communication: The PONS test*. Baltimore, MD: Johns Hopkins University Press.

Russell, J. A., & Fehr, B. (1987). Relativity in the perception of emotion in facial expressions. *Journal of Experimental Psychology: General*, *116*, 223-237.

Sternglanz, R. W., & Depaulo, B. M. (2004). Reading non-verbal cues to emotions: The advantages and liabilities of relationship closeness. *Journal of Nonverbal Behavior*, *28*, 245-266.

Tsagarakis, M., Kafetsios, K., & Stalikas, A. (2007). Factor structure, validity, and reliability of the Greek version of the Revised Experiences in Close Relationships (ECR-R) measure of adult attachment. *European Journal of Psychological Assessment*, *23*, 47-55.

Tsai, J. L., Chentsova-Dutton, Y., Freire-Bebeau, L., & Przymus, D. E. (2002). Emotional expression and physiology in European Americans and Hmong Americans. *Emotion*, *2*, 380-397.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063-1070.

West, T. V., & Kenny, D. A. (2011). The truth and bias model of judgment. *Psychological Review*, *118*, 357-378.

Yrizarry, N., Matsumoto, D., & Wilson-Cohn, C. (1998). American-Japanese differences in multiscalar intensity ratings of universal facial expressions of emotion. *Motivation and Emotion*, *22*, 315-327.

Yuki, M., & Schug, J. (2012). Relational mobility: A socioecological approach to personal relationships. In O. Gillath, G. Adams, & A. Kunkel (Eds.), *Relationship science: Integrating evolutionary, neuroscience, and sociocultural approaches* (pp. 137-151). Washington, DC: American Psychological Association.

Zaki, J., Bolger, N., & Ochsner, K. (2008). It takes two: The interpersonal nature of empathic accuracy. *Psychological Science*, *19*, 399-404.

Zaki, J., & Ochsner, K. (2011). Reintegrating the study of accuracy into social cognition research. *Psychological Inquiry*, *22*, 159-182.