Research Article:

Witnessing Meaningful Interpersonal Encounters Facilitates the Perception of Social Emotions

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Abstract

Judging the emotional states of others based on visual information alone is a fundamental aspect of rapid impression formation. However, it remains unclear whether complex social emotions (such as feelings of pride or envy) can be inferred by merely observing others. Here we demonstrate consistent perception of such complex social emotions when a person is seen in the context of a meaningful interpersonal encounter. In Study 1 we show that the perception of social emotions is enhanced when emotionally expressive target individuals are seen with meaningful social companions rather than with social distractors or in isolation. In Study 2 we illustrate that the perception of social emotions increases systematically when formerly isolated individuals are subsequently seen with meaningful social companions rather than with social distractors or objects. We conclude that interpersonal encounters play an integral part in the perception of social emotions.

Keywords: dyad perception, emotion perception, person perception, social cognition, social interaction

Witnessing Meaningful Interpersonal Encounters Facilitates the Perception of Social Emotions

Simply looking at other people's facial expressions and/or bodily postures can drive far-reaching inferences about their emotional states (e.g., App et al., 2011; de Gelder et al., 2015; Lange et al., 2022; Tracy et al., 2015). Spotting an exuberant smile or a clenched fist, for example, can elicit rapid impressions about a person's momentary feelings of happiness or anger. In turn, these impressions frequently provide pivotal opportunities to empathize with others and can serve as important precursors to forging responsive relationships with them (e.g., Gregory et al., 2019; Hall et al., 2009; for a recent review see van Kleef & Côte, 2022). But despite their interpersonal significance, the mental processes involved in skillful emotion perception remain a matter of scientific debate (e.g., Nook et al., 2015; Schirmer & Adolphs, 2017; Shuman et al., 2017).

Ongoing empirical efforts to elucidate these processes frequently rely on a simple method of inquiry: Adult perceivers are typically asked to view photographs or videos of isolated target individuals in order to judge their emotional states (e.g., Bänziger et al., 2009; Matsumoto et al., 2000). Though widely use, this method rarely specifies whether the targets' expressed emotions are directed at the perceiver or at someone or something else (but see Algoe et al., 2020; Harenski et al., 2018). This failure to distinguish between self- and other-directed emotions has the potential to limit scientific progress because it overlooks the influential role that context can play in emotion perception (Mesquita & Boiger, 2014). The exact same facial or bodily displays can, after all, be perceived quite differently depending on whom or what they refer to (Aviezer et al., 2017; Chen & Whitney, 2019; Feldman Barrett & Kensinger, 2010; Hess & Hareli, 2015): A person's clenched fist may signal anger towards a perceiver, but can also convey feelings of triumph following the defeat of a third-party competitor (Eibl-Eibesfeldt, 1989; Tops & de Jong, 2006).

Despite mounting evidence in support of context effects, most research in emotion perception has investigated the recognition of allegedly context-transcending emotional expressions (see Feldman Barrett et al., 2019 for discussion). Numerous studies have focused on probing the detection of just six so-called basic emotions (i.e., anger, disgust, fear, happiness, sadness, and surprise) by presenting isolated individuals with prototypical nonverbal displays (based on Ekman & Friesen, 1971). Although this focused approach has substantially advanced our understanding of universality and innateness in basic emotion perception (e.g., Darwin 1872/1965; Izard, 2007), it has neglected to explore how (much) the perception of other people's emotions can change in both content and scope once context is made available (cf. Trope, 1986). The perceptibility of more complex emotions, for instance, appears to be particularly context-dependent (e.g., Carroll & Russell, 1996; Clarke et al., 2005; Hess et al., 2016; Kosti et al., 2020).

Though a comprehensive taxonomy of complex emotions in humans remains elusive (see Cowen et al., 2019; Kron, 2019 for discussion), one particularly popular subcategory is known as social emotions (e.g., Leary, 2004; Zinck & Newen, 2008). Social emotions differ from basic emotions because they inherently capture how one person feels about another (Leary, 2000; Zhu et al., 2019). Well-known examples of social emotions include attachment-related emotions (e.g., love and desire; Diamond, 2003), self-conscious emotions (e.g., embarrassment and shame; Royce, 1895), self-transcendent emotions (e.g., compassion and gratitude; Stellar et al., 2017), and secondary emotions (e.g., envy and guilt; Kemper, 1987). Though both basic and social emotions can arise in social situations, only the latter strictly require real or imagined contact between people (Hareli & Parkinson, 2008; Leary, 2000). A brief example illustrates this difference: Someone may feel just as sad about breaking up with their partner as they are about crashing their car, but they are unlikely to feel equally guilty towards both.

Given their inherently interpersonal nature, social emotions may be difficult to judge when perceivers are asked to assess the emotional states of isolated individuals (as discussed by Lange et al., 2020, but see Sogon & Masutani, 1989; Tracy et al., 2009). To conclude that isolated individuals experience complex social emotions, perceivers must either assume that they are directly involved with the target individual themselves (in the case of self-directed social emotions) or that the target individual is/was involved with someone else (in the case of other-directed social emotions). In acknowledgement of this conundrum, some researchers have begun to study the perception of social emotions by adopting a modified method of inquiry: Instead of displaying emotionally expressive targets in isolation, they portray these targets in the company of other people. Using this modified method, it has been shown that the perception of envy is common when a target's negative affect is seen in combination with another person's success (Silver & Sabini, 1978; Lange et al., 2022) Similarly, romantic affection can be recognized when a target's positive affect is seen in the presence of their alleged love interest (Clarke et al., 2005).

These initial findings suggest that meaningful social contexts – in the form of emotion-compatible social companions – can facilitate the perception of social emotions in unfamiliar targets. But further research is needed to support this far-reaching conclusion: First, given that empirical studies on the topic are scarce, it remains uncertain whether the reported effects generalize to social emotions other than envy or (romantic) affection. Second, given that prior work has occasionally used multimodal stimuli (e.g., videos with speech, see Silver & Sabini, 1978), the question whether visual information alone can facilitate social emotion perception deserves careful re-evaluation. Third, given that most studies on the topic have failed to include a no-context control condition (but see Clarke et al., 2005 for an exception), it cannot be ruled out that some targets attract equivalent perceptions of social emotions when seen with and without company.

These limitations provide a motivation for further investigations on the role of social context effects in social emotion perception. Note that such investigations are of practical significance as social contexts are rarely absent in daily life. On the contrary, perceivers often witness directly whom a person is involved with (e.g., Ciaramidaro et al., 2014; Hafri et al., 2013; Masson & Isik, 2021) and/or feels emotionally towards (e.g., Abramson et al., 2021; Gray et al., 2017; Hareli & David, 2017, Mumenthaler & Sander, 2012). The resulting percepts of person dyads can entail visual information about coordinated expressions and/or actions between people that allow perceivers to gain social insights beyond those elicited by isolated individuals (cf. Floyd & Erbert, 2003; Quadflieg & Penton-Voak, 2017). But how exactly could such emerging ('dyadic') insights arise when it comes to social emotion perception?

To date, two specific psychological mechanisms have been proposed. On the one hand, it has been argued that social emotions (unlike basic emotions) lack typical expressions in individuals and must be inferred from multiple cues across individuals (e.g., Lange et al., 2022). In this view, the integration of target and companion cues may enable perceivers to detect nonverbal patterns at the dyadic level which then initiate the perception of specific social emotions. On the other hand, it has been suggested that social emotions result in typical, but ambiguous expressions in individuals (e.g., Keltner et al., 2019). In this view, companion cues may help to disambiguate the perception of an emotion that was partially initiated by looking at the target. Importantly, proponents of both views argue that apprehending the relation between targets and companions can systematically facilitate the perception of social emotions. Thus, an important first step to advance recent theorizing on the topic lies in demonstrating the existence of a relation-dependent (i.e., dyadic) facilitation effect for multiple social emotion under well-controlled experimental conditions.

With this goal in mind, the current studies were designed to examine the effects of social context on social emotion perception more systematically and for a wider range of emotions than previously reported. Specifically, we first demonstrated that targets seen with meaningful social companions, but not with mere social distractors elicit more consistent social emotion perception compared to isolated targets (Study 1). We then showed that this effect occurs even when the same participants view the same targets with and without meaningful social companions (Study 2). Based on these findings, we conclude that encounters between people do not only play an integral part in arousing social emotions, but also in perceiving them. Please note that all measures, manipulations and exclusions as used in our studies are disclosed in full detail below. In addition, all data as reported in this paper are accessible at the Open Science Framework (OSF).

Study 1

In preparation for Study 1, we developed three novel sets of pictorial stimuli. The first set of stimuli depicts a wide range of affective social encounters. Each encounter portrays an emotionally expressive target in the presence of an emotion-compatible non-target in order to convey four well-known social emotions, namely affection, guilt, envy, and vicarious pride (i.e., pride in others, cf. Ritzenhöfer et al., 2019). The second set of stimuli shows the exact same targets and non-targets as the first set, but re-pairs them in an arbitrary manner in order to undermine the perception of meaningful relations between them (as confirmed by a pilot study, see our Supplementary Online Material, SOM). Finally, a third set of stimuli displays all original targets in isolation. Using these three sets of stimuli, different participants in Study 1 were asked to evaluate identical targets, but either as part of a meaningful affective encounter (i.e., with a social companion), as part of an ambiguous affective encounter (i.e., with a social distractor), or in isolation.

Irrespective of their experimental condition, participants judged how likely it was that each target felt eight common emotions. Four of these emotions matched the study's designated social emotions (i.e., affection, envy, guilt, and pride in others). The remaining four referred to basic emotions that were deemed similar to these social emotions in valence and content (i.e., happiness, anger, sadness, and surprise, respectively). Judgments of similarity between social and basic emotions were based on prior research on cognitive representations of emotion concepts. This research suggests conceptual links between affection and happiness, envy and anger, guilt and sadness, and pride and happiness (cf. Shaver et al., 1987). We were mindful, however, that the last of these pairs has been subject to criticism as it was derived without considering different types of pride (such as self-referential versus vicarious pride) and their implications on social cognition (Chakrabarti, 1992; Ritzenhöfer et al., 2019). Based on this criticism, and initial evidence that pride expressions can be mistaken as both happiness and surprise (e.g., Tracy et al., 2005), we also included surprise as a possible counterpart to pride beyond happiness.

Guided by previous studies on social emotion perception, we predicted that ratings of target-congruent social emotions (i.e., affection ratings for affectionate targets) would be stronger for targets seen with emotion-compatible social companions than for isolated targets. In other words, we hypothesized to find a clear dyadic facilitation effect (DFE) in social emotion perception. In addition, we expected that this effect would be reduced for targets with mere social distractors based on the assumption that the DFE is not a mere social presence effect but relies on the integrative analysis of two people's emotion-compatible nonverbal displays. Finally, we explored whether the DFE would be more pronounced for ratings of target-congruent social emotions than for ratings of target-relevant basic emotions (i.e., happiness ratings for affectionate targets).

Method

Participants

A convenience sample of 84 participants was recruited from the University of Bristol academic community (none of which had taken part in the pilot study). The data from five participants were affected by technical difficulties (e.g., the computer froze). In addition, one participant completed the task in an unrealistic timeframe (i.e., in half the time it took the remaining participants). After excluding these participants, a final sample of 78 participants (54 females; aged 18 to 29 years, M = 21.04, SD = 2.79) was retained for analysis. No further participants were added to this sample at a later point in time and no interim analyses were run during data collection.

A sensitivity analysis (implemented in G*Power 3.1.9.2) indicated that this sample was sufficient to detect a moderate difference in participants' ratings for targets with social companions compared to isolated targets (i.e., Cohen's $d_z \geq 0.32$) with 80% power and at an alpha level of 0.05 (using a two-tailed test). Each participant included in the final sample was pseudo-randomly assigned to one of three counterbalanced versions of the main task, resulting in eight men and 18 women completing each version of the task. All reported normal or corrected-to-normal vision and received either course credit or £5.00 for their time. The study was reviewed and approved by the Faculty of Science Human Research Ethics Committee at the University of Bristol, and the procedures followed were in accordance with the Helsinki Declaration as revised in 2013. All participants provided written informed consent to participate in the study. In addition, all participants provided active post-study consent to release their data for analysis and publication.

Materials

All stimuli were created by modifying color photographs downloaded from Shutterstock (www.shutterstock.com) using Adobe Photoshop© (Version 13.0). The first

set of stimuli consisted of 96 mixed-gender person dyads that depicted easy to read (i.e., meaningful) social encounters between two White individuals (e.g., a couple in conflict, see Figure 1A). Each meaningful dyad was selected to portray one of four social emotions, resulting in 24 affection dyads, 24 envy dyads, 24 guilt dyads and 24 vicarious pride dyads (see Figures S1 to S4 in the Supplementary Online Material, SOM). All dyads were standardized in height and inserted on a white background (450 x 450 pixels). One individual per dyad was defined as the primary target of evaluation and marked with an asterisk, whereas the accompanying individual (i.e., the non-target) served as the target's emotion-compatible social companion. Target sex (i.e., male versus female) and location (i.e., right or left side of the dyad) was matched across all four types of dyads.

Based on this initial set of affective social encounters, a second set of 96 ambiguous mixed-gender person dyads was created. This second set included the same targets but paired them with emotion-incompatible non-targets (i.e., social distractors) by pseudo-randomly combining targets from affection dyads with non-targets from envy dyads (and vice versa) and targets from pride dyads with non-targets from guilt dyads (and vice versa). For each new stimulus, the target's original location and overall dyad width was preserved (see Figure 1B). In addition, a third stimulus set was prepared that showed all targets in their original location, but without any non-target (i.e., in isolation, see Figure 1C). To ensure that neither targets, nor non-targets were seen twice by any participant during data collection, all stimuli were assigned to one of three counterbalanced compilations of stimuli. Each compilation contained 32 targets from each stimulus set (consisting of eight affectionate targets, eight envious targets, eight guilty targets, and eight proud targets with equal numbers of males/females on either side of the image). Across compilations, all targets were shown equally often with social companions, social

distractors, or in isolation and all non-targets were shown equally often as social companions or social distractors.

Please note that Shutterstock's standard license terms of service does not allow redistributing, sharing, or transferring their photographs (http://www.shutterstock.com/licensing.mhtml). For this reason, our stimuli are not publicly accessibly but thumbnails of all images have been provided in the Supplementary Online Material (SOM).

Figure 1. Example stimuli as used in Studies 1 and 2. All four images include the same emotionally expressive male target individual (marked with an asterisk for identification), but display him either (A) in the presence of a social companion, (B) in the presence of a social distractor, (C) in isolation, or (D) with a prominent object. All grey lines/labels in this figure are for illustration purposes only. Images were prepared by downloading photographs from www.shutterstock.com and are reproduced here in adherence with the company's standard license terms of service (http://www.shutterstock.com/licensing.mhtml).

Apparatus and Procedure

Participants were tested individually in a quiet room seated facing a Dell Desktop PC computer with a 19-inch display set to a resolution of 1920 x 1080 pixels. Instructions and stimuli were presented, and participants' responses recorded, using the Qualtrics survey tool (www.qualtrics.com). Upon arrival at the laboratory, participants were asked for their sex (as assigned by birth). Based on this information, they were assigned to one of three versions of the main task to ensure that each compilation of stimuli was rated by the same number of men and women. Following their assignment, the main task was administered in two blocks of 48 trials with a short break between blocks. In each block of trials, participants encountered 16 targets with social companions, 16 targets with social distractors, and 16 targets in isolation. For each type of context, they further saw the same number of affectionate, proud, guilty, and envious male and female targets on either side of the dyad/image. The order of all trials was randomized per block for each participant.

On each trial, participants were shown one image that depicted either one or two individuals. Underneath the image, eight rating scales were shown in randomized order, and participants were required to indicate how affectionate, angry, envious, guilty, happy, proud (of someone), sad, and surprised each designated target individual was likely to feel (from 1 = extremely unlikely to 7 = very likely). The scale's midpoint allowed participants to signal if they were 'undecided' about the likelihood of a specific emotion. Please note that this approach differs from asking participants to rate the intensity of an emotion as ratings above (below) the midpoint declare an emotion increasingly (un-)likely to be present rather than present in high (low) intensity. Participants were instructed to give their ratings speedily by relying on their 'gut feeling'. Familiarization with the task occurred via two practice trials (using spare photographs) before the main task. Following task completion,

participants completed a brief questionnaire (that was not relevant for the current work but was the same as in our Pilot Study, see SOM for details).

Results

Social Emotion Ratings

A manipulation check confirmed that all four types of targets conveyed their intended social emotions when seen with their meaningful social companions (for details see SOM). Accordingly, all subsequent analyses focused exclusively on these target-congruent social emotions (see Figure 2). To directly test our main hypothesis, we first run a simple paired samples t-test to confirm that the same targets elicited higher target-congruent social emotion ratings when they were seen with their social companions (M = 5.53, SD = 0.48) than in isolation (M = 4.83, SD = 0.63), M_{Diff} = 0.70, SD_{Diff} = 0.58, $t(77)$ = 10.53, $p < .001$, 95% CI [0.56, 0.83], Cohen's d_z = 1.19.

This result held for each type of target (see Figure 2): Affection ratings were higher for affectionate targets with social companions than for isolated affectionate targets, M_{Diff} = 0.74, SD_{Diff} = 0.84, $t(77)$ = 7.78, $p < .001$, 95% CI [0.55, 0.93], Cohen's d_z = 0.88. Envy ratings were higher for envious targets with social companions than for isolated envious targets, M_{Diff} = 0.85, SD_{Diff} = 0.94, $t(77)$ = 7.98, $p < .001$, 95% CI [0.63, 1.06], Cohen's d_z = 0.90. Guilt ratings were higher for guilty targets with social companions than for isolated guilty targets, M_{Diff} = 0.42, SD_{Diff} = 0.82, $t(77)$ = 4.53, $p < .001$, 95% CI [0.24, 0.61], Cohen's d_z = 0.51. Pride ratings were higher for proud targets with social companions than for isolated proud targets, M_{Diff} = 0.77, SD_{Diff} = 0.81, $t(77)$ = 8.40, $p < .001$, 95% CI [0.59, 0.95], Cohen's d_z = 0.95. These findings provided initial support for the idea of dyadic facilitation in social emotion perception.

However, based on our initial analyses, it remained unclear whether the observed effect was larger for targets with social companions than for targets with social distractors. Hence, we proceeded by submitting participants' average target-congruent social emotion ratings to a 4 (target type: affectionate, envious, guilty versus proud) × 3 (context type: companion, distractor versus isolation) repeated measures ANOVA. We found a significant main effect of target type [$F(3,231) = 53.64$, $p < .001$, $\eta^2_p = .411$], a significant main effect of context type [$F(2,154) = 139.96$, $p < .001$, $\eta^2_p = .645$], and a significant target type × context type interaction effect [$F(6,462) = 24.57$, $p < .001$, $\eta^2_p = .242$].

Given the significant two-way interaction effect, we then conducted a series of simple estimated means comparisons (also known as follow-up 'simple effects tests') to fully examine the effect of context type for each type of target. A Bonferroni-corrected p-value of 0.017 was used for these comparisons (to account for the three pairwise comparisons per target type). Please note that we already reported that targets with social companions elicited higher ratings than isolated targets for all four target types in the opening paragraph of this results section. Rerunning these initial paired t-tests as simple effects tests did not alter any of the results (all *p*s < .001). Therefore, we exclusively report the outcomes of the remaining pairwise comparisons below. To facilitate their interpretation, all comparisons are presented by context type (see also Figure 2).

As predicted, all targets elicited higher target-congruent social emotion ratings when they were seen with social companions than with social distractors, irrespective of whether we examined affection ratings for affectionate targets ($p < .001$), $M_{Diff} = 0.50$, $SD_{Diff} = 0.55$, 95% CI [0.38, 0.63], Cohen's $d_z = 0.91$, envy ratings for envious targets ($p < .001$), $M_{Diff} = 1.31$, $SD_{Diff} = 1.09$, 95% CI [1.06, 1.55], Cohen's $d_z = 1.20$, guilty ratings for guilty targets ($p < .001$), $M_{Diff} = 1.26$, $SD_{Diff} = 0.98$, 95% CI [1.04, 1.48], Cohen's $d_z = 1.28$, or pride ratings for proud targets ($p < .001$), $M_{Diff} = 1.72$, $SD_{Diff} = 1.12$, 95% CI [1.47, 1.98], Cohen's

d_z = 1.54. In addition, most targets elicited higher target-congruent social emotion ratings when they were seen in isolation than with social distractors. Specifically, isolated envious targets elicited higher envy ratings than envious targets with social distractors (p < .001), M_{Diff} = 0.46, SD_{Diff} = 1.07, 95% CI [0.22, 0.70], Cohen's d_z = 0.43. Similarly, isolated guilty targets elicited higher guilt ratings than guilty targets with social distractors (p < .001), M_{Diff} = 0.84, SD_{Diff} = 0.92, 95% CI [0.63, 1.05], Cohen's d_z = 0.91. Isolated proud targets elicited higher pride ratings than proud targets with social distractors (p < .001), M_{Diff} = 0.95, SD_{Diff} = 1.03, 95% CI [0.72, 1.19], Cohen's d_z = 0.92. In contrast, isolated affectionate targets elicited lower affection ratings than affectionate targets with social distractors (p = .012), M_{Diff} = -0.24, SD_{Diff} = 0.83, 95% CI [-0.43, -0.05], Cohen's d_z = 0.29. In other words, for affectionate targets only, we observed that any type of social presence (companions and distractors) attracted higher target-congruent social emotion ratings.

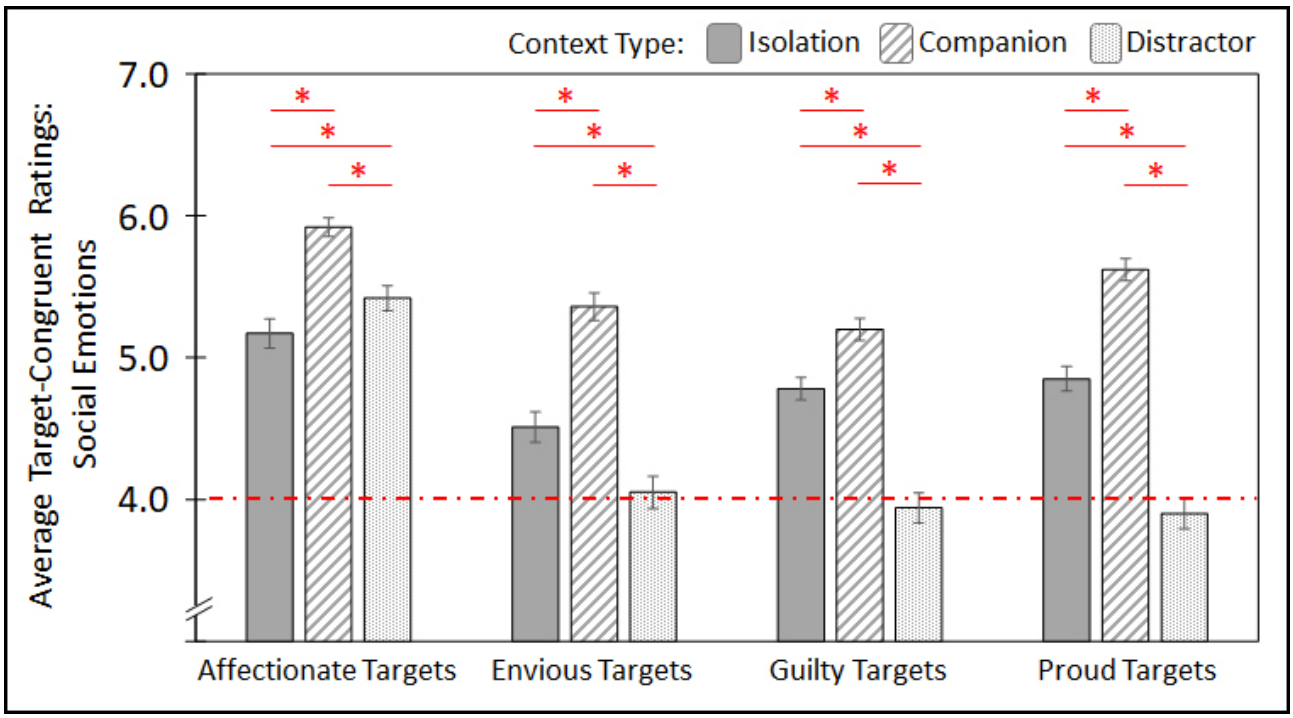

Figure 2. Mean target-congruent social emotion ratings for affectionate, envious, guilty, and proud targets by context type. Error bars indicate SEMs. The dashed line highlights the rating scale's midpoint. Asterisks signal significant pairwise comparisons at p < .017 (Bonferroni-corrected).

Basic Emotion Ratings

Initial checks examined again whether all four types of targets preferentially conveyed their intended basic emotion when seen with meaningful social companions. This was the case for all types of targets except for proud targets who were not perceived as preferentially conveying surprise (see SOM for details). To accommodate this finding, all subsequent analyses considered those basic emotions as target-relevant that had resulted in the highest average ratings in the social companion condition, namely happiness for affectionate and proud targets, anger for envious targets, and sadness for guilty targets.

To examine whether the DFE would generalize to target-relevant basic emotion ratings, participants' relevant average ratings were submitted to a 4 (target type: affectionate, envious, guilty, versus proud) × 3 (context type: companion, distractor, versus in isolation) × 2 (rating type: social emotions versus basic emotions) repeated measures ANOVA. All main effects and two-way interaction effects reached statistical significance [all $Fs > 20.45$, $p < .001$, $\eta^2_p > .209$]. There was also a significant three-way interaction effect [$F(6,462) = 8.07$, $p < .001$, $\eta^2_p = .095$].

In a next step, to mirror the previously reported ANOVA for social emotion ratings, we also conducted a 4 (target type: affectionate, envious, guilty, versus proud) × 3 (context type: companion, distractor, versus isolation) ANOVA that focused on basic emotion ratings only (see Figure 3). The analysis returned again a significant main effect of target type [$F(3,231) = 453.85$, $p < .001$, $\eta^2_p = .855$], a significant main effect of context type [$F(2,154) = 57.63$, $p < .001$, $\eta^2_p = .428$] and a significant interaction effect [$F(6,462) = 5.97$, $p < .001$, $\eta^2_p = .072$]. Based on the latter ANOVA, we then conducted additional simple estimated means comparisons to re-visit the effect of context type for each type of target (but this time for basic emotion judgments only). As before, a Bonferroni-corrected

p-value of 0.017 was used for these comparisons. To facilitate their interpretation, all comparisons are again presented below by context type (see also Figure 3).

First, none of the tests comparing target-relevant basic emotion ratings for targets with social companions and for isolated targets reached statistical significance, irrespective of whether we examined happiness ratings for affectionate targets (p = .048), M_{Diff} = 0.09, SD_{Diff} = 0.38, 95% CI [0.00, 0.17], Cohen's d_z = 0.23, anger ratings for envious targets (p = .599), M_{Diff} = -0.05, SD_{Diff} = 0.86, 95% CI [-0.24, 0.14], Cohen's d_z = 0.06, sadness ratings for guilty targets (p = .283), M_{Diff} = -0.10, SD_{Diff} = 0.85, 95% CI [-0.30, 0.09], Cohen's d_z = 0.12 or happiness ratings for proud targets (p = .154), M_{Diff} = 1.00, SD_{Diff} = 0.61, 95% CI [-0.04, 0.24], Cohen's d_z = 0.16. These findings indicate that there was little evidence in favor of a DFE for basic emotion ratings.

Second, most tests revealed higher target-relevant basic emotion ratings for targets with social companions than for targets with social distractors. Specifically, significant results were obtained for affectionate targets (p < .001), M_{Diff} = 0.18, SD_{Diff} = 0.43, 95% CI [0.09, 0.28], Cohen's d_z = 0.43; guilty targets (p < .001), M_{Diff} = 0.52, SD_{Diff} = 0.79, 95% CI [0.34, 0.69], Cohen's d_z = 0.65 and proud targets (p < .001), M_{Diff} = 0.64, SD_{Diff} = 0.81, 95% CI [0.46, 0.82], Cohen's d_z = 0.79. Only anger ratings for envious targets with social companions failed to differ significantly from anger ratings for envious targets with social distractors (p = .054), M_{Diff} = 0.20, SD_{Diff} = 0.89, 95% CI [0.00, 0.40], Cohen's d_z = 0.22.

Third, most tests revealed higher target-relevant basic emotion ratings for isolated targets than for targets with social distractors. Specifically, this pattern of results was observed for envious targets (p = .017), M_{Diff} = 0.25, SD_{Diff} = 0.90, 95% CI [0.04, 0.45], Cohen's d_z = 0.28; guilty targets (p < .001), M_{Diff} = 0.62, SD_{Diff} = 0.87, 95% CI [0.43, 0.82], Cohen's d_z = 0.72; and proud targets (p < .001), M_{Diff} = 0.54, SD_{Diff} = 0.68, 95% CI [0.39, 0.70], Cohen's d_z = 0.80. Only for affectionate targets happiness ratings for isolated

targets failed to differ significantly from happiness ratings for targets with distractors (p = .044), M_{Diff} = 0.10, SD_{Diff} = 0.41, 95% CI [0.00, 0.19], Cohen's d_z = 0.23.

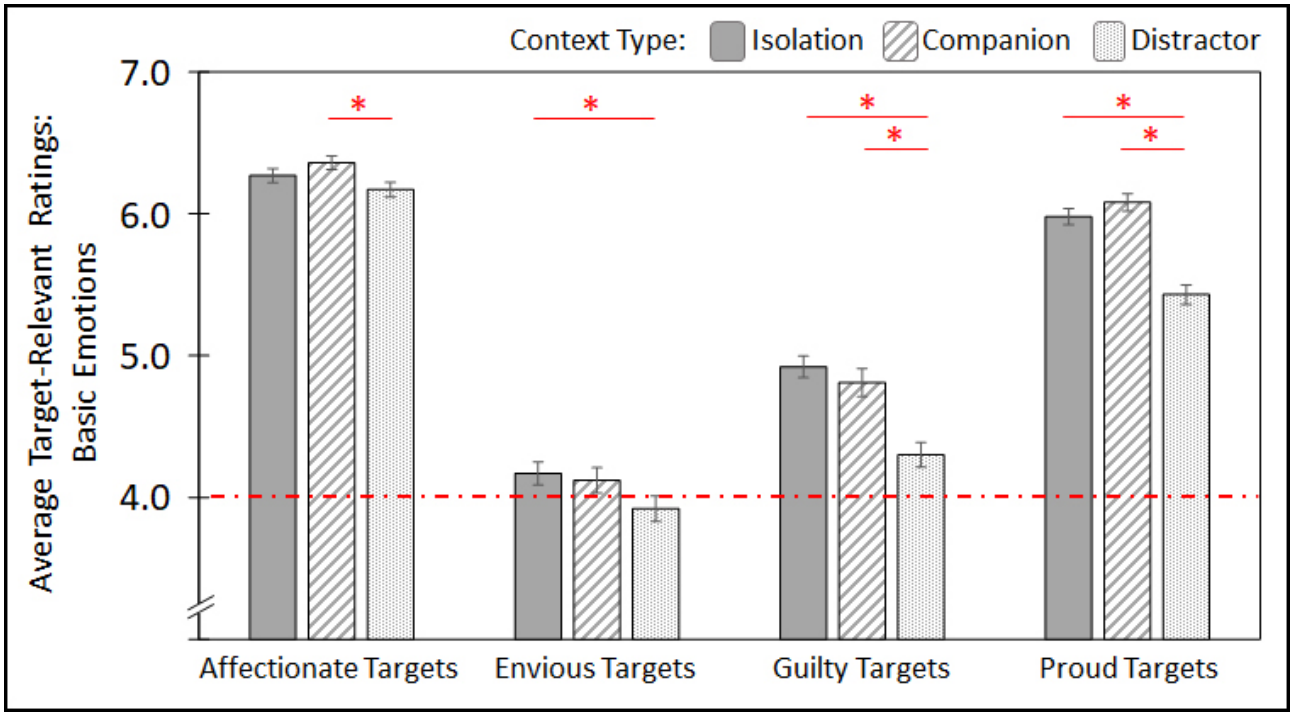

Figure 3. Mean target-relevant basic emotion ratings for affectionate, envious, guilty and proud targets by context type. Error bars indicate SEMs. The dashed line highlights the rating scale's midpoint. Asterisks indicate significant pairwise comparisons [at p (Bonferroni-corrected) < .017].

Interim Discussion

Study 1 confirmed that the perception of target-congruent social emotions, but not the perception of target-relevant basic emotions was facilitated for targets seen with meaningful social companions compared to the same targets seen in isolation. This so-called DFE could not be reproduced by simply presenting the same targets with social distractors. Supplementary analyses further confirmed that the effect could not be accounted for by the companions' appearance alone (see SOM). These findings suggest that the observed facilitation effect relies on the integration of two people's emotion-compatible nonverbal displays. A second study was designed to replicate and extend

these findings. This additional study examined whether the DFE would still occur if the same targets were evaluated with and without a meaningful social companion by the same perceiver. In addition, it explored whether isolated targets may spontaneously imply a meaningful social companion and, thereby, conceal the true size of the DFE. The latter concern was based on recent data highlighting that perceivers often use targets' directional nonverbal displays (e.g., eye gaze and gestures) to speculate about their interpersonal involvement (Chen & Whitney, 2019; Teoh et al., 2017). In order to minimize such speculations and to account for our targets' nonverbal displays in the absence of another person, we also presented all targets with prominent objects in Study 2 (see Figure 1D).

Study 2

In Study 2 participants were again asked to evaluate the emotional states of designated targets across different contexts. This time, however, all participants rated all targets in isolation before rating them again in the presence of a social companion, a social distractor, or a mere object. As before, we expected that the DFE would occur only for social (but not for basic) emotions, and only for targets with social companions (but not for targets with social distractors or objects). In addition, we explored whether targets seen with objects would attract even lower social (but not basic) emotion ratings than isolated targets, given that such objects may reduce perceivers' spontaneous inclination to speculate about a target's momentary involvement with another person. Our main predictions for Study 2 were preregistered at the OSF, including the study's intended sample size, procedure, and planned analysis. Additional explorative, non-registered analyses are clearly highlighted in the text below.

Participants

An a-prior power analysis determined the minimum sample size required to re-establish the DFE. Given that the size of this effect varied in Study 1, we based our power calculation on the smallest effect observed (i.e., d_z = .51 for guilty targets). This analysis revealed that we would need at least 33 participants to detect the effect with 80% power at an alpha level of 0.05 (with a two-tailed test). However, considering that Study 2 also aimed to compare ratings for isolated targets and targets with objects, we preregistered a sample that would be sensitive enough to detect even smaller differences in participants' ratings across these two experimental conditions (i.e., d_z = .30; n = 90). With this goal in mind, we recruited 95 participants from the University of Bristol community. Data of four participants were subsequently discarded because they completed the task in less than the preregistered minimum duration of 40 minutes. Another participant was excluded because they had previously participated in Study 1 (due to an oversight).

The performance of four additional participants fell below a preregistered cut-off on a distractor task. But upon closer inspection of these data, we noticed that even the lowest performing participant still fell within 1.5 standard deviations of the sample's overall mean on this task. Therefore, we refrained from excluding these four participants, after we confirmed that none of them (or any of the remaining participants) showed unusual response patterns on the main task (e.g., no one provided the exact same rating for at least one of the emotions across all trials in Block 1 or in Block 2; for further details see our preregistered exclusion criteria). As a result, a final sample of 90 participants (75 females; 18 to 30 years, M = 19.74, SD = 2.10) was analyzed in Study 2. All participants reported normal or corrected-to-normal vision and study participation was remunerated with course credit or £6.00. The distribution of valid participants across our three counterbalanced versions of the main rating task was again based on self-reported sex (resulting in five

men and 25 women per version). The study was reviewed and approved by the Faculty of Science Human Research Ethics Committee at the University of Bristol, and the procedures followed were in accordance with the Helsinki Declaration as revised in 2013. All participants provided written informed consent to participate in the study. In addition, all participants provided active post-study consent to release their data for analysis and publication.

Materials

An additional set of images depicting targets with prominent objects was created for Study 2. Relevant color photographs of common everyday objects that matched the height of a person were identified via a google image search (i.e., coat stands, floor lamps, fridges, plants, bookshelves, and wardrobes). Sixteen unique exemplars were then downloaded per object and standardized in size to pair them with two female targets and two male targets per target type (so that each object appeared once on the left and once on the right side of the image). In total, this resulted in a fourth set of stimuli that showed all 96 targets in the presence of an object. To ensure that each target would feature only once in the second part of Study 2, we again counterbalanced three compilations of stimuli across participants. Each compilation contained eight affectionate targets, eight envious targets, eight guilty targets, and eight proud targets per context type (with equal numbers of males/females on either side of the dyad). Across compilations, all targets were shown equally often with social companions, social distractors, and objects.

Apparatus and Procedure

In Study 2, we used the same room, apparatus, and procedure as in Study 1 unless otherwise stated. The rating task was administered in two blocks of trials. The first block of

trials displayed all 96 targets without context (i.e., as isolated targets). The second block of trials displayed the same 96 targets with context (i.e., 32 targets with meaningful social companions, 32 targets with ambiguous social distractors, and 32 targets with objects). To avoid participant fatigue, each stimulus was shown with only four emotion scales (instead of the original eight). Specifically, targets of positive valence (i.e., affectionate and proud targets) were only shown with rating scales that prompted participants to indicate how affectionate, happy, proud (of someone), and surprised each target was likely to feel. By contrast, targets of negative valence (i.e., envious and guilty targets) were only shown with rating scales that prompted participants to indicate how angry, envious, guilty, and sad each target was likely to feel (from 1 = very unlikely to 7 = very likely).

The order of all four emotion judgments was randomized on each trial. In addition, the order of all trials was randomized per block for each participant. Participants were familiarized with the task by two practice trials using spare photographs of isolated individuals. In addition, before the second block of trials, participants were explicitly told that they would see people that they had previously encountered during the task and that their ratings could be similar or different from the ones they had given before. Between blocks of trials, participants were also asked to complete a timed distractor task. This task gave participants a break from the main rating task. It consisted of a paper booklet that contained four word-search puzzles in a fixed order (e.g., Lloyd, 2013; Schuler, Mlynski, & Wright, 2017). Each puzzle portrayed an array of 20 x 20 letters and ten neutral target words (i.e., instruments and tools) underneath. Participants were instructed to circle as many target words as possible in a (timed) five-minute interval. Their performance ranged from 4 to 23 words (M = 9.64, SD = 3.83). Finally, following the completion of the rating task, participants filled in the same brief questionnaire as in the Pilot Study.

Results

Social Emotion Ratings

A manipulation check confirmed again that all four types of targets preferentially conveyed their designated social emotions when seen with their meaningful social companions (see SOM). As in Study 1, participants' average target-congruent social emotion ratings were significantly higher for targets with social companions (M = 5.65, SD = 0.51) than for isolated targets (M = 4.99, SD = 0.53), M_{Diff} = 0.66, SD_{Diff} = 0.44, $t(89)$ = 14.14, $p < .001$, 95% CI [0.57, 0.75], Cohen's d_z = 1.49. As before, this finding applied to all four types of targets (see Table 1A): Affection ratings increased for affectionate targets with social companions compared to isolated affectionate targets, M_{Diff} = 0.56, SD_{Diff} = 0.59, $t(89)$ = 9.02, $p < .001$, 95% CI [0.43, 0.68], Cohen's d_z = 0.95. Envy ratings increased for envious targets with social companions compared to isolated envious targets, M_{Diff} = 0.71, SD_{Diff} = 0.83, $t(89)$ = 8.05, $p < .001$, 95% CI [0.53, 0.88], Cohen's d_z = 0.85. Guilt ratings increased for guilty targets with social companions compared to isolated guilty targets, M_{Diff} = 0.63, SD_{Diff} = 0.67, $t(89)$ = 8.97, $p < .001$, 95% CI [0.49, 0.77], Cohen's d_z = 0.95. Pride ratings increased for proud targets with social companions compared to isolated proud targets, M_{Diff} = 0.74, SD_{Diff} = 0.74, $t(89)$ = 9.47, $p < .001$, 95% CI [0.58, 0.89], Cohen's d_z = 1.00. In short, even when the exact same perceivers saw the exact same targets twice, higher target-congruent social emotion ratings occurred for targets with rather than without meaningful social companions.

We next examined whether the DFE was more pronounced for targets with social companions (compared to isolated targets) than for targets with social distractors or objects. Note that due to an oversight we specified this analysis in our preregistration without considering target type, but we still included this factor below to enhance data transparency. Accordingly, participants' average target-congruent social emotion ratings

were analyzed in a 4 (target type: affectionate, envious, guilty, versus proud) × 3 (context type: companion, distractor, versus object) × 2 (trial type: context present versus context absent) repeated measures ANOVA (see Table 1). All main effects and two-way interaction effects reached statistical significance [all *Fs* > 20.32, all *ps* < .001, each η^2_p > .185] as did the three-way interaction effect [$F(6,534) = 44.07$, $p < .001$, $\eta^2_p = .331$].

Table 1.
Mean target-congruent social emotion ratings (and their standard deviations) by context type and trial type as obtained in Study 2 for all four types of targets.

Target Type	Affectionate	Envious	Guilty	Proud
A) Targets With and Without Social Companions				
With	6.04 (0.61)	5.20 (0.85)	5.43 (0.67)	5.91 (0.60)
Without	5.48 (0.66)	4.50 (0.82)	4.80 (0.66)	5.18 (0.81)
Diff1 (With – Without)	0.56 (0.59)	0.71 (0.83)	0.63 (0.67)	0.74 (0.74)
B) Targets With and Without Social Distractors				
With	5.48 (0.76)	3.82 (1.03)	3.87 (0.97)	3.77 (1.05)
Without	5.56 (0.67)	4.51 (0.93)	4.81 (0.70)	5.25 (0.76)
Diff2 (With – Without)	-0.08 (0.63)	-0.70 (0.92)	-0.94 (0.84)	-1.48 (0.91)
C) Targets With and Without Objects				
With	3.74 (1.38)	3.64 (1.18)	4.06 (1.06)	3.62 (1.41)
Without	5.60 (0.63)	4.54 (0.89)	4.71 (0.77)	5.18 (0.77)
Diff3 (With – Without)	-1.86 (1.35)	-0.90 (1.11)	-0.65 (0.92)	-1.55 (1.29)

In accordance with our preregistration, we then examined the significant interaction effects in further detail by computing three difference scores per target type (see also Table 1), namely *Diff1* (average target-congruent social emotion ratings for targets with social companions – average target-congruent social emotion ratings for identical targets in isolation), *Diff2* (average target-congruent social emotion ratings for targets with social distractors – average target-congruent social emotion ratings for identical targets in isolation), and *Diff3* (average target-congruent social emotion ratings for targets with objects – average target-congruent social emotion ratings for identical targets in isolation). Computing these difference scores enabled us to directly compare *Diff2* and *Diff3* against *Diff1* (with a Bonferroni corrected alpha level of .025 per paired t-test) to learn whether the DFE for targets with social companions was systematically larger than for targets with social distractors or objects. As hypothesized, we found that *Diff1* was significantly larger than both *Diff2* and *Diff3*, irrespective of target type, all *ts*(89) > 8.28, *ps* < .001, 95% CIs [> 0.47, < 2.76], each Cohen's d_z > 0.86.

To additionally determine whether the three difference scores differed from zero, we also conducted three Bonferroni-corrected one-sample t-tests. As previously reported (in the form of paired t-tests), we found that *Diff1* was larger than zero for all four types of targets, all *ts*(89) > 8.04, *ps* < .001, all 95% CIs [> 0.42, < 0.90], each Cohen's *d* > 0.84. In contrast, *Diff2* did not differ from zero for affectionate targets, *t*(89) = 1.19, *p* = .238, 95% CI [-0.21, 0.05], Cohen's *d* = 0.13, and was smaller than zero for envious, guilty, and proud targets, all *ts*(89) > 7.17, *ps* < .001, 95% CIs [> -1.67, < -0.49], each Cohen's *d* > 0.74. Finally, *Diff3* was consistently smaller than zero for all four types of targets, all *ts*(89) > 6.67, *ps* < .001, 95% CIs [> -2.15, < -0.45], each Cohen's *d* > 0.69. These findings confirmed that the DFE occurred only for targets with social companions, but not for targets with social distractors or objects.

Finally, in going beyond our preregistration, we also examined our social emotion data by trial type (i.e., context absent versus present). Doing so confirmed that participants' ratings only showed context-dependent modulation once context was made available, but not before (see SOM for details). Figure 4 presents participants' ratings for targets without contexts averaged across all three types of (absent) contexts to facilitate ease of comparison with Study 1.

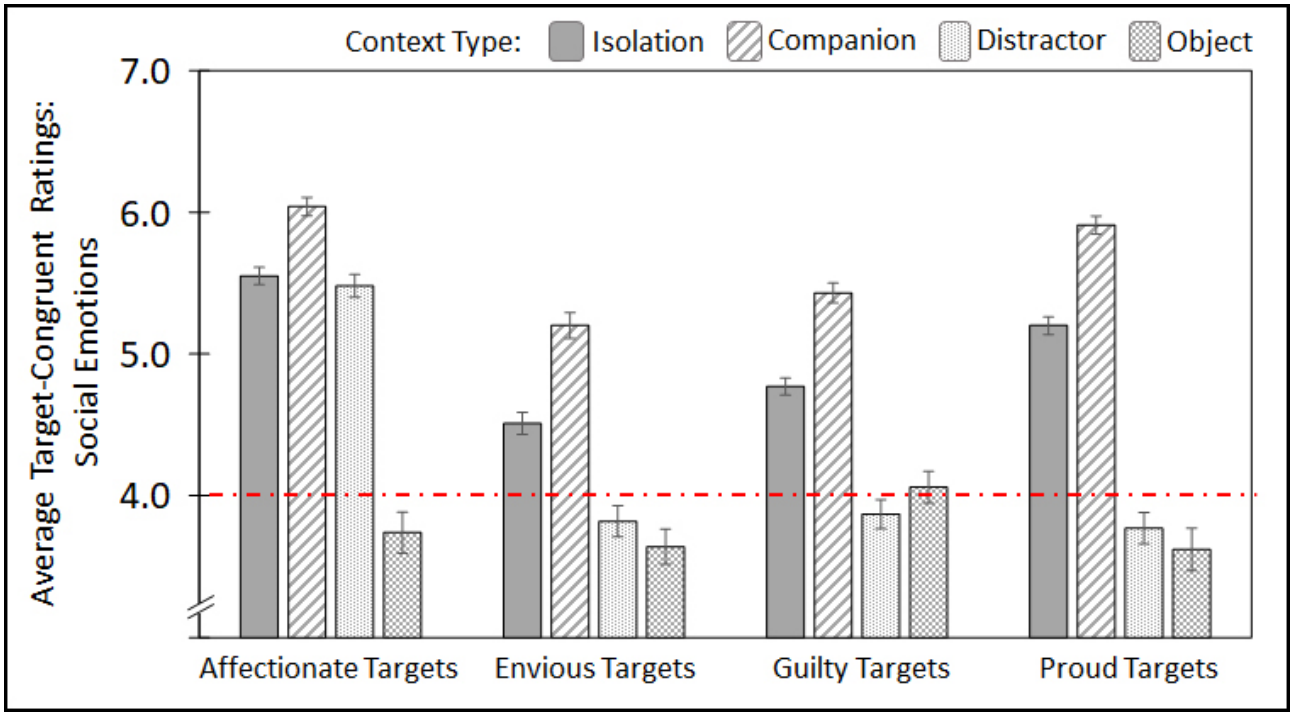

Figure 4. Mean target-congruent social emotion ratings for affectionate, envious, guilty and proud targets by context type. Error bars indicate SEMs. The dashed line highlights the rating scale's midpoint. The outcomes of relevant planned contrasts are described in the main text.

Basic Emotion Ratings

As in Study 1, all analyses considered those basic emotion ratings as target-relevant that obtained the highest values for targets with meaningful social companions (i.e., happiness ratings for affectionate and proud targets, anger ratings for envious targets, and sadness ratings for guilty targets; see SOM for details). Again, we examined

whether participants' basic emotion ratings differed from their social emotion ratings. Note that our preregistration specified the relevant analyses again without considering target type, but the factor was added below for reasons of transparency. Participants' average ratings were analyzed in a 4 (target type: affectionate, envious, guilty, versus proud) × 3 (context type: companion, distractor, versus object) × 2 (trial type: context absent versus context present) × 2 (rating type: social emotions versus basic emotions) repeated measures ANOVA. All main effects [all *Fs* > 111.23, all *ps* < .001, each η^2_p > .555], two-way interaction effects [all *Fs* > 14.26, all *ps* < .001, each η^2_p > .137], and three-way interaction effects [all *Fs* > 19.31, *p* < .001, η^2_p > .177] reached statistical significance as did the relevant four-way interaction [$F(6,534) = 30.21$, $p < .001$, $\eta^2_p = .253$].

To further explore these significant interaction effects, we again computed three difference scores for each type of target, namely *Diff4*, *Diff5*, and *Diff6*. When we compared the latter two against the former (using two Bonferroni corrected paired t-tests), we found that *Diff4* was significantly larger than both *Diff5* and *Diff6*, irrespective of target type, all *ts*(89) > 2.53, *ps* ≤ .013, 95% CIs [> 0.05, < 1.35], each Cohen's d_z > 0.26. To further examine whether the difference scores differed from zero, we run a series of Bonferroni-corrected one-sample t-tests. Based on our findings from Study 1, we expected that *Diff4* would fail to differ significantly from zero. In line with this prediction, no significant difference was found for anger ratings in response to envious targets, $t(89) = 1.58$, $p = .118$, 95% CI [-0.30, 0.03], Cohen's $d = 0.16$. But unexpectedly affectionate and proud targets attracted significantly higher happiness ratings when they were seen with social companions than in isolation, both *t*s(89) > 2.64, *p*s ≤ .010, 95% CIs [> 0.02, <0.23], each Cohen's *d* > 0.27. Furthermore, one marginally significant result raised the possibility that guilty targets also elicited higher sadness ratings when seen with such companions than in isolation, $t(89) = 2.38$, $p = .019$, 95% CI [0.03, 0.32], Cohen's $d = 0.25$.

Table 2.
Mean target-relevant basic emotion ratings (and their standard deviations) by context type and trial type as obtained in Study 2 for all four types of targets.

Target Type	Affectionate	Envious	Guilty	Proud
A) Targets With and Without Social Companions				
With	6.44 (0.44)	4.16 (0.85)	5.02 (0.78)	6.22 (0.52)
Without	6.35 (0.46)	4.29 (0.82)	4.84 (0.66)	6.08 (0.46)
Diff4 (With – Without)	0.09 (0.32)	-0.13 (0.81)	0.17 (0.69)	0.14 (0.41)
B) Targets With and Without Social Distractors				
With	6.10 (0.57)	3.89 (0.93)	4.07 (0.88)	5.14 (0.82)
Without	6.38 (0.44)	4.27 (0.74)	4.82 (0.76)	6.15 (0.51)
Diff5 (With – Without)	-0.28 (0.40)	-0.38 (0.73)	-0.75 (0.76)	-1.01 (0.77)
C) Targets With and Without Objects				
With	6.09 (0.54)	3.66 (0.86)	4.29 (0.87)	5.86 (0.67)
Without	6.34 (0.44)	4.25 (0.70)	4.72 (0.73)	6.14 (0.57)
Diff6 (With – Without)	-0.26 (0.39)	-0.59 (0.66)	-0.43 (0.79)	-0.28 (0.55)

With regards to *Diff5*, the findings largely confirmed our results from Study 1. *Diff5* was significantly smaller than zero for all four types of targets, all *t*s(89) > 4.85, *p*s < .001, 95% CIs [> -0.91, < -0.19], each Cohen's *d* > 0.50, indicating that targets with distractors attracted lower target-relevant basic emotion ratings than isolated targets. In going beyond Study 1, we also found that *Diff6* was significantly smaller than zero for all four types of targets, all *t*s(89) > 4.84, *p*s < .001, 95% CIs [> -0.73, < -0.16], each Cohen's *d* > 0.50,

indicating that targets with objects attracted even lower target-relevant basic emotion ratings than isolated targets.

In a final step, we used a series of Bonferroni-corrected t-tests to directly compare equivalent difference scores for participants' social and basic emotion ratings for each type of target (i.e., *Diff1* versus *Diff4*, *Diff2* versus *Diff5*, and *Diff3* versus *Diff6*). Based on our findings from Study 1, we predicted that *Diff1* would be larger than *Diff4*. Our prediction was confirmed, irrespective of whether participants' ratings concerned affectionate targets, $t(89) = 6.91$, $p < .001$, 95% CI [0.33, 0.60], Cohen's $d_z = 0.73$, envious targets, $t(89) = 7.78$, $p < .001$, 95% CI [0.63, 1.06], Cohen's $d_z = 0.82$, guilty targets, $t(89) = 4.64$, $p < .001$, 95% CI [0.26, 0.65], Cohen's $d_z = 0.49$, or proud targets, $t(89) = 7.97$, $p < .001$, 95% CI [0.45, 0.74], Cohen's $d_z = 0.84$.

As per our preregistration, we further predicted no significant differences between *Diff2* and *Diff5*. Contrary to this prediction, the relevant contrasts returned three significant results and one marginally significant result: For affectionate targets, *Diff2* was significantly larger than *Diff5*, $t(89) = 3.20$, $p = .002$, 95% CI [0.08, 0.33], Cohen's $d_z = 0.34$. In contrast, for envious and proud targets, *Diff2* was significantly smaller than *Diff5*, both $ts(89) > 3.25$, $p \leq .002$, 95% CIs [> -0.65, < -0.12], each Cohen's $d_z > 0.33$. A similar result emerged for guilty targets, $t(89) = 2.37$, $p = .020$, 95% CIs [-0.35, -0.03], Cohen's $d_z = 0.25$. As per our preregistration, we also predicted no significant difference for comparisons involving *Diff3* and *Diff6*. Nevertheless, all four contrasts revealed that *Diff3* was significantly smaller than *Diff6*, irrespective of target type, all $ts(89) > 2.42$, $ps \leq .017$, 95% CIs [> -1.87, < -0.03], each Cohen's $d_z > 0.25$. Taken together, these findings suggest that the increase in ratings observed for isolated targets compared to targets with social distractors or objects is more pronounced for target-congruent social emotions than for target-relevant basic emotions (except for *Diff2* for affectionate targets).

Finally, in going beyond our preregistration, we also examined our basic emotion data by trial type to confirm that participants' ratings only showed context-dependent variation once context was made available, but not before (see SOM). Figure 5 presents participants' ratings for targets without context again averaged across all three types of (absent) contexts.

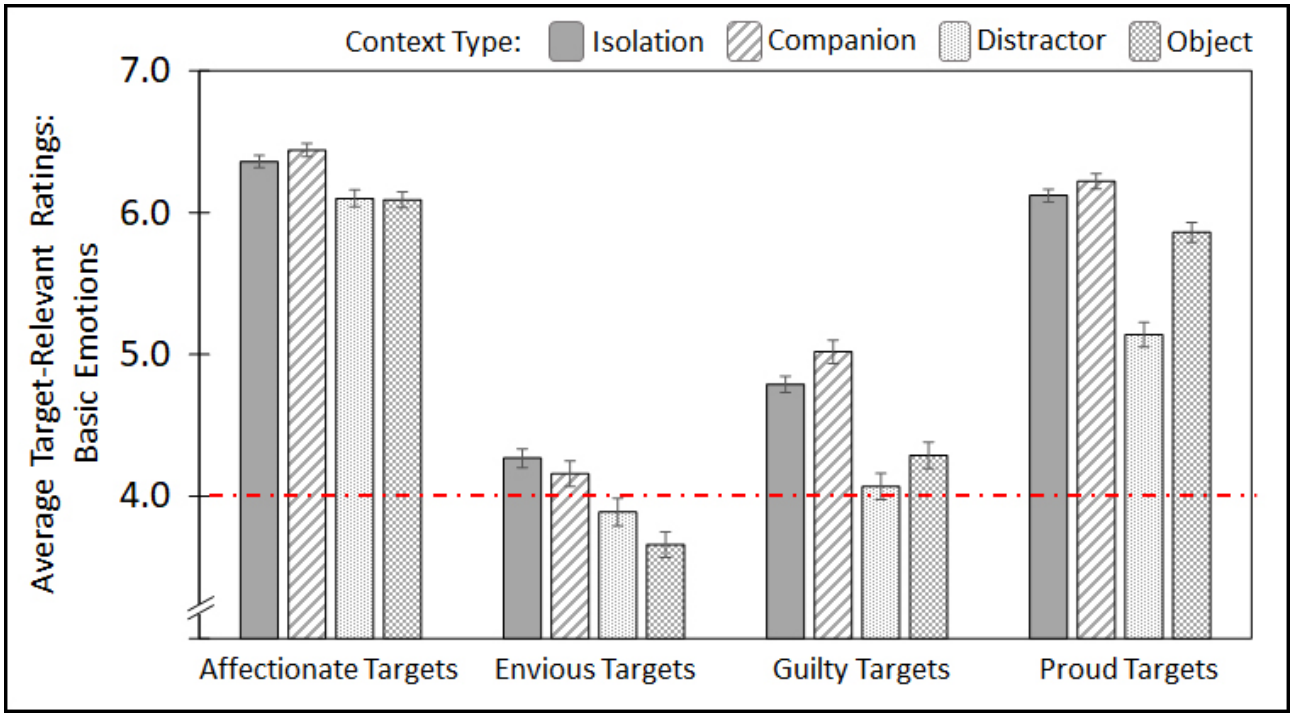

Figure 5. Mean target-relevant basic emotion ratings for affectionate, envious, guilty and proud targets by context type. Error bars indicate SEMs. The dashed line highlights the rating scale's midpoint. The outcomes of relevant planned contrasts are described in the main text.

Interim Discussion

Study 2 replicated that the perception of target-congruent social emotions was facilitated for targets with meaningful social companions, but not for targets with mere social distractors compared to isolated targets. In contrast to Study 1, Study 2 also captured a similar (albeit much weaker) facilitation effect for target-relevant basic emotions. Finally, in going beyond Study 1, Study 2 revealed a notable reduction in

emotion ratings for targets with objects compared to isolated targets. Considering that these condition-specific results can hardly be accounted for by Study 2's potential methodological limitations (e.g., order effects, see SOM for discussion), we conclude that the DFE can be captured irrespective of whether a between- or within-subject design is used for probing it. We further note that the observed differences in ratings for isolated targets and targets with objects (see SOM for additional analyses) support the notion that isolated targets may spontaneously be perceived as being interpersonally engaged rather than as lacking such engagement (like targets with objects). Though our object-related findings are ultimately limited in their interpretability (given the stimuli's uncontrolled perceived meaning/-fulness), they serve as an important reminder that future investigations interested in the true size of the DFE should aim to portray targets in unambiguously social and non-social contexts rather than in allegedly 'context-free' displays (cf. Chen & Whitney, 2019; Teoh et al., 2017).

General Discussion

When viewing meaningful social encounters from a third-person perspective, human perceivers habitually form rapid impressions about other people's interpersonal relations. Previous evidence suggested that these contextualized impressions can systematically facilitate the perception of complex emotions such as envy or romantic affection in unfamiliar others (Clarke et al., 2005; Lange et al., 2022; Silver & Sabini, 1978). The current paper hypothesized that these findings may not be accidental, but that social contextualization benefits the attribution of complex social emotions in a systematic manner. Based on this hypothesis, we designed two studies that examined the effects of meaningful social context on social emotion perception. In going beyond prior work on this topic, these studies included a larger set of social emotions, adopted stricter experimental controls, and compared context effects for social and basic emotion perception directly.

As predicted, both studies confirmed that the same emotionally expressive targets consistently elicit higher social emotion ratings when they are seen with, rather than without, meaningful social companions. Study 1 demonstrated that this facilitation effect cannot be accounted for by the social companions' appearance or nonverbal behavior alone, indicating that the effect is inherently relational (i.e., dyadic) and relies on the integration of perceptual information from two people (see also Clarke et al., 2005). Yet both studies also showed that seeing the same targets with mere social distractors was insufficient to trigger the DFE. In other words, the effect is not simply caused by social presence alone but requires the presence of an emotion-compatible companion.

Our data further suggests that use of social distractors can actively hinder the perception of target-congruent social emotions (compared to the use of isolated targets). With one exception: In the current studies, social distractors did not hinder the perception of affection. In fact, in Study 1, affection perception was slightly facilitated by them (though this effect was not replicated in Study 2). This exception acts as an important reminder that participants' ratings for targets with companions and targets with distractors showed noteworthy variations across social emotions and future research will be needed to better understand possible emotion-specific effects. For instance, perceptions of affection may prevail as long as two people show some form of positive nonverbal involvement (e.g., reciprocal smiles; see Bernieri et al., 1996), whereas perceptions of envy, guilt, or pride may require the detection of more intricate patterns of nonverbal coordination (Mesquita & Boiger, 2014). Consequently, the perception of affection may arise for a wider range of social partners than the perception of other social emotions.

In either case, the context-dependent findings in the current studies challenge the predominant use of isolated targets in emotion perception research and indicate that this traditional approach is particularly ill suited to study social emotion perception. This insight

may be of practical significance when it comes to understanding emotion perception deficits. For instance, despite 20 years of research, it remains unclear whether basic emotion recognition is systematically disturbed in autism (Uljarevic & Hamilton, 2013). Social emotion perception research, based on the dyadic paradigms developed here and elsewhere, could therefore help to examine disorder-related deficits for both basic and complex emotions (Heerey, Keltner, & Capps, 2003). But for such an extension of research to be well-advised, it is essential to better understand which mechanisms give rise to the DFE in neurotypical individuals.

Note that the current studies primarily aimed to demonstrate the existence of the DFE rather than to identify its underlying mental mechanism(s). Nevertheless, some of our analyses provide initial mechanistic insights. For example, careful data inspection shows that even isolated individuals conveyed specific social emotions to some degree in the current studies (see SOM for further discussion), favoring the notion that emotion-compatible companions help to disambiguate social emotion perception (cf. Keltner et al., 2019) rather than to initiate it (cf. Lange et al., 2022). Still, further research is needed to determine whether the observed DFE fully relies on apprehending meaningful social relations between people (as hypothesized here) or also has a perceptual origin.

Prior work on social context effects in basic emotion recognition has frequently discussed the influential role of contextual congruency. Contextual congruency refers to the observation that designated targets sometimes attract higher emotion ratings when seen in the company of another person that expresses the same basic emotion even when there is no meaningful link between them (see Abramson et al., 2021 for discussion). Interestingly, the current data suggest that this mechanism plays a minor role (if any) in the DFE, considering that the effect was found for social emotions with and without congruent nonverbal displays across individuals (e.g., affection dyads versus envy dyads).

Nevertheless, perceptual mechanisms other than emotional congruency may contribute to the DFE, such as perceptual averaging (i.e., a change in perception of an individual's emotional expression based on the average expression extracted from an array of emotionally expressive people; e.g., Haberman & Whitney, 2007) or perceptual priming (i.e., a change in perception of an individual's emotional expression based on unrelated people or objects surrounding them; e.g. Masuda et al., 2008).

Prior work on dyadic emotion perception has occasionally tried to rule out these perceptual alternatives by presenting the same individuals face-to-face and back-to-back (e.g., Abramson et al., 2020; Gray et al., 2017). This approach rests on the assumption that back-to-back presentations reliably undermine the perception of people's social relations (e.g., coordinated actions) while preserving pivotal visual relations between them (e.g., congruent expressions). When it comes to social emotion perception, this assumption is hard to uphold (cf. Lange et al., 2022). Not only can affective encounters convey meaningful social relations in back-to-back arrangements (e.g., when a target may try to conceal their negative emotion from a companion; see Figure S5 in our SOM for illustration), but such arrangements can also disturb the perceptual integration of individual-level features into dyadic configurations that may be essential for complex emotion perception (cf. Vestner et al., 2020).

Thus, while the study of dyadic emotion perception is an exciting new field, finding suitable control conditions to determine its contributing psychological mechanisms remains an ongoing experimental challenge. In acknowledgement of this challenge, the current work avoided the use of back-to-back dyads, but provided alternative evidence in favor of the influential role of social relations over perceptual relations in the arousal of the DFE. Specifically, it demonstrated that the DFE i) is more prevalent for social compared to basic emotions (a result which poses a theoretical challenge for conceptually indiscriminate

perceptual mechanisms), ii) can be elicited using a wide range of social encounters (i.e., in the absence of highly repetitive perceptual expressions and postures that could result in systematic congruency, averaging, or priming effects), and iii) disappears when seemingly interactive dyads lack meaningful social relations.

Not surprisingly though, each of these points comes with its own limitations that were not yet fully addressed in this initial investigation. Further evidence is needed, for instance, to verify that the observed difference in the DFE for social and basic emotions is a truly systematic phenomenon, considering that the size of context effects in basic emotion perception can be emotion- and expression-dependent (e.g., Aviezer et al., 2017; Clarke et al., 2005). Relatedly, the use of staged photographs in the current work allowed the portrayal of perceptually varied person dyads but may have encouraged an artificial overreliance on context cues by causing non-naturalistic emotion perception (e.g., Abramson et al., 2017). Moreover, the use of social distractors may not only have changed a dyad's perceived meaningfulness, but also its (ambiguous) meaning (see SOM for a more detailed discussion). Considering these caveats, the current findings await replication across emotions and stimuli.

On a related point, it remains to be established whether static stimuli (as used in the current study) are ideally suited to study social emotion perception. Note that exposure to such stimuli is not uncommon in daily life. After all, many couples post carefully curated relationship photographs on social networking sites in an attempt to display their affection for each other to third-party perceivers (Seidman et al. 2019). Nevertheless, static stimuli severely limit the range of nonverbal cues that perceivers can use when making social emotion judgments. Compared to dynamic stimuli (such as videos of social interactions or real-world observations), they lack informative temporal cues at the level of the individual (e.g., the speed of facial movements, cf. Krumhuber et al., 2023) and the level of the dyad

(e.g., the degree of synchronized movements; cf. Quadflieg & Westmoreland, 2019). Therefore, the use of static and dynamic stimuli may afford distinct insights into social emotion perception.

Despite these limitations, the current paper makes three important contributions: First, it provides additional evidence that inferring other people's social emotions can be facilitated by seeing them in meaningful social contexts rather than in isolation (cf. Clarke et al., 2005; Lange et al, 2022). In doing so it challenges the assumption that human emotion perception revolves around a small set of basic emotions (e.g., Ekman & Friesen, 1971) and supports the claim that understanding complex emotion perception remains an ongoing scientific challenge (e.g., Cowen et al., 2019; Feldman Barrett et al., 2019). Second, it advances experimental efforts to distinguish between social contexts indicative of interpersonal involvement versus mere social presence (cf. Hareli & David, 2017), thereby underscoring the importance of exploring different types of (social) context effects in emotion perception. Third, by presenting contextualized targets, it highlights a naturalistic method to convey whom other people's expressions refer to. In championing this method (see also Abramson et al., 2021; Gray et al., 2017; Harenski et al, 2018), it offers a feasible experimental approach to separate the study of self- and other-directed emotions in future emotion perception research.

Open Practices

Open Data at https://osf.io/6apgq/?view_only=56e285194acc4e5786704af70beebbd5

Pre-registration for Study 2 at osf.io/kt45r

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SUPPLEMENTARY ONLINE MATERIAL (SOM)

Pilot Study

Two novel sets of pictorial stimuli were created for our main studies. Both sets depict affective social encounters, but differ in their meaningfulness as outlined below.

Participants: An a-priori power analysis (run in G*Power 3.1.9.2; Faul et al., 2009) indicated that 52 valid participants would be needed to detect a moderate difference in the perceived meaningfulness of both sets of stimuli (i.e., Cohen's $d_z \geq 0.40$) with 80% power at an alpha level of 0.05 (using a two-tailed test). Accordingly, we recruited 56 participants from the University of Bristol community. In light of recent reports of age-based differences in emotion perception (e.g., Mill et al., 2009; Rim Noh & Isaacowitz, 2013) and to enhance consistency with our studies as reported in the main manuscript, five participants over 30 years of age were subsequently excluded. This resulted in a final sample of 51 valid participants (42 females; 18 to 29 years old, M = 20.69, SD = 2.71). All participants reported normal or corrected-to-normal vision and provided written informed consent before and after study completion. Participation in the study was remunerated with course credit or chocolates. The pilot study was reviewed and approved by the Faculty of Science Human Research Ethics Committee at the University of Bristol.

Materials: Two sets of stimuli were created by modifying color photographs downloaded from Shutterstock (www.shutterstock.com) using Adobe Photoshop© (Version 13.0). The first set consisted of 96 mixed-gender person dyads that depicted easy to read (i.e., meaningful) affective encounters between two White individuals (e.g., a couple in conflict, see Figure 1A in the main manuscript). Each encounter was selected to portray one of four social emotions, resulting in 24 affection dyads, 24 envy dyads, 24 guilt dyads and 24 pride dyads. All dyads were standardized in height and inserted on a white background (450 x 450 pixels). One individual per dyad was defined as the primary target of evaluation, whereas the other individual (i.e., the non-target) served as the target's emotion-compatible social companion. Target sex (i.e., male versus female) and location (i.e., right or left side of the dyad) was matched across all dyad types. Thumbnails of all meaningful dyads are reproduced in Figures S1 to S4 in adherence with Shutterstock's standard license terms of service. Asterisks (to identify designated targets) were not shown during the pilot study, but were added to identify relevant targets for our two main studies (and are included in the Figures below). Based on this initial set of dyads, a second set of 96 ambiguous mixed-gender person dyads was created (see Figure 1B in the main manuscript). This second set included the same targets and non-targets as the first set, but re-paired them in a pseudo-random manner (based on Quadflieg et al., 2015): Targets from affection dyads were combined with non-targets from envy dyads (and vice versa) and targets from pride dyads with non-targets from guilt dyads (and vice versa). For each new stimulus, the target's original location and overall dyad width was preserved (see Figure 1 in the main manuscript). Re-pairing of targets and non-targets was further constrained to support counterbalancing of stimuli across participants during data collection. To do so, each dyad was assigned to one of three compilations of stimuli in the pilot study. Neither compilation portrayed any of the targets or non-targets more than once, but each compilation contained eight affectionate targets, eight envious targets, eight guilty targets and eight proud targets per stimulus set (i.e., meaningful versus ambiguous).

Apparatus and Procedure: Participants were tested individually in a quiet room seated facing a Dell Desktop PC computer with a 19 inch display set to a resolution of 1920 x 1080 pixels. Instructions and stimuli were presented, and participants' responses recorded, using the Qualtrics survey tool (www.qualtrics.com). Upon arrival at the laboratory, participants were asked for their sex (as assigned by birth). Based on this information, they were assigned to one of three versions of the main task to ensure that each compilation of stimuli was rated by the same number of men and women (with three men and 14 women per compilation). All participants were required to complete one block of 64 randomized experimental trials. On each trial, they were shown one dyad with the following question displayed underneath: 'To what extent do you understand what is going on in this photograph?' Participants responded to this question on an rating scale, ranging from 1 (0%) to 11 (100%) in 10% increments. The main task was preceded by two practice trials using spare dyads. Following the main task, participants also filled in a brief questionnaire before they were debriefed about the study and thanked for their time. The questionnaire included the updated brief version of the Schizotypal Personality Questionnaire (SPQ-BRU, Davidson et al., 2016). It also prompted participants to report their sex (as assigned at birth), age (in years), nationality (as listed in their passport), self-identified race, and highest level of education (in this order).

Results and Discussion: Participants' ratings were first averaged and then submitted to a 2 (dyad type: meaningful vs. ambiguous) × 4 (target type: affectionate, envious, guilty, versus proud) repeated measures analysis of variance (see Table S1). The analysis returned a significant main effect of dyad type [$F(1,50) = 643.81$, $p < .001$, $\eta^2_p = .928$], a significant main effect of target type [$F(3,150) = 17.51$, $p < .001$, $\eta^2_p = .259$], and a significant interaction effect [$F(3,150) = 71.44$, $p < .001$, $\eta^2_p = .588$]. As intended, the main effect of dyad type indicated that meaningful dyads ($M = 8.44$, $SD = 1.03$) elicited higher comprehension ratings than ambiguous dyads ($M = 4.70$, $SD = 1.39$). To confirm that this effect prevailed across all types of targets despite the significant interaction effect, four additional pairwise estimated marginal means comparisons were run. These comparisons revealed significantly higher ratings for meaningful than for ambiguous dyads for each of our four targets, all *p*s < .001, all 95% CIs [> 1.42, < 5.26], each Cohen's $d > 1.53$. We then used eight one-sample t-tests to compare the average rating for each experimental condition against the rating scale's midpoint (i.e., 6). As expected, ratings for meaningful dyads fell consistently above the scale's midpoint, all *t*s(50) > 3.37, all *p*s ≤ .001, all 95% CIs [> 0.34, < 3.82], each Cohen's $d > 0.46$. In contrast, ratings for ambiguous dyads fell consistently below the scale's midpoint, all *t*s(50) > 3.35, all *p*s ≤ .002, all 95% CIs [> -2.20, < -.35], each Cohen's $d > 0.46$. In summary, these results confirm that the pseudo-random pairing of targets and non-targets succeeded at undermining the perception of meaningful relations between them.

Table S1. *Mean participant ratings by target type and dyad type (with standard deviations in brackets) as collected in the Pilot Study.*

Target Type	Affectionate	Envious	Guilty	Proud
Ambiguous Dyads	4.67 (1.41)	5.11 (1.89)	4.24 (1.49)	4.77 (1.49)
Meaningful Dyads	9.50 (1.10)	6.86 (1.82)	8.50 (1.50)	8.90 (1.16)

Figure S1. Thumbnails of all meaningful affection dyads as presented in the pilot study. All dyads were prepared by downloading photographs from www.shutterstock.com and are reproduced here in adherence with the company's standard license terms of service (http://www.shutterstock.com/licensing.mhtml).

Figure S2. Thumbnails of all meaningful envy dyads as presented in the pilot study. All dyads were prepared by downloading photographs from www.shutterstock.com and are reproduced here in adherence with the company's standard license terms of service (http://www.shutterstock.com/licensing.mhtml).

Figure S3. Thumbnails of all meaningful guilt dyads as presented in the pilot study. All dyads were prepared by downloading photographs from www.shutterstock.com and are reproduced here in adherence with the company's standard license terms of service (http://www.shutterstock.com/licensing.mhtml).

Figure S4. Thumbnails of all meaningful pride dyads as presented in the pilot study. All dyads were prepared by downloading photographs from www.shutterstock.com and are reproduced here in adherence with the company's standard license terms of service (http://www.shutterstock.com/licensing.mhtml).

Study 1: Additional Information

Social Emotion Ratings: Manipulation Check

To verify that our targets portrayed the intended social emotions when seen with their meaningful social companions, participants' ratings were first averaged by target type and judgment type for this condition (see Table S2).These averages were then submitted to a 4 (target type: affectionate, envious, guilty, versus proud) × 4 (judgment type: affection, envy, guilt, versus pride) repeated measures ANOVA. This analysis returned a significant main effect of target type [$F(3,231) = 126.71$, $p < .001$, $\eta^2_p = .622$], a significant main effect of judgment type [$F(3,231) = 150.89$, $p < .001$, $\eta^2_p = .662$] and a significant target type × judgment type interaction effect [$F(9,693) = 736.76$, $p < .001$, $\eta^2_p = .905$]. Given the significant interaction effect, we also run a series of (Bonferroni-corrected) pairwise estimated marginal means comparisons to assess each target-congruent rating against all target-incongruent ratings per type of target. As expected, affectionate targets elicited higher affection ratings than target-incongruent envy ratings, guilt ratings, and pride ratings, all *ps* < .001, all 95% CIs [> 0.76, < 4.41], each Cohen's $d_z > 1.10$. Envious targets elicited higher envy ratings than target-incongruent affection ratings, guilt ratings, and pride ratings, all *ps* < .001, all 95% CIs [> 2.29, < 3.07], each Cohen's $d_z > 2.14$. Guilty targets elicited higher guilt ratings than target-incongruent affection ratings, envy ratings, and pride ratings, all *ps* < .001, all 95% CIs [> 2.01, < 3.73], each Cohen's $d_z > 2.06$. Proud targets elicited higher pride ratings than target-incongruent affection ratings, envy ratings, and guilt ratings, all *ps* < .001, all 95% CIs [> 0.17, < 4.12], each Cohen's $d_z > 0.47$. In summary, when seen with meaningful social companions, all four types of targets conveyed their designated social emotion more so than any other social emotion.

Table S2.
Mean social emotion ratings (and their standard deviations) as obtained in Study 1 for all four types of targets when seen with their meaningful social companions. Target-congruent social emotion ratings are shown in bold.

Target Type		Affectionate	Envious	Guilty	Proud
Judgment Type	Affection	**5.92 (0.58)**	2.79 (0.75)	2.20 (0.75)	5.29 (0.71)
	Envy	2.17 (0.89)	**5.36 (0.85)**	2.94 (1.05)	2.49 (0.86)
	Guilt	1.71 (0.55)	2.62 (0.90)	**5.20 (0.69)**	1.72 (0.55)
	Pride	4.95 (0.86)	2.52 (0.69)	1.67 (0.57)	**5.62 (0.69)**

Social Emotion Ratings: Remaining Conditions

For reasons of data transparency, we also averaged participants' social emotion ratings by target type and judgment type for isolated targets and for targets with ambiguous social distractors. The descriptive statistics as shown in Table S3 revealed that most targets preferentially conveyed their congruent social emotion irrespective of context type (with the exception of proud targets with distractors).

Table S3.
Mean social emotion ratings (and their standard deviations) as obtained in Study 1 for all four types of targets when seen in isolation and with ambiguous social distractors. Target-congruent social emotion ratings are shown in bold.

Target Type		Affectionate	Envious	Guilty	Proud
A) Targets in Isolation					
Judgment Type	Affection	**5.17 (0.90)**	2.33 (0.74)	2.01 (0.59)	4.42 (0.95)
	Envy	2.16 (0.80)	**4.51 (0.94)**	3.68 (1.11)	2.31 (0.81)
	Guilt	1.79 (0.63)	3.02 (0.91)	**4.78 (0.70)**	1.88 (0.67)
	Pride	4.71 (0.98)	2.26 (0.76)	1.84 (0.57)	**4.85 (0.77)**
B) Targets with Ambiguous Social Distractors					
Judgment Type	Affection	**5.42 (0.78)**	2.97 (0.92)	2.67 (0.80)	4.14 (0.85)
	Envy	2.93 (0.92)	**4.05 (1.01)**	3.80 (0.86)	2.08 (0.65)
	Guilt	1.76 (0.58)	2.63 (0.74)	**3.94 (0.94)**	2.19 (0.69)
	Pride	4.78 (0.92)	2.45 (0.83)	2.41 (0.83)	**3.90 (0.95)**

Social Emotion Ratings: Irreducibility of the Dyadic Facilitation Effect

To rule out that the dyadic facilitation effect (DFE) during social emotion perception as observed in Study 1 was simply driven by the non-targets' nonverbal displays, we run additional analyses that exploited the fact that all non-targets were shown twice throughout the study. For instance, the original affectionate non-targets were shown with affectionate targets (as meaningful social companions) and with envious targets (as ambiguous social distractors). Vice versa, the original envious non-targets were shown with affectionate targets (as ambiguous social distractors) and with envious targets (as meaningful social companions). Accordingly, we submitted perceivers' average ratings for these conditions to a 2 (target type: affectionate vs. envious) × 2 (non-target type: affectionate vs. envious) × 4 (judgment type: affection, envy, guilt, and pride) repeated measures ANOVA (see Table S4). All main and interaction effects for this analysis reached statistical significance, all $Fs > 3.65$, all $ps < .014$, each $\eta^2_p > .044$.

Relatedly, all original guilty non-targets were shown with guilty targets (as meaningful social companions) and with proud targets (as ambiguous social distractors). Vice versa, all original proud non-targets were shown with guilty targets (as ambiguous social distractors) and with proud targets (as meaningful social companions). Therefore, we also submitted perceivers' average ratings for these conditions to a 2 (target type: guilty vs. proud) × 2 (non-target type: guilty vs. proud) × 4 (judgment type: affection, envy, guilt, and pride) repeated measures ANOVA (see Table S5). Again, all main effects and interaction effects reached statistical significance, all $Fs > 28.22$, all $ps < .001$, each $\eta^2_p > .267$. Given the significant three-way interactions in both analyses, we then followed up on them with a series of estimated marginal means comparisons that were of theoretical interest.

Table S4*.
Mean social emotion ratings (and their standard deviations) as obtained in Study 1 for affectionate and envious non-targets when seen with emotion-compatible and emotion-incompatible targets.

	Affectionate Non-Targets		*Envious Non-Targets*	
Judgment Type	*Affectionate Targets*	*Envious Targets*	*Affectionate Targets*	*Envious Targets*
Affection	**5.92 (0.58)**	**2.97 (0.92)**	5.42 (0.78)	2.79 (0.75)
Envy	2.17 (0.89)	4.05 (1.01)	**2.93 (0.92)**	**5.36 (0.85)**
Guilt	1.71 (0.55)	2.63 (0.74)	1.76 (0.58)	2.62 (0.90)
Pride	4.95 (0.86)	2.45 (0.83)	4.78 (0.92)	2.52 (0.69)

**Please note that data shown in this table can also be found in Tables 2 and 3, but are repeated here in a new arrangement and with different labels to match the logic of our additional analyses.*

Table S5*.
Mean social emotion ratings (and their standard deviations) as obtained in Study 1 for guilty and proud non-targets when seen with emotion-compatible and emotion-incompatible targets.

	Guilty Non-Targets		*Proud Non-Targets*	
Judgment Type	*Guilty Targets*	*Proud Targets*	*Guilty Targets*	*Proud Targets*
Affection	2.20 (0.75)	4.14 (0.85)	2.67 (0.80)	5.29 (0.71)
Envy	2.94 (1.05)	2.08 (0.65)	3.80 (0.86)	2.49 (0.86)
Guilt	**5.20 (0.69)**	**2.19 (0.69)**	3.94 (0.94)	1.72 (0.55)
Pride	1.67 (0.57)	3.90 (0.95)	**2.41 (0.83)**	**5.62 (0.69)**

**Please note that data shown in this table can also be found in Tables 2 and 3, but are repeated here in a new arrangement and with different labels to match the logic of our additional analyses.*

First, we examined whether perceivers' (target-directed) ratings as elicited by dyads with the same type of non-target (e.g., affectionate non-targets) differed for the social emotion that was congruent with this non-target (i.e., affection). Note that equivalent ratings of this kind would be expected if perceivers relied solely on the non-targets' appearances to inform their (target-directed) ratings. Therefore, we conducted four (Bonferroni-corrected) pairwise comparisons of interest (marked in bold in Tables S4 and S5). Contrary to the notion of equivalent ratings across conditions, all comparisons were statistically significant: Affection ratings for dyads with affectionate non-targets were higher when seen with affectionate targets than with envious targets, $p < .001$, 95% CI [2.71, 3.18], Cohen's $d_z = 2.80$. Envy ratings for dyads with envious non-targets were higher when seen with envious targets than with affectionate targets, $p < .001$, 95% CI [2.19, 2.67], Cohen's $d_z = 2.28$. Guilt ratings for dyads with guilty non-targets were higher when seen with guilty targets than with proud targets, $p < .001$, 95% CI [2.81, 3.21], Cohen's d_z

= 3.41. Pride ratings for dyads with proud non-targets were higher when seen with proud targets than with guilty targets, $p < .001$, 95% CI [3.01, 3.43], Cohen's $d_z = 3.51$. In other words, there was no evidence that participants' elevated ratings for targets with meaningful companions (as reported in the main manuscript) were simply due to the non-targets' nonverbal displays.

Second, we examined whether perceivers' (target-directed) ratings as elicited by dyads from conditions with the same type of target (e.g., affectionate targets) differed for the social emotion that was congruent with the emotion-incompatible non-target (i.e., envy). Note that equivalent ratings of this kind would be expected if perceivers largely dismissed (or fully re-interpreted) the non-targets' appearances to inform their (target-directed) ratings. Therefore, we conducted four (Bonferroni-corrected) pairwise comparisons of interest (marked in grey in Tables S4 and S5). Contrary to the notion of equivalent ratings across conditions, three of the comparisons reached statistical significance: Envy ratings for affectionate targets were higher when seen with envious non-targets than with affectionate non-targets, $p < .001$, 95% CI [0.56, 0.95], Cohen's $d_z = 0.89$. Guilt ratings for proud targets were higher when seen with guilty non-targets than with proud non-targets, $p < .001$, 95% CI [0.34, 0.61], Cohen's $d_z = 0.78$. Pride ratings for guilty targets were higher when seen with proud non-targets than with guilty non-targets, $p < .001$, 95% CI [0.58, 0.90], Cohen's $d_z = 1.05$. Finally, affection ratings for envious targets were higher when seen with affectionate non-targets than with envious non-targets, but this difference failed to reach statistical significance, $p = .131$, 95% CI [0.05, 0.41], Cohen's $d_z = 0.17$. These data indicate that participants' (target-directed) ratings were generally affected by incompatible non-targets in a predictable manner. Based on this observation, we called the latter social distractors as they distracted from the targets' congruent social emotion in a systematic manner.

Basic Emotion Ratings: Assumption Check

We expected each target to preferentially portray one of four basic emotions when shown with their meaningful social companions. To examine this assumption, we averaged the relevant ratings and carried out a 4 (target type: affectionate, envious, guilty, versus proud) $\times$ 4 (judgment type: anger, happiness, sadness, surprise) repeated measures ANOVA (see Table S4). There was a significant main effect of target type [$F(3,231) = 64.21$, $p < .001$, $\eta^2_p = .455$], a significant main effect of judgment type [$F(3,231) = 192.81$, $p < .001$, $\eta^2_p = .715$] and a significant interaction effect [$F(9,693) = 692.18$, $p < .001$, $\eta^2_p = .900$]. Given the significant interaction effect, we again run a series of (Bonferroni-corrected) pairwise estimated marginal means comparisons to contrast each target-relevant rating against all target-irrelevant ratings per type of target. As expected, for affectionate targets, target-relevant happiness ratings exceeded target-irrelevant anger ratings, sadness ratings, and surprise ratings, all *ps* < .001, all 95% CIs [> 2.31, < 5.13], each Cohen's $d_z > 2.13$. Similarly, for guilty targets, target-relevant sadness ratings exceeded target-irrelevant anger ratings, happiness ratings, and surprise ratings, all *ps* < .001, all 95% CIs [> 0.42, < 2.91], each Cohen's $d_z > 0.79$. For envious targets, however, target-relevant anger ratings exceeded only target-irrelevant happiness ratings and surprise ratings, both *ps* < .001, both 95% CIs [> 0.48, < 1.60], each Cohen's $d_z > 0.69$, but failed to differ significantly from sadness ratings, $p = .523$, 95% CI [-0.11, 0.21], Cohen's $d_z = 0.07$. Furthermore, for proud targets, target-relevant surprise ratings exceeded only target-irrelevant anger ratings and sadness ratings, both *p*s < .001, both 95% CIs [> 1.99, < 2.46], each Cohen's $d_z > 2.27$, but fell significantly below happiness ratings, $p < .001$, 95% CI [-2.49, -2.01], Cohen's $d_z = 2.09$. To accommodate these unexpected findings, the main analyses of Study 1 considered those basic emotions as target-relevant that had descriptively obtained the

highest average ratings in the meaningful social companion condition (i.e., happiness ratings for affectionate and proud targets, anger ratings for envious targets, and sadness ratings for guilty targets).

Table S4.
Mean basic emotion ratings (and their standard deviations) as obtained in Study 1 for all four types of targets when seen with their meaningful social companions. Target-relevant basic emotion ratings are highlighted in grey.

Target Type		Affectionate	Envious	Guilty	Proud
Judgment Type	Anger	1.39 (0.35)	4.12 (0.79)	4.22 (1.00)	1.61 (0.48)
	Happiness	6.36 (0.43)	2.78 (0.64)	2.18 (0.59)	6.08 (0.54)
	Sadness	1.52 (0.44)	4.07 (0.87)	4.81 (0.87)	1.59 (0.50)
	Surprise	3.76 (1.09)	3.40 (0.98)	3.96 (0.95)	3.83 (0.97)

Basic Emotion Ratings: Remaining Conditions
As before, to enhance data transparency, we also averaged participants' basic emotion ratings by target type and judgment type in the remaining experimental conditions (see Table S5). The resulting descriptive statistics indicate that most targets preferentially conveyed their relevant basic emotion as determined above irrespective of context type (with the exception of envious targets in isolation).

Table S5.
Mean basic emotion ratings (and their standard deviations) as obtained in Study 1 for all four types of targets when seen in isolation and with social distractors. Target-relevant basic emotion ratings are highlighted in grey.

Target Type		Affectionate	Envious	Guilty	Proud
A) Targets in Isolation					
Judgment Type	Anger	1.45 (0.42)	4.17 (0.70)	4.13 (0.92)	1.81 (0.50)
	Happiness	6.27 (0.44)	2.68 (0.67)	2.25 (0.67)	5.98 (0.50)
	Sadness	1.60 (0.55)	4.17 (0.74)	4.92 (0.67)	1.69 (0.49)
	Surprise	3.99 (0.96)	3.44 (0.91)	3.88 (0.87)	3.94 (0.95)
B) Targets with Ambiguous Social Distractors					
Judgment Type	Anger	1.53 (0.41)	3.92 (0.78)	3.83 (0.81)	2.22 (0.60)
	Happiness	6.17 (0.45)	2.94 (0.85)	2.72 (0.67)	5.43 (0.62)
	Sadness	1.70 (0.51)	3.81 (0.94)	4.30 (0.77)	1.98 (0.62)
	Surprise	3.65 (1.13)	3.41 (1.05)	3.71 (1.02)	3.62 (1.06)

Study 2: Additional Information

Social Emotion Ratings: Manipulation Check

As in Study 1, we examined whether each type of target attracted higher target-congruent than target-incongruent social emotion ratings when seen with their meaningful social companions. To do so, we carried out two 2 (target type) × 2 (judgment type) repeated measures ANOVAs on participants' relevant average ratings, separately for positively and negatively valenced targets (see Table S6).

Table S6.
Mean social emotion ratings (and their standard deviations) as obtained in Study 2 for all four types of targets when seen with their meaningful social companions. Target-congruent social emotion ratings are highlighted in grey.

Target Type		Affectionate	Envious	Guilty	Proud
Judgment Type	Affection	6.04 (0.61)	-	-	5.47 (0.75)
	Envy	-	5.20 (0.85)	3.11 (1.21)	-
	Guilt	-	2.80 (0.96)	5.43 (0.67)	-
	Pride	5.13 (0.96)	-	-	5.91 (0.60)

For positively valenced targets, the relevant 2 (target type: affectionate versus proud) × 2 (judgment type: affection vs. pride) repeated measures ANOVA returned a significant main effect of target type [$F(1,89) = 4.47$, $p = .037$, $\eta^2_p = .048$], a significant main effect of judgment type [$F(1,89) = 13.32$, $p < .001$, $\eta^2_p = .130$] and a significant two-way interaction effect [$F(1,89) = 170.16$, $p < .001$, $\eta^2_p = .657$]. Two additional (Bonferroni-corrected) pairwise estimated marginal means comparisons confirmed that affectionate targets attracted higher affection ratings than pride ratings, $p < .001$, 95% CI [0.73, 1.09], Cohen's $d_z = 1.06$, whereas proud targets attracted higher pride ratings than affection ratings, $p < .001$, 95% CI [0.30, 0.59], Cohen's $d_z = 0.63$. For negatively valenced targets, the relevant 2 (target type: envious versus guilty) × 2 (judgment type: envy versus guilt) repeated measures ANOVA returned a significant main effect of target type [$F(1,89) = 19.36$, $p < .001$, $\eta^2_p = .179$], no main effect of judgment type [$F(1,89) = 0.49$, $p = .484$, $\eta^2_p = .006$], and a significant two-way interaction effect [$F(1,89) = 598.77$, $p < .001$, $\eta^2_p = .871$]. Two additional (Bonferroni-corrected) pairwise estimated marginal means comparisons confirmed that envious targets attracted higher envy ratings than guilt ratings, $p < .001$, 95% CI [2.19, 2.62], Cohen's $d_z = 2.37$, whereas guilty targets attracted higher guilt ratings than envy ratings, $p < .001$, 95% CI [2.07, 2.56], Cohen's $d_z = 1.97$. In summary, just as in Study 1, all targets conveyed the intended social emotions when seen with their meaningful social companions.

Social Emotion Ratings: Further Conditions

For reasons of data transparency, we also averaged participants' social emotion ratings by target type and judgment type in the remaining experimental conditions (see Table S7). As in Study 1, the descriptive statistics indicate that most targets preferentially conveyed their designated social emotion irrespective of context type (except for envious and proud targets with ambiguous social distractors).

Table S7.
Mean social emotion ratings (and their standard deviations) as obtained in Study 2 for all four types of targets when seen in isolation, with social distractors, and with objects. Target-congruent social emotion ratings are highlighted in grey.

Target Type		Affectionate	Envious	Guilty	Proud
A) Targets in Isolation					
Judgment Type	Affection	5.55 (0.58)	-	-	4.86 (0.69)
	Envy	-	4.51 (0.73)	3.85 (0.88)	-
	Guilt	-	3.08 (0.71)	4.77 (0.58)	-
	Pride	4.99 (0.66)	-	-	5.20 (0.59)
B) Targets with Ambiguous Social Distractors					
Judgment Type	Affection	5.48 (0.76)	-	-	3.94 (1.01)
	Envy	-	3.82 (1.03)	3.93 (0.87)	-
	Guilt	-	2.72 (0.86)	3.87 (0.97)	-
	Pride	4.77 (0.90)	-	-	3.77 (1.05)
C) Targets with Objects					
Judgment Type	Affection	3.74 (1.38)	-	-	3.48 (1.33)
	Envy	-	3.64 (1.18)	3.09 (1.13)	-
	Guilt	-	2.94 (0.98)	4.06 (1.06)	-
	Pride	3.30 (1.43)	-	-	3.62 (1.41)

Social Emotion Ratings: Trial Type Analysis
Participants' average ratings were analyzed in a 4 (target type: affectionate, envious, guilty, versus proud) × 3 (context type: companion, distractor, versus object) repeated measures ANOVA separately for both types of trials (i.e., targets without context vs. targets with context). As expected, for targets without context (shown during part 1 of Study 2), there was neither a significant main effect of context type [$F(2,178) = 0.38$, $p = .682$, $\eta^2_p = .004$], nor a significant context type × target type interaction effect [$F(6,534) = 1.02$, $p = .415$, $\eta^2_p = .011$]. Only a significant main effect of target type emerged [$F(3,267) = 80.58$, $p < .001$, $\eta^2_p = .475$]. By contrast, for targets with context (shown during part 2 of Study 2), there was a significant main effect of target type [$F(3,267) = 43.35$, $p < .001$, $\eta^2_p = .328$], a significant main effect of context type [$F(2,178) = 241.73$, $p < .001$, $\eta^2_p = .731$] and a significant context type × target type interaction [$F(6,534) = 53.43$, $p = .001$, $\eta^2_p = .375$].

Basic Emotion Ratings: Assumption Check
As in Study 1, we examined whether each type of target attracted higher target-relevant than target-irrelevant basic emotion ratings when seen with their meaningful social companions. To do so, we carried out two 2 (target type) × 2 (judgment type) repeated measures ANOVAs on participants' relevant average ratings, separately for positively and negatively valenced targets (see Table S8).

Table S8.
Mean basic emotion ratings (and their standard deviations) as obtained in Study 2 for all four types of targets when seen with their meaningful social companions. Target-relevant basic emotion ratings are highlighted in grey.

Target Type		Affectionate	Envious	Guilty	Proud
Judgment Type	Anger	-	4.16 (0.85)	4.21 (0.99)	-
	Happiness	6.44 (0.44)	-	-	6.22 (0.52)
	Sadness	-	3.96 (0.93)	5.02 (0.78)	-
	Surprise	3.92 (1.10)	-	-	4.17 (1.02)

For positively valenced targets, the relevant 2 (target type: affectionate versus proud) × 2 (judgment type: happiness versus surprise) repeated measures ANOVA returned no significant main effect of target type [$F(1,89) = 0.18$, $p = .673$, $\eta^2_p = .002$], but a significant main effect of judgment type [$F(1,89) = 507.08$, $p < .001$, $\eta^2_p = .851$], and a significant two-way interaction effect [$F(1,89) = 22.75$, $p < .001$, $\eta^2_p = .204$]. As before, we used two additional (Bonferroni-corrected) pairwise estimated marginal means comparisons to follow up on contrasts of theoretical interest. As expected, we found that affectionate targets attracted higher happiness ratings than surprise ratings, $p < .001$, 95% CI [2.28, 2.75], Cohen's $d_z = 2.22$. In addition, consistent with our findings from Study 1 (but inconstant with our original expectations), proud targets also attracted higher happiness ratings than surprise ratings, $p < .001$, 95% CI [1.84, 2.26], Cohen's $d_z = 2.05$. For negative targets, the relevant 2 (target type: envious versus guilty) × 2 (judgment type: anger versus sadness) repeated measures ANOVA returned a significant main effect of target type [$F(1,89) = 61.36$, $p < .001$, $\eta^2_p = .408$], a significant main effect of judgment type [$F(1,89) = 20.30$, $p < .001$, $\eta^2_p = .186$] and a significant interaction [$F(1,89) = 82.46$, $p < .001$, $\eta^2_p = .481$]. Two additional (Bonferroni-corrected) pairwise estimated marginal means comparisons confirmed that envious targets attracted higher anger ratings than sadness ratings, $p = .022$, 95% CI [0.03, 0.36], Cohen's $d_z = 0.25$, whereas guilty targets attracted higher sadness ratings than anger ratings, $p < .001$, 95% CI [0.63, 0.99], Cohen's $d_z = 0.93$. As in Study 1, all subsequent analyses considered those basic emotion ratings as target-relevant that obtained the highest (descriptive) values for targets with meaningful social companions (i.e., happiness ratings for affectionate and proud targets, anger ratings for envious targets, and sadness ratings for guilty targets).

Basic Emotion Ratings: Further Conditions

For reasons of data transparency, we also averaged participants' basic emotion ratings by target type and judgment type in the remaining experimental conditions (see Table S9). As in Study 1, the descriptive statistics indicate that most targets preferentially conveyed their relevant basic emotion irrespective of context type (with the exception of envious targets with objects).

Table S9.
Mean basic emotion ratings (and their standard deviations) as obtained in Study 2 for all four types of targets when seen in isolation, with social distractors, and with objects. Target-relevant basic emotion ratings are highlighted in grey.

Target Type		Affectionate	Envious	Guilty	Proud
A) Targets in Isolation					
Judgment Type	Anger	-	4.27 (0.63)	4.11 (0.74)	-
	Happiness	6.36 (0.41)	-	-	6.12 (0.42)
	Sadness	-	4.06 (0.67)	4.79 (0.55)	-
	Surprise	4.00 (0.75)	-	-	4.01 (0.79)
B) Targets with Ambiguous Social Distractors					
Judgment Type	Anger	-	3.89 (0.93)	3.61 (0.97)	-
	Happiness	6.10 (0.57)	-	-	5.14 (0.82)
	Sadness	-	3.46 (0.93)	4.07 (0.88)	-
	Surprise	3.97 (0.91)	-	-	3.85 (0.89)
C) Targets with Objects					
Judgment Type	Anger	-	3.66 (0.86)	3.77 (1.02)	-
	Happiness	6.09 (0.54)	-	-	5.86 (0.67)
	Sadness	-	3.80 (0.97)	4.29 (0.87)	-
	Surprise	3.59 (0.99)	-	-	3.69 (0.92)

Basic Emotion Ratings: Explorative Trial Type Analysis
Participants' average ratings were analyzed in a 4 (target type: affectionate, envious, guilty, versus proud) × 3 (context type: companion, distractor, versus object) repeated measures ANOVA separately for both types of trials (i.e., targets without context and targets with context). As expected, for targets without context, there was neither a significant main effect of context type [$F(2,178) = 1.10$, $p = .336$, $\eta^2_p = .012$], nor a significant context type × target type interaction effect [$F(6,534) = 0.73$, $p = .628$, $\eta^2_p = .008$]. Only a significant main effect of target type emerged [$F(3,267) = 564.35$, $p < .001$, $\eta^2_p = .864$]. By contrast, for targets with context, this analysis revealed a significant main effect of target type [$F(3,267) = 456.42$, $p < .001$, $\eta^2_p = .837$], a significant main effect of context type [$F(2,178) = 137.85$, $p < .001$, $\eta^2_p = .608$] and a significant context type × target type interaction [$F(6,534) = 21.60$, $p = .001$, $\eta^2_p = .195$].

Social and Basic Emotion Ratings: Explorative Scale Midpoint Analysis
Our pre-registered analyses revealed that both social emotion ratings and basic emotion ratings were systematically lower for targets with objects than for isolated targets. To better understand this difference, we also run an explorative series of one-sample t-tests (uncorrected) to learn whether and how these two sets of ratings differed from the rating scales' midpoint ('4'). This midpoint was labelled 'undecided', whereas ratings above (below) this point declared it likely (unlikely) that a person felt a specific emotion. For

target-congruent social emotion ratings, these additional analyses revealed that none of the four types of targets elicited ratings above the scale's midpoint when shown with mere objects: Affectionate and guilty targets with objects attracted ratings that failed to differ from the midpoint, both *ts*(89) < 1.80, *ps* > .075, 95% CIs [> -0.54, < 0.29], each Cohen's *d* < 0.19, whereas envious and proud targets with objects elicited ratings that fell significantly below it, both *ts*(89) > 2.52, *ps* ≤ .013, 95% CIs [> -0.67, < -0.09], each Cohen's *d* > 0.25. In contrast, all four types of targets elicited ratings (averaged across all three types of contexts per target type, see Figure 5) that significantly exceeded the scale's midpoint when shown in isolation, all *ts*(89) > 6.67, all *ps* < .001, 95% CI [> 0.36, < 1.67], each Cohen's *d* > 0.69. In other words, perceivers only questioned the arousal of social emotions categorically once designated targets were seen in an object-only context (i.e., with objects), but not when they were seen without any context. But for target-relevant basic emotion ratings, a different pattern of results emerged. Specifically, for targets with objects, only anger ratings for envious targets fell significantly below the scale's midpoint, *t*(89) = 3.72, *p* <.001, 95% CI [-0.52, - 0.16], Cohen's *d* = 0.39, whereas all remaining ratings significantly exceeded the scales' midpoint, all *ts*(89) > 3.21, *p* ≤ .002, 95% CIs [> 0.11, < 2.20], Cohen's *d* > 0.32. Similarly, for isolated targets, all ratings (averaged across all three types of context, see also Figure 6) exceeded the scales' midpoint, all *ts*(89) > 4.07, *p* < .001, 95% CIs [> 0.13, < 2.45], Cohen's *d* > 0.42. Thus, perceivers declared the arousal of (most) basic emotions likely, irrespective of whether targets were seen with objects or without context.

Interim Discussion: Potential Study Confounds

In Study 2, contextualized targets (i.e., targets with social companions, social distractors, and objects) were always presented after participants had seen the same targets in isolation. This approach was adopted so that perceivers could provide naïve ratings for isolated targets without being biased by (memorized) contextual information. But it meant that the effect of condition was partially confounded by the order in which the different conditions appeared during the task. This circumstance carried several methodological risks: The mere repetition of stimuli may can cause participants to increase their ratings the second time they encounter the same target (e.g., Rozenkrants et al., 2008; Sawyer, 1975). So is this a likely explanation for the DFE as found in Study 2? If repetition per se could explain the observed increase in participants' ratings, a similar increase should also have been found for all contextualized stimuli (but the DFE was confined to targets with social companions). Nevertheless, it could still have happened that an order-dependent increase in ratings was limited to non-ambiguous targets (i.e., targets with social companions). In other words, the observed DFE may reflect an order × ambiguity interaction. But even this scenario seems unlikely, considering that such an interaction effect should have altered participants' social and basic emotions ratings in a similar manner (which was not the case). Finally, the repetition of stimuli may have caused fatigue that may have led to more careless or in-attentive responding the second time participants encountered the same target (e.g., Meade & Craig, 2012). For non-ambiguous contextualized targets (i.e., targets with social companions), such responding may have resulted in more extreme replies. In addition, for ambiguously contextualized targets (i.e., targets with distractors and targets with objects), such responding may have resulted in more random replies. If this was the case, however, similar effects should have been observed for social and basic emotion ratings for non-ambiguous targets. As for ambiguous targets, it must be noted that our results for targets with social distractors in Study 2 were very similar to those obtained in Study 1 (which involved no stimulus repetition), declaring the assumption of random replies rather unlikely. In addition, several

data quality checks were conducted before our main data analysis (as preregistered) in order to detect obvious forms of careless responding, such as unusually quick or consistent responders (see Study 2: Methods in the main manuscript).

Main Discussion: Additional Information

Though the current research demonstrates the existence of the DFE, it remains uncertain whether the effect relies on impressions of meaningful social relations between people and/or has a perceptual origin. To distinguish between these two competing possibilities, prior dyad perception research has sometimes used spatially rearranged person dyads as control stimuli. Figure S5 depicts two common spatial arrangements of person dyads as previously used in basic emotion perception research, namely face-to-face arrangements and back-to-back arrangements. It applies these arrangements to an envy dyad and a guilt dyad as used in the current work in order to illustrate that back-to-back arrangements do not necessarily interrupt the perception of meaningful social relations between people.

In our work, one alternative approach to study the specificity of the DFE involved the use of so-called ambiguous social distractors. The primary reason behind this approach was to demonstrate that it was not the mere presence of a second person that was driving the DFE (as it could be argued that any social context makes the perception of target-congruent social emotions more likely), but the presence of an emotion-compatible one. We believe that our use of social distractors was successful in this regard. However, our work fails to demonstrate why social distractors elicit different target-congruent social emotion ratings than social companions as there are competing possibilities: As shown in our Pilot Study, once our emotionally expressive targets were paired with emotion-incompatible distractors the arising ‘social’ situations were perceived as less meaningful. But even though they were perceived as less meaningful, these situations were not void of meaning, especially since superficial cues of interpersonal involvement – as per our intention – were typically preserved in these stimuli (such as people directing their eye gaze and/or gestures towards each other).

The situation shown in Figure 1B in the main manuscript, for example, could still be interpreted as the man feeling either intimidated or embarrassed by being less fit than the woman. Accordingly, perceivers may have reduced their ratings of his originally designated social emotion (guilt) not because the situation was considered ambiguous, but rather because it implied another meaning (and, correspondingly, another social emotion). Please note, however, that this possibility would directly support the argument we are trying to put forward – namely that social contexts can significantly change which social emotions are perceived in the exact same emotionally expressive targets once contexts are interpreted in a meaningful manner. In other words, while we cannot be sure whether the observed decrease in emotion-congruent social emotion ratings for targets with distractors in our work is due to a lack of meaning or a change in meaning, both would imply that the DFE’s arousal for a specific social emotion depends on the meaningful interpretation of people’s social relations. Nevertheless, future research is needed to demonstrate this proposed link directly.

Figure S5. Examples of two affective social encounters, showing the same two individuals in two different spatial arrangements, including face-to-face (as used in the current research) and back-to-back (for illustrative purposes only). All encounters were prepared by downloading photographs from www.shutterstock.com and are reproduced here in adherence with the company's standard license terms of service (http://www.shutterstock.com/licensing.mhtml).

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