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Nonverbal Channel Use in Communication of Emotion: How May Depend on Why

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This study investigated the hypothesis that different emotions are most effectively conveyed through specific, nonverbal channels of communication: body, face, and touch. Experiment 1 assessed the production of emotion displays. Participants generated nonverbal displays of 11 emotions, with and without channel restrictions. For both actual production and stated preferences, participants favored the body for embarrassment, guilt, pride, and shame; the face for anger, disgust, fear, happiness, and sadness; and touch for love and sympathy. When restricted to a single channel, participants were most confident about their communication when production was limited to the emotion's preferred channel. Experiment 2 examined the reception or identification of emotion displays. Participants viewed videos of emotions communicated in unrestricted and restricted conditions and identified the communicated emotions. Emotion identification in restricted conditions was most accurate when participants viewed emotions displayed via the emotion's preferred channel. This study provides converging evidence that some emotions are communicated predominantly through different nonverbal channels. Further analysis of these channel-emotion correspondences suggests that the social function of an emotion predicts its primary channel: The body channel promotes social-status emotions, the face channel supports survival emotions, and touch supports intimate emotions.

Keywords: nonverbal communication, social function, emotion display, touch

For social animals, answering questions about what another is feeling and how one should respond to that emotional state with its correlated actions is a key adaptational problem. For example, should I run *from* him or away *with* him? (Premack & Woodruff, 1978; Kozak, Marsh, & Wegner, 2006). Moreover, successfully communicating one's likely next action is an effective way to avoid risk or expending additional energy (i.e., a glare preempts a fight), to aid one's kin (i.e., a scream causes companions to run for cover), or to elicit supportive behaviors (i.e., a frown can extract a cookie; Campos, Campos, & Barrett, 1989). The importance of such communication precedes the evolution of verbal abilities (Darwin, 1872/1998; Parr, Waller, & Fugate, 2005; Masson & McCarthy, 1996). Therefore, it is not surprising that people communicate emotions through several nonverbal channels, including the face, body, and touch (Buck, 1984). Some channels may be better suited to convey some messages than others; a channel's communication efficacy has been shown to vary across some types of information conveyed, such as likability (Zuckerman & Driver, 1989), dominance (Hall, Coats, & Smith LeBeau, 2005), personality, and general mood (Ekman, Friesen, O'Sullivan, & Scherer, 1980). Do nonverbal communication channels vary in efficacy across specific emotions? If so, then the preferred channels for communicating should vary by emotion. In this study, we investigated whether people would prefer certain channels to communicate differing emotions and, if so, why.

We examined communication of a variety of emotions across multiple channels to demonstrate that (a) there are such preferences (Experiment 1), (b) people use preferred channels more frequently than nonpreferred channels to *produce* emotion displays (Experiment 1), and (c) people *identify* emotions more accurately through preferred channels (Experiment 2). We used the pattern of associations between emotions and channel preferences to develop a conceptual account that emotions are communicated most effectively through the channel whose communicative properties best support each emotion's social function.

Emotions Are Communicated Through Multiple Channels

Beginning with Darwin (1872/1998), researchers have demonstrated people's ability to produce and identify emotion displays communicated through a variety of nonverbal channels. These channels are often used simultaneously to communicate thoughts

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and intentions (Knapp & Hall, 1997). Although redundancy likely increases the odds that emotional messages are communicated quickly and accurately, people do not use *all* channels to convey *all* messages; it would require a tremendous expense of energy. Instead, some channels are more correlated with specific types of emotional expressions than others. In other words, the link between the message (i.e., the emotion) and the means by which it is communicated appears nonrandom. The power of the face to communicate anger, disgust, fear, happiness, and sadness is well documented (e.g., Ekman & Friesen, 1971; Izard, 1971; see also Ekman & Rosenberg, 2005), but some emotions appear better communicated through other channels, such as touch (Hertenstein & Campos, 2001; Hertenstein, Holmes, McCullough, & Keltner, 2009; Hertenstein, Keltner, App, Bulleit, & Jaskolka, 2006), body posture, and movement (Atkinson, Dittrich, & Gemmell, 2004; Coulson, 2004; Keltner, 1995; Keltner & Harker, 1998; Tracy & Robins, 2004a; Walk & Homan, 1984; Wallbott, 1998).

Despite substantial work suggesting that differing emotions are communicated in a variety of ways, it is not well understood whether there is order to this variation of emotional display production and what guides it. Recent research has documented that some emotions appear to be conveyed most effectively through channels other than the face; for example, pride is most effectively conveyed through body posture (Tracy & Robins, 2004a). However, few studies have directly compared communication efficacy through one channel versus another. Without this direct comparison, what appears to be a close association between an emotion and a particular nonverbal channel may reflect either a real preference over other channels, or the apparent pattern could be a meaningless artifact of the types of emotions included in previous studies assessing single-channel communication. If there are indeed real preferences, the pattern of differential associations may provide the foundation for a coherent account of why certain emotions may be best communicated through particular channels, whereas other emotions may be best communicated through other channels.

Present Research

The present research provides empirical evidence for systematic channel preferences across a wide range of emotions. We report two experiments that examined the relationship between the emotion and the primary channel of communication (i.e., body, face, and touch) used to communicate it. Because emotion displays serve functions that increase chances of survival for both the producer and the receiver (Darwin, 1872/1998; Fridlund, 1994), we examined both production and reception of emotion messages.[1] In Experiment 1, we investigated the production side of emotion communication. We examined whether there are channel preferences for producing displays that differ depending upon the emotion communicated. In Experiment 2, we investigated the reception side of emotion communication. We examined whether the same correspondences or links between primary communication channels and emotions hold for the visual identification of emotion displays. In addition, we used this distribution of preferences to identify clusters of emotions linked more closely with one or some channels than other clusters. Finally, we assessed these clusters and developed a theory to explain the variation in cluster-channel associations.

Experiment 1: Emotion Production

In Experiment 1, we focused on the *production* of displays of 11 different emotions (anger, disgust, embarrassment, fear, guilt, happiness, love, pride, sadness, shame, and sympathy) via three nonverbal channels: face, body, and touch. Is there an association between the emotions and the three communicative channels? If an emotion is differentially associated with the three channels, then channel preferences, use, and perceived communication efficacy (i.e., confidence) should be distributed nonrandomly across the three channels.

To investigate this question, we first asked participants to communicate each emotion as naturally and effectively as possible (*unrestricted production* condition). Second, we asked participants to indicate which of the three channels they would prefer to use to communicate each emotion, if they had to choose just one. Third, we asked participants to use a single, specified channel to communicate each emotion (*restricted condition*) and then evaluate their confidence in how well they communicated the emotion.

Method

Participants. Participants were 42 students who received extra credit in university psychology courses. Three participants failed to follow instructions and were excluded from analyses. The sample contained 39 participants (22 females; age: $M = 19.41$, $SD = 1.14$; 82% Caucasian, 13% Hispanic, and 5% other self-identified ethnicity). To determine whether results were driven by task order, a second sample of 27 participants (19 females; age: $M = 19.67$, $SD = 1.15$) completed the three tasks, but in an alternative order, as described below.

Stimuli. A set of 11 emotions was used in both Experiments 1 and 2: anger, disgust, embarrassment, fear, guilt, happiness, love, pride, sadness, shame, and sympathy. These emotions were selected due to their previously demonstrated use through one or more of the channels of interest: body (e.g., Tracy & Robbins, 2004a), face (e.g., Ekman & Friesen, 1971), and touch (Hertenstein et al., 2006).

Participants communicated emotions to a life-sized, human-like mannequin that had minimally defined, affectively neutral facial features (e.g., no mouth) and was soft to the touch. A mannequin was used because it was important for the recipient of the emotional production to be affectively neutral and not react differently across trials and participants. Prior to experimental trials, participants were introduced to the mannequin. The mannequin was seated and dressed casually in a T-shirt and sweatpants. Participants provided the name, gender, and relationship of a person they liked and to whom they felt close that they wanted the mannequin to represent. The mannequin was then referred to as this person for the duration of the session. For order 1, the mannequin represented

[1] It is important to note that outward displays of emotion may not correspond to the displayer's subjective emotional experience (see Fridlund, 1994, 1997). Therefore, the minimal conceptualization of emotion communication requires only that an individual produce an emotion display, and that it be identified by one or more observers as a display of emotion or behavioral intentions associated with the display (see Parkinson, 2005, for a review of the emotion-expression vs. motive-communication approaches to facial configurations).

a close friend for 74% (29/39) of the participants, a romantic partner for 18% (7), and a family member for the remaining 8% (3) of the participants. For 49% of participants (19), the mannequin represented a female.

Design and procedure. After providing consent, participants were tested individually in a three-part, 45-min session. They were videotaped during parts 1 and 3 (emotion production parts). One camera was focused on the participant's face from a face-on perspective, and one was focused on the body from a side-profile perspective.

Part 1: Unrestricted production of emotions. Part 1 determined which channel(s) people use when communicating each emotion. Without using their voices, participants were instructed to communicate each emotion to the mannequin as naturally as possible. They were asked to communicate the designated emotion for a minimum of 3 s to the mannequin, so that the person represented by the mannequin could identify the emotion. Participants were told there were no correct or incorrect ways to communicate the emotions.

Before the trials, the experimenter provided examples of emotions not used in the experimental set: experimenter displayed *confusion* using her face, *frustration* using her face and body, and *gratitude* using her face and touch. Participants then completed one practice trial in which they produced a *gratitude* display and asked any questions. Once the participant was comfortable interacting with the mannequin, the experimenter went behind a visual screen and experimental trials began. Emotions were presented randomly, one at a time on a computer screen, with one trial for each emotion. Participants began each trial with neutral affect and standing at a designated starting position 0.75 m in front of the mannequin. After the emotion appeared, participants could move from the starting position, if desired, to best communicate the emotion. Following each trial, participants rated their degree of confidence that the emotion had been communicated effectively (i.e., the person would have understood the emotion being conveyed). Ratings were made on a scale from 1 (*not at all confident*) to 5 (*very confident*). Participants were randomly assigned one of three counterbalanced trial (emotion) orders.

Part 2: Channel preference selection. Part 2 was designed to reveal which channel participants *say* they would use to communicate each emotion, if they had to use just a single channel. Participants were not told about face, body, and touch channels until this point to ensure that their performance in Part 1 was not influenced by thinking about what they were doing. Here, participants viewed randomly presented emotion words on a computer screen and indicated with a key press whether they would prefer using the face, body, or touch to communicate the emotion. They were told that moving of the facial muscles constitutes using the face channel, body movement (excluding the face muscles) constitutes using the body channel, and tactile interaction constitutes using the touch channel.

Part 3: Restricted production of emotions. Part 3 was similar to Part 1, with the exception that participants were only allowed to use one channel to express the emotions. This condition provided information regarding how effectively each channel could communicate each of the 11 emotions. In three separate blocks, participants communicated the emotions using (a) just the body, (b) just the face, and (c) just touch (without using any expressive body movement). After each trial, participants rated their confidence that the emotion had been effectively communicated. Block and emotion order were counterbalanced across participants. After completing this task, participants were thanked and debriefed.

Alternative order condition. It is possible that the channel preference selection task (Part 2) may have biased participants' responses in the restricted production task (Part 3). To demonstrate that task order had little effect on performance, additional participants were tested who performed Part 3 prior to Part 2.

Video coding of channel use. All trials in Parts 1 and 3 were videotaped. Two blind coders scored trials for channel use. On each trial, channels used received a score of 1 and those not used received a score of 0. One, two, or three channels could be used in any trial. Interrater reliability was acceptable (Cohen's $\kappa = .74$).

Results and Discussion

Below, we report (a), which channels they *actually* used when there were no channel restrictions (Part 1: unrestricted production), (b) which channels participants *said* they would use to communicate each emotion (Part 2: channel preference selection), and (c) how display production was affected when participants were limited to a single channel (Part 3: restricted production). Next, we examined potential task order effects. Last, we tested whether the 11 emotions could be separated into clusters, based on how they were produced through each of the three channels individually.

Unrestricted production of emotions: Which channels do participants use when producing each emotion? To test the prediction that channel use varies by emotion, we analyzed the proportion of participants who used each channel for each emotion using an Emotion (11) × Channel (3) within-subjects analysis of variance (ANOVA). A significant Emotion × Channel interaction emerged (Figure 1, panel 1), $F(20, 760) = 21.82$, $p < .0001$, partial $\eta^2 = .37$. This interaction suggests that participants favored the body for embarrassment, guilt, pride, and shame emotions; the face for anger, disgust, fear, happiness, and sadness emotions; and touch for love and sympathy emotions.

Channel preference selection: Which channels do participants say they prefer for communicating each emotion? To test the prediction that channel preferences exist, we analyzed the distribution of channel preferences for each emotion using 11 Emotion (1) × Channel (3) chi-square analyses. All 11 chi-square tests were significant. Controlling for family wise error, 10 of the 11 emotion analyses were significant at the .005 level, and one (guilt) was significant at the .009 level, $\chi^2(2) = 9.39$. The distribution of channel preferences was not random for any of the emotions, and the pattern was similar to what was found for the unrestricted production of emotions (Figure 2, panel 1).

Restricted production of emotions: Does confidence of effective emotion communication decline when single channels are used, compared to all channels? We computed three "uncertainty" (i.e., confidence decrement) scores for each of the 11 emotions by subtracting Part 3 (restricted) confidence ratings from those of Part 1 (unrestricted; baseline). An Emotion (11) × Channel (3) within-subjects ANOVA, using mean uncertainty scores, revealed a significant Emotion × Channel interaction (Figure 3, panel 1), $F(20, 760) = 24.06$, $p < .0001$, partial $\eta^2 = .39$, indicating that confidence reduction varied as a function of the emotion and the channel through which it was communicated. Specifically, participants showed minimal reductions in confi-

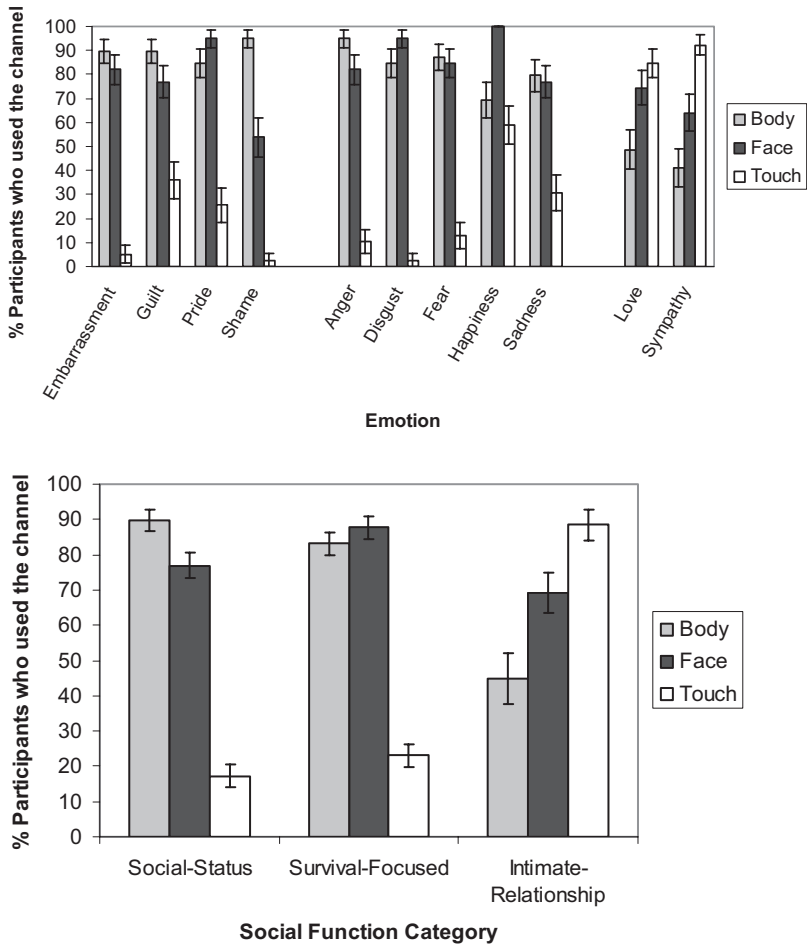

Figure 1. The mean proportions of participants who used each channel as a function of emotion (panel 1) and emotion type (panel 2) during the unrestricted production portion of Experiment 1. For social-status emotions, the proportion of participants who used the body was higher than the proportion using the face or touch. Within the survival-focused category, participants used the face more frequently than both the body and touch. Within the intimate-relationship category, participants used touch more frequently than the body, but not more than the face. Bars represent plus or minus one standard error.

dence when the body was used to convey embarrassment, guilt, pride, and shame emotions; when the face was used to convey anger, disgust, fear, happiness, and sadness emotions; and when touch was used to convey love and sympathy emotions. Again, this pattern replicated the channel-emotion patterns found for the unrestricted production of emotion- and channel-selection data.

To further assess how the different emotions group together, based on their communication through each of the three channels in the restricted production condition, we conducted a hierarchical agglomerative cluster analysis on the 11 emotions, using the variables of mean uncertainty for each emotion communicated through the body, the face, and through touch. *Agglomerative* refers to the process by which emotions were combined into groups by first treating each emotion as a separate cluster, then grouping them together into increasingly larger clusters, using Ward's (1963) linking method until an optimal balance between within-cluster similarity and between-cluster distinctiveness was achieved. This process considers all possible cluster combinations and links the two clusters with the highest similarity, based on squared Euclidean distance. Solutions were inspected to determine which provided the optimal within-cluster and between-cluster variance balance (Aldenderfer & Blashfield, 1984; Borgen & Barnett, 1987). Examination of the hierarchical tree and the agglomeration schedule revealed a jump in within-group variance between a three- (variance coefficient = .08) and four-cluster solution (variance coefficient = .18), indicating that the three-cluster solution differentiated adequately among the emotions. Solutions consisting of more than three clusters reduced within-cluster variance only minimally, thereby failing to provide any additional distinct groupings. The K-means iterative partitioning clustering method (Punj & Stewart, 1983) provided further support for the three-cluster solution. This confirmatory procedure obtains the lowest within-cluster variance and the highest between-cluster variance by allowing any misaligned emotions to be moved into a more appropriate cluster. None of the emotions was relocated, thus reflecting the stability of the three clusters.

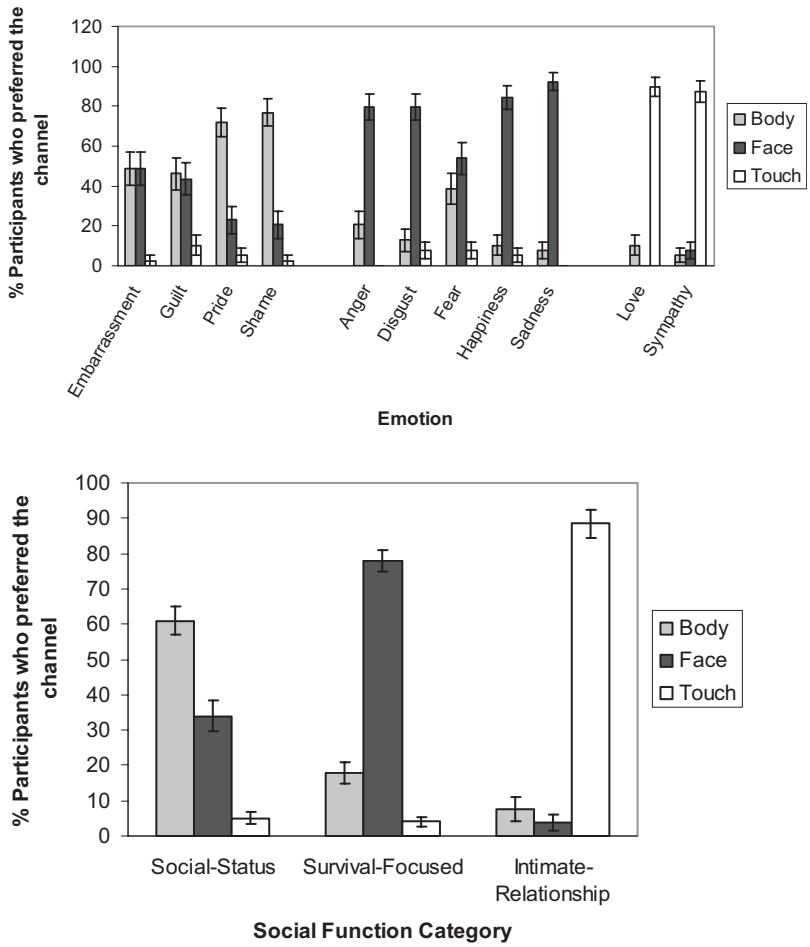

Figure 2. The mean proportions of participants who selected each channel as their preferred channel of communication for each emotion (panel 1) and as a function of emotion type (panel 2) for the Experiment 1 channel selection task. Participants preferred to communicate social-status emotions using the body more than the face or touch; for survival-focused emotions, participants preferred to use the face more than the body or touch; and for intimate-relationship emotions, participants preferred to use touch more than the body or face. Bars represent plus or minus one standard error.

Figure 4 depicts the three clusters in three dimensions, with each dimension reflecting the uncertainty with which an emotion was produced via one of the three channels. Cluster 1 included embarrassment, guilt, shame, and pride. It featured low uncertainty when using the body, moderate to high uncertainty scores when using the face, and high uncertainty when using touch. Cluster 2 included anger, disgust, fear, happiness, and sadness. This cluster was characterized by low to moderate uncertainty using the body, low uncertainty scores when using the face, and high uncertainty using touch. Cluster 3 included love and sympathy. This cluster was differentiated by high uncertainty when using the body, high uncertainty when using the face, and low uncertainty when using touch.

Alternative order condition. We confirmed that task order did not influence our results by examining the uncertainty scores for the additional participants who completed Part 3 and then Part 2. An Emotion (11) × Channel (3) within-subjects ANOVA was conducted and a significant Emotion × Channel interaction emerged, $F(20, 520) = 12.72$, $p < .0001$, partial $\eta^2 = .33$. The channel-emotion pattern was consistent with our results from the original order.

Summary and New Conceptualization

To summarize the results of Experiment 1, systematic links were found between particular emotions and the nonverbal channels used to produce them. Stated channel preferences varied by emotion and largely aligned with actual channel use as well as with perceived communication efficacy through each channel in isolation. Cluster analysis revealed that the patterns of perceived communication efficacy when displaying an emotion through each of the three channels in isolation could be used to classify the emotions into three categories. Embarrassment, guilt, pride, and shame were in one cluster that was associated most strongly with the body; anger, disgust, fear, happiness, and sadness were in another cluster that was associated most strongly with the face; and love

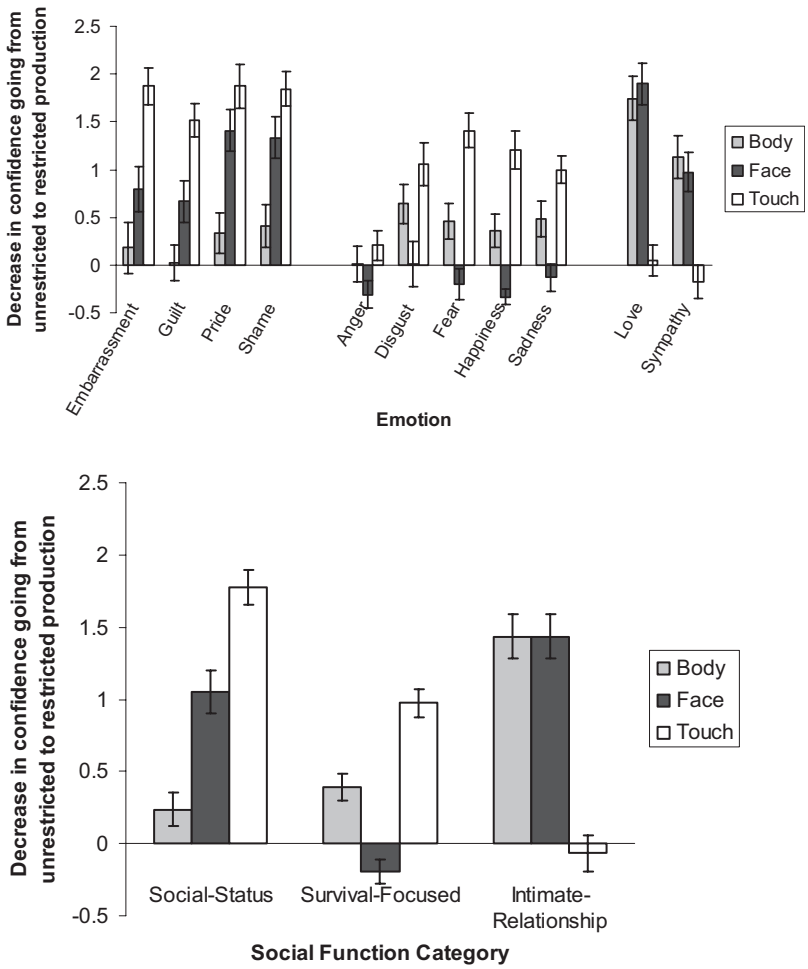

Figure 3. The mean uncertainty scores for each channel as a function of emotion (panel 1) and emotion type (panel 2) during the restricted production portion of Experiment 1. Going from unrestricted to restricted emotion production, confidence was least diminished for social-status emotions when restricted to the body channel, compared with the face and touch; confidence was least diminished for survival-focused emotions when restricted to the face channel, compared with body and touch; and confidence was least diminished for intimate-relationship emotions when restricted to touch, compared with the body and face. Bars represent plus or minus one standard error.

and sympathy were in a third cluster that was associated most strongly with touch.

What factors might explain these strong, systematic associations of emotions with channels? Because situational and social inputs were held constant in Experiment 1, it is unlikely that they contributed differentially to these results. However, an examination of the particular clusters suggests that an emotion's social function may underlie the channel-emotion link. The three clusters may each be associated with a different aspect of an individual's relationship with the social environment: social status, survival, and intimate relationship goals. The social goal may influence the primary channel through which the emotion will be primarily communicated (e.g., body, face, and touch, respectively). This explanation is supported by emotion researchers who emphasize that social functions drive emotion processing (Barrett & Campos, 1987; Campos, Mumme, Kermoian, & Campos, 1994; Keltner & Gross, 1999; Keltner, Haidt, & Shiota, 2006). In addition, the close connection between social communication functions and display are predicted by the behavioral ecology view of emotion displays (Fridlund, 1994). Although multiple channels can be used to express each emotion and emotions do not just serve a single function, we propose that emotions can be classified based on their primary social function and their optimal channel expression. In other words, we believe our data imply that the primary channel (i.e., the channel that conveys the emotion most effectively) is related to the social function of the emotion.

Previous research has established that specific emotions have social functions, but our data show that these social functions are related to the primary channel of expression. First, social-status emotions include embarrassment, guilt, pride, and shame. These emotions coordinate interactions within a social hierarchy and require an awareness of the self, compared with others (Tracy & Robins, 2004b). The body channel (i.e., its postures) may be better suited to convey these emotions than the face or touch, because

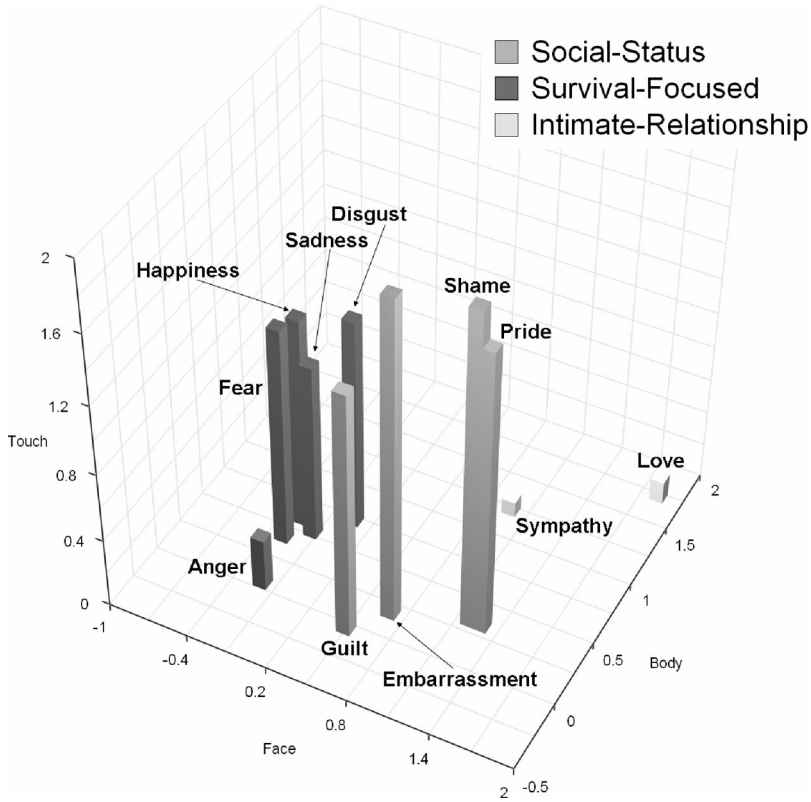

Figure 4. Experiment 1: Three-dimensional representation of three-cluster solution. Axes represent differences in uncertainty that the emotion was communicated when moving from unrestricted production to single-channel production. Social-status emotions featured low uncertainty when using just the body to communicate, moderate to high uncertainty scores when using the face, and high uncertainty when using touch. Survival-focused emotions were characterized by low to moderate uncertainty using the body, low uncertainty scores when using the face, and high uncertainty using touch. The intimate-relationship emotions were differentiated from the other categories by high uncertainty when using the body, high uncertainty when using the face, and low uncertainty when using touch.

information encoded in postures is transmitted more effectively to larger audiences across longer distances, such as to one's social group or across social groups (Tracy & Robins, 2004b). Variation on the physical dimension of size is associated with perceivers' judgments of relative power (Schubert, Waldzus, & Giessner, 2009); thus, expanded postures may convey emotions representing high power and status (e.g., pride), whereas contracted postures convey emotions representing low power and status (e.g., shame).

Second, survival-focused emotions have received the most empirical focus and include anger, disgust, fear, sadness, and happiness (see Fredrickson, 2001, regarding the appropriate inclusion of happiness). They reflect the action tendencies that are relevant to the producer's immediate appraisal of a situation (Johnson-Laird & Oatley, 1989; Shaver, Schwartz, Kirson, & O'Connor, 1987). We acknowledge the survival value of all of emotions, but use the working label "survival-focused" for this group to emphasize their uniqueness; these emotions contribute more directly to survival than other emotions whose survival value is mediated by relationships with others. The face channel (i.e., its expressions) may be used more than the body or touch to communicate survival-focused emotions because it has flexible, small muscles that permit quick, parsimonious responses without interrupting the overall actions of the organism (i.e., running away from danger). Given that basic survival is often related to changes in sensory input (e.g., eyes widening) or oral function (e.g., eating, biting), facial changes can serve functional purposes during communication. Based on the need for quick action resulting from this emotion communication and perception, survival-focused emotions may show more overlap across channels in production and identification than do emotions in the other categories.

Third, intimate-relationship emotions include love and sympathy. They focus on the affiliation of self and other in terms of deploying resources to benefit the relationship, provide the partner with aid, or other altruistic or cooperative acts (Keltner, Horberg, & Oveis, 2006). The use of touch to convey love and sympathy has been documented in both nonhuman and human research to communicate intimacy and liking for one's partner (Jones & Yarbrough, 1985; Silverthorne, Micklewright, O'Donnell, & Gibson, 1976), reduce physiological and behavioral markers of stress (Aureli, Preston, & de Waal, 1999), or increase future attachment security (e.g., Weiss, Wilson, Hertenstein, & Campos, 2000). The touch channel may be used more frequently than the body and face channels to convey intimate-relationship emotions.

To demonstrate the associations between social-function category and communication channel more clearly, we reanalyzed Experiment 1 data by collapsing the emotions into the three categories. For Part 1 (*unrestricted emotion production)*, we computed nine composite scores by averaging across channel use frequency for all emotions within a social function category and conducted a Social Function Category (3) × Channel (3) within-subjects ANOVA. As illustrated in Figure 1 (panel 2), a significant interaction between Social Function and Channel, $F(4, 152) = 78.08$, $p < .0001$, partial $\eta^2 = .67$, and post-hoc *t* tests (see Table 1) showed that within the survival-focused category, participants used the face more frequently than touch, but not more frequently than the body; within the intimate-relationship category, participants used touch more frequently than both the body and face, and within the social-status category, participants used the body more than the face and touch.

For Part 2 (*channel preference selection*), nine composite scores were created by averaging preference frequency for the emotions within each social function category. Three *t* tests were conducted to assess whether the proportion of participants who preferred the functionally related channel was greater than the proportion expected by chance: 33%. Preferences to use the body to communicate social-status emotions (61%) was greater than chance, $t(38) = 7.01$, $p < .0001$ (all *p*s are two-tailed), as were preferences to use the face to communicate survival-focused emotions (78%), $t(38) = 14.93$, $p < .0001$, and touch to communicate intimate-relationship emotions (88%), $t(38) = 14.30$, $p < .0001$ (Figure 2, panel 2). Functionally related channels were preferred at a rate *greater* than what would be expected if preferences were equally distributed among the three channels.

For Part 3 (*restricted production*) data, we used the uncertainty score data from the alternative order condition so not as to reanalyze the data used in the hierarchical cluster analysis that led to these additional analyses. After calculating nine composite uncertainty scores, we conducted a Social Function Category (3) × Channel (3) within-subjects ANOVA and found a significant Social Function × Channel interaction, $F(4, 104) = 62.99$, $p < .0001$, partial $\eta^2 = .71$. Consistent with the cluster results from the original order condition, *t* tests (see Table 2) revealed that confidence was least diminished for social-status emotions when restricted to the body channel, compared with face and touch; confidence was least diminished for survival-focused emotions when restricted to the face channel, compared with the body and touch; and confidence was least diminished for intimate-relationship emotions when restricted to touch, compared with the body and face.

All together, the results of Experiment 1 suggest that participants preferred, and actually used, the channel associated with the emotion's social function: The body was the preferred channel for communicating social-status emotions, the face for survival-focused emotions, and touch for intimate-relationship emotions. Actual channel use aligned with stated preferences, with the exception of intimate-relationship emotions: The face was not used significantly less than the functionally related channel, touch. Moreover, participants in the alternative order condition reported greater uncertainty that the emotion had been conveyed effectively when emotion production was restricted to a functionally unrelated channel than when restricted to a channel related to the emotion's social function. However, not all three categories showed the same selectivity of channel preference. Survival-focused emotions showed the least decrement in confidence that they had been conveyed across the three channels. This finding is not surprising, given the immediate importance of a message directly affecting survival. Redundancy increases the odds that the survival-related signal will be detected quickly and accurately (e.g., Partan & Marler, 1999). These findings suggest that the channel through which an emotion is naturally and effectively produced is linked to the social goal underlying the communication.

Experiment 2: Emotion Identification

Adaptive communication comprises both effective production *and* reception of the sender's message (Buck, 1984; Fridlund, 1994; Frijda, 1986). For instance, a sadness display is likely to elicit sympathy and helping behaviors in receivers who identify it correctly (e.g., Campos et al., 1989). Thus, emotion displays help coordinate social interactions. Over the course of evolution, coevolutionary processes occurred, such that conspecifics who could both produce and accurately identify emotional displays had an evolutionarily adaptive advantage (Darwin, 1872/1998; Fridlund, 1994). Experiment 2 investigated whether the patterns of association between emotion and channel, related to their social function, would hold for the receptive side of emotion communication, namely emotion identification. We examined participants' ability to accurately identify the videotaped emotion displays from Experiment 1.

Table 1
Experiment 1: Proportion of Participants Using Each Channel for Each Type of Emotion in the Unrestricted Condition

	Body *M* (*SD*)	Face *M* (*SD*)	Touch *M* (*SD*)	*t*(38)	*p*
Social-status emotions					
Body vs. face	.90 (.19)	.77 (.22)		2.80	.01
Body vs. touch	.90 (.19)		.17 (.21)	15.53	<.0001
Survival-focused emotions					
Face vs. body	.83 (.20)	.88 (.20)		1.07	.29
Face vs. touch		.88 (.20)	.23 (.20)	14.00	<.0001
Intimate-relationship emotions					
Touch vs. body	.45 (.46)		.88 (.27)	4.55	<.0001
Touch vs. face		.69 (.36)	.88 (.27)	2.57	.01

Note. All *t* tests are two-tailed.

Table 2
Experiment 1: Alternative Order Condition: Change in Confidence of Production When Channel Use Is Restricted

	Body *M* (*SD*)	Face *M* (*SD*)	Touch *M* (*SD*)	*t*(38)	*p*
Social-status emotions					
Body vs. face	−.12 (.80)	.18 (.61)		2.21	.04
Body vs. touch	−.12 (.80)		1.10 (.71)	7.96	<.0001
Survival-focused emotions					
Face vs. body	.68 (.79)	.01 (.67)		4.38	.0002
Face vs. touch		.01 (.67)	1.13 (.73)	7.35	<.0001
Intimate-relationship emotions					
Touch vs. body	1.28 (.87)		.04 (.76)	7.32	<.0001
Touch vs. face		1.00 (.95)	.04 (.76)	6.49	<.0001

Note. Higher numbers reflect greater uncertainty when communication is restricted to that channel. All *t* tests are two-tailed.

Method

Participants. Participants were 49 students (30 females; age: $M = 20.41$, $SD = 1.44$) who received extra credit for university psychology courses. None had participated in Experiment 1. The sample was 86% Caucasian, 6% Hispanic, and 8% other self-identified ethnicity.

Stimuli. People can identify emotion displays visually, including displays produced via touch, by observing interactions among other individuals (e.g., Hertenstein et al., 2006). Stimuli for evaluating emotion identification accuracy were, therefore, selected from the video recordings of Experiment 1 participants. We excluded trials in which participants used nonemotional symbols to communicate an emotion (e.g., using one's hands to form a heart on one's chest to convey love, inappropriate channels in restricted production conditions, or went outside the viewing range of the camera; less than 1% of trials). Of the remaining video clips, one male and one female participant clips were selected at random for each emotion. All emotions were recorded such that the viewer could see the profile of the participant interacting with the mannequin. For trials in which the sender was restricted to the face channel, we also showed a male and a female clip for each emotion that was recorded from the mannequin's perspective (i.e., frontal view of participant's face) to ensure the face could be seen. The final set of stimuli contained 10 silent video clips for each of the 11 emotions: one male and one female in the unrestricted (profile), restricted to the body (profile), restricted to the face (profile), restricted to the face (frontal view), and restricted to touch (profile). The 110 video clips were randomized and put together into four movies: two movies of 27 trials and two movies of 28). Movie presentation order was counterbalanced across eight sessions.

Procedure. Groups of 3 to 12 participants watched the video-clip movies on a large classroom screen. Participants would watch a trial from the movie, the movie would be paused, and then they ranked on a response sheet the top three emotions that they thought were most likely to have been communicated during the trial (i.e., 1 = *most likely to have been communicated*, 2 = *second most likely*, and 3 = *third most likely*). Participants could choose from a list of the 11 emotions in alphabetical order (*anger*, *disgust*, *embarrassment*, *fear*, *guilt*, *happiness*, *love*, *pride*, *sadness*, *shame*, and *sympathy*) and an "other" category, which was included to reduce inflated accuracy rates due to forced choice (Frank & Stennett, 2001; Russell, 1993).

Results and Discussion

For each of the five presentation conditions, identification accuracy was calculated based on the first-place rankings of the presented emotions. A paired-sample *t* test indicated that the frontal and profile face conditions were statistically indistinguishable from each other for all emotions. So as to include only one condition for each channel, we only included the more ecologically valid frontal-view face conditions in the analyses reported below.

Are unrestricted displays of emotion identified accurately more often than restricted displays? We conducted an Emotion (11) × Unrestricted versus Restricted Production (2) within-subjects ANOVA for proportion accuracy and found a main effect for unrestricted versus restricted displays, $F(1, 48) = 72.57$, $p < .0001$, partial $\eta^2 = .60$. As expected, unrestricted displays of emotion ($M = 48\%$, $SD = .01$) were identified more accurately than restricted displays ($M = 34\%$, $SD = .02$). When redundant information is presented across communication channels, people make use of this multichannel emotion information.[2]

Does emotion identification vary as a function of restricted channel and emotion? We conducted an Emotion (11) × Channel (3) within-subjects ANOVA on accuracy data. A significant interaction, $F(20, 960) = 33.67$, $p < .0001$, partial $\eta^2 = .41$, indicated that there were differences among the emotions in iden-

[2] There was also a significant main effect for emotion, $F(10, 480) = 32.17$, $p < .0001$, partial $\eta^2 = .40$, which was qualified by a significant interaction term, $F(10, 480) = 6.54$, $p < .0001$, partial $\eta^2 = .12$. The decrement in identification accuracy going from unrestricted to restricted displays was greater for some emotions than for others. One question of interest is whether this decrement is greater for the non-survival-focused categories. We averaged the identification accuracy scores across all emotions within a social-functional category and conducted a Social Function Category (3) × Unrestricted versus Restricted Production (2) within-subjects ANOVA. Again, there were significant main effects for both unrestricted versus restricted displays, $F(1, 48) = 60.87$, $p < .001$, partial $\eta^2 = .56$, and for emotion, $F(2, 96) = 68.66$, $p < .001$, partial $\eta^2 = .59$. However, the interaction term was not significant, $F(2, 96) = 2.35$, $p = .10$, partial $\eta^2 = .05$. In sum, although some emotions may be displayed more effectively than others using a single channel, this decrement is not systematically related to the different social function categories.

tification accuracy as a function of the channel through which each was observed (Figure 5, panel 1). The links between channel and emotion for emotion identification were similar to those observed for emotion production observed in Experiment 1.

To assess whether identification accuracy would be highest when an emotion was observed through its functionally related channel, we computed three composite scores by averaging across identification accuracy scores for all the emotions within a social-functional category. We conducted a Social Function Category (3) × Channel (3) within-subjects ANOVA and found a significant Social Function Category × Channel interaction, $F(4, 192) = 79.97$, $p < .0001$, partial $\eta^2 = .63$ (Figure 5, panel 2). Post-hoc comparisons (see Table 3) revealed that social-status emotions were identified more accurately when production was observed through the body than the face or touch; survival-focused emotions were identified more accurately when emotion production was observed through the face than the body or touch; and intimate-relationship emotions were identified more accurately when emotion production was observed through touch than the body or face.

Confusion of emotion assignment. The social-function categories permit another prediction to be made from the emotion-identification data. If channel use is associated with the type of emotion being displayed, then receivers should be more likely to confuse emotions belonging to the same social-functional category when observing emotions displayed through the category's associated channel. That is, the channel may convey something about the *type* of information being communicated, even if it does not fully convey the emotion in a way that is distinguishable from all others. For each social-functional category of emotions, we compared the proportion of within-category errors (e.g., mistaking love for sympathy) to the proportion of out-of-category errors (e.g., mistaking love for happiness) for displays observed through the channel associated with that category. Two of the three categories of emotions showed the expected pattern of more confusion within

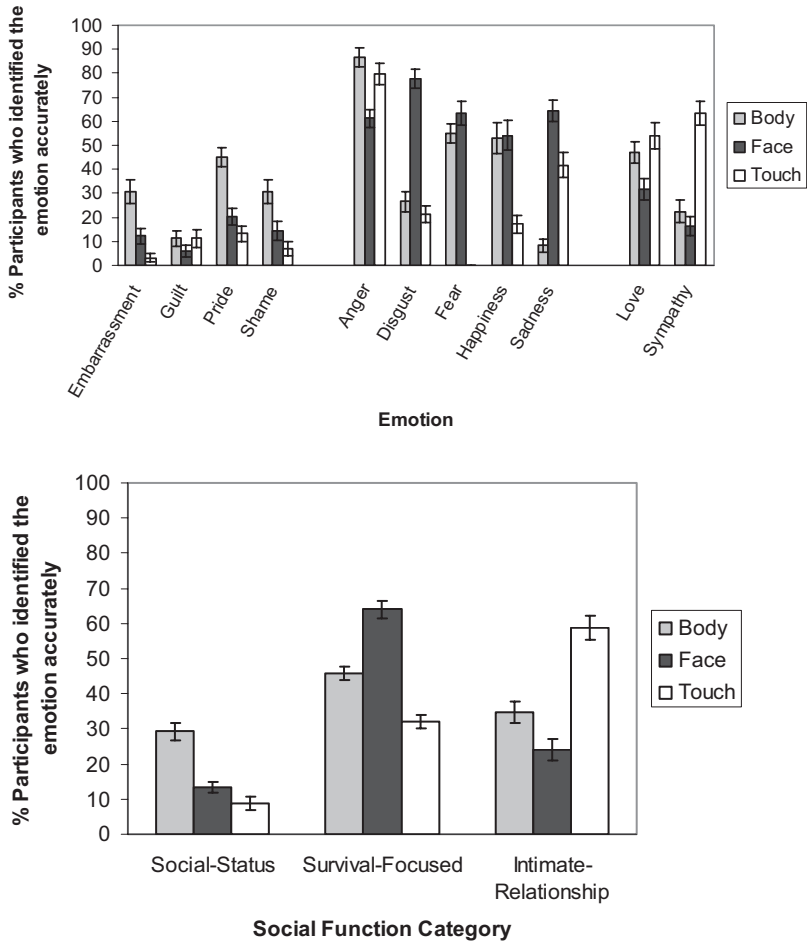

Figure 5. Experiment 2: Mean proportions of participants who accurately identified each emotion as a function of emotion (panel 1) and emotion type (panel 2) as observed through each channel in isolation. Social-status emotions were identified more accurately when production was observed through the body than through the face or touch; survival-focused emotions were identified more accurately when emotion production was observed through the face than when observed through the body or touch; and intimate-relationship emotions were identified more accurately when observed through touch than through the body or face. Bars represent plus or minus one standard error.

Table 3
Experiment 2: Tests of A Priori Contrasts Between Identification Accuracy Rates for Restricted Displays of Emotion

	Body *M* (*SD*)	Face *M* (*SD*)	Touch *M* (*SD*)	*t*(38)	*p*
Social-status emotions					
Body vs. face	.29 (.17)	.13 (.11)		6.80	< .0001
Body vs. touch	.29 (.17)		.09 (.14)	8.59	< .0001
Survival-focused emotions					
Face vs. body	.46 (.14)	.64 (.17)		9.11	< .0001
Face vs. touch		.64 (.17)	.32 (.13)	13.96	< .0001
Intimate-relationship emotions					
Touch vs. body	.35 (.23)		.59 (.25)	5.65	< .0001
Touch vs. face		.24 (.22)	.59 (.25)	7.64	< .0001

Note. All *t* tests are two-tailed.

category than between. For social-status emotions identified through the body, within-category errors (9.7% of all responses) were greater than were out-of-category errors (4.9%), $t(48) = 5.26$, $p < .001$. Also, for intimate-relationship emotions identified through touch, within-category errors (27.0% of all responses) were greater than were out-of-category errors (1.2%), $t(48) = 7.89$, $p < .0001$. However, for survival-focused emotions identified through the face, no differences were found between within-category (3.4% of all responses) and out-of-category errors (2.8% of all responses), $t(48) = 1.08$, $p = .29$. This null result is consistent with the notion that though facial expressions convey survival-focused better than any other channel alone, these emotions have higher redundancy and can thus be seen in other channels.

In summary, Experiment 2 demonstrated that although many emotions can be effectively identified through more than one channel, they tended to be better identified through specific channels. The channels preferred and used for display of an emotion in Experiment 1 were similar to those channels best suited for identification of the emotion. Further, participants identified an emotion more accurately when the display involved the channel supporting the emotion's social function. Additional confirmation of the robustness of these categories was revealed when emotion identification errors tended to be greater within than between category when the emotion was observed through its preferred channel. Thus, the results from Experiment 2 provide converging evidence for a social-functional explanation of variations in emotion communication.

General Discussion

The vast majority of studies assessing nonverbal communication focus on only one channel (e.g., Ekman & Friesen, 1971; Hertenstein et al., 2006; Scherer, Banse, Wallbott, & Goldbeck, 1991). For one of the first times in the literature, we tested the efficacy of communication of a wide range of emotions through multiple channels (body, face, and touch) both in terms of production and identification. Two experiments systematically demonstrated that at least some emotions appear to be conveyed predominantly through different nonverbal channels. Participants either produced or viewed other people producing 11 different emotions that were chosen because they had previously been demonstrated to be expressed though at least one of the three channels. An analysis of the pattern of results from the two experiments suggests a conceptual framework for explaining these results, based on the social function of emotions.

Experiment 1 demonstrated that the channel through which people produce and prefer to produce emotional displays vary by emotion. While being videotaped, participants communicated each of 11 emotions to a mannequin who represented a familiar person to them. First they communicated the emotions naturalistically, and then they produced the emotions through a single nonverbal channel. For each production, they rated their confidence that the emotion was communicated effectively. The naturalistic videotaped data scored for channel use and the confidence ratings for all conditions were analyzed. Both types of data indicated that although multiple channels are often used for emotional communication, particular channels are preferred for communicating a specific emotion. Participants tended to use their bodies to communicate pride, shame, embarrassment, and guilt. They tended to use their faces to communicate anger, disgust, fear, happiness, and sadness. Finally, they used touch to communicate love and sympathy. A multidimensional analysis of confidence ratings established this clustering. The nonverbal channel varied systematically by emotion.

Experiment 2 demonstrated that this same systematic grouping of emotions by channel was preserved for emotion reception as well. Participants viewed videotapes of participants in Experiment 1 producing emotions. They identified the emotion expressed in each videotape. Participants were more accurate when identifying the videotaped emotions produced by the channel preferred by the participants in Experiment 1. In sum, by examining a wide range of emotions in both the production and reception sides of emotional communication, we are able to document consistent, nonarbitrary, nonverbal channel-emotion links.

The clustering of the emotions and the pattern of emotion identification errors suggest one explanation for this study's findings. It appears that the channel by which an emotion is principally communicated (*how* it is communicated) depends in part on the social function of that emotion (*why* that emotion is typically communicated). Specifically, we suggest that although all channels of communication may be available in a given situation, an emotion serving a particular social function is associated with its

primary channel because the communicative properties of that channel support the social goal underlying the emotion's communication. Communication necessarily involves both sending and receiving accuracy, and these are coevolutionary processes essential for survival (Buck, 1984; Dittmann, 1972; Fridlund, 1994, 1997).

This study presents a novel framework for developing a multichannel theory of emotional communication and permits predictions for developmental and cross-cultural studies. Beyond the association of specific emotions with particular nonverbal channels, it integrates research on emotions not primarily communicated by the face with those emotions traditionally associated with facial expressions, including the relatively less explored intimate-relationship emotions closely tied to touch. This integrative approach emphasizes that emotion communication is a complex system comprising multiple channels and provides insight into how the system works as a whole across an array of emotions. In particular, by considering multiple channels together, this study adds to other recent work showing that the face is not uniformly the sole or most important disseminator of all social-emotional information (Tracy & Robins, 2004b); moreover, the current study underscores the importance of the emotions most tightly associated with facial expressions and is consistent with Ekman's and others' (e.g., Ekman & Friesen, 1971; Izard, 1971) findings regarding the utility of the face for conveying this set of emotions.

Facial expressions appear especially important for conveying a particular *type* of information. The early and consistent attention to facial communication of emotion may be based less on the face being a singular communication channel, and more on the special, survival importance of the emotions associated primarily with the face. Consistent with this, we found that when participants produced emotion displays through each channel individually (Experiment 1, restricted emotion production task), confidence that the emotion had been conveyed was the least degraded across all three channels for survival-focused emotions. The importance of these emotions is reflected by the redundancy in their communication across channels. This redundancy for survival-focused emotions supports the notion that an emotion's function is related to how it is communicated (i.e., through multiple channels).

More broadly, this study provides additional support for a functionalist conceptualization of emotions as well as theories that emphasize the centrality of communication in understanding emotional processes. Emotions are not merely subjective, internal experiences; rather, they arise from the individual's interactions with the social and physical environment and serve valuable functions. Although many definitions of emotion focus on subjective experience, functionalist definitions place primary importance on emotions' role as a tool to change or influence the environment in some way that is meaningful to the individual (Barrett & Campos, 1987; Campos et al., 1994). As emphasized in the behavioral ecology view, emotion displays evolved for social functioning, influencing the environment by providing interpretable signals to others (Fridlund, 1994, 1997). Establishing systematic connections between the social function of an emotion and its primary communication channel further emphasizes the utility of a functionalist perspective and accentuates the importance of studying all emotions specifically in a social interactional and communications context (e.g., Buck, 1984).

Most generally, the findings here underscore the bond of action and perception. Perception accuracy was highest when the observed person was using the channel typically used by perceivers. Across channels of communication, the specific behaviors, from avoiding eye contact to baring teeth to demonstrating proximity, are tied to producing, receiving, and enacting the purposes of the emotions. *Doing* the functional action is physically connected with *showing* the subjective state, and *perceiving* the state in others. As argued in embodiment approaches to emotion (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005), reenacting (e.g., by automatic mimicry) another's perceived facial or body movement appears to facilitate understanding others' emotion communication (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001), perhaps through facial feedback processes (McIntosh, 1996). If acting and perceiving are yoked, then individuals who are good at one should be good at the other. Indeed, better encoders are also better decoders (Elfenbein et al., 2010), although task factors, such as producing and identifying posed versus spontaneous or naturalistic displays, may moderate the degree of association between encoding and decoding ability (Elfenbein & Eisenkraft, 2010). Similarly, emotion perception involves both peripheral and central (e.g., "mirror neuron") processes, and task factors such as engagement and encouragement to focus on emotions may influence the extent to which each mechanism is involved (Winkielman, McIntosh, & Oberman, 2009).

Although future research will need to determine the specifics of the perception and action link, the reciprocal implication of this bond is that those who have trouble encoding emotion displays may face difficulty with decoding. Supporting this proposition, high-functioning individuals with autism, who exhibit impaired mimicry (Beall, Moody, McIntosh, Hepburn, & Reed, 2008; McIntosh, Reichmann-Decker, Winkielman, & Wilbarger, 2006), also display atypical processing of facial displays (Humphreys, Minshew, Leonard, & Behrmanna, 2007; Rutherford & McIntosh, 2007), body postures (Reed, Beall, Kopelioff, Pulham, & Hepburn, 2007), and body movements (Blake, Turner, Smoski, Pozdol, & Stone, 2003). These deviations from more typical processing may be due in part to deficits in how emotional states are embodied (Gallese, 2006; Winkielman et al., 2009), suggesting that the cognitive efficiencies of embodied social-emotional perception may be crucial for effective social functioning (Reed & McIntosh, 2008). The present study pinpoints specific connections between behaviors and social functions, thus suggesting the types of emotion communication deficits that may be evident with specific physical impairments.

Alternative Explanations

Although the data fit our social-functional framework relatively well, this is a preliminary study and several issues remain. First, there are some methodological questions. Was the pattern of findings merely a product of demands placed on participant responses? We believe this is unlikely for several reasons. First, in Experiment 1, the experimenter demonstrated displays of confusion, frustration, and gratitude, none of which were included in the 11 emotions presented in the tasks. Further, it is unlikely that any of these example displays primed an association between a category of emotions and a particular channel. Finally, such demands

would not easily account for the preferences, confidence effects, or Experiment 2 results.

We based our predictions on an evolutionary foundation; however, the present data cannot determine whether the observed differences in channel associations reflect evolved processes or culturally learned ways of expressing and identifying categories of emotions. Although the general conclusion that how an emotion is communicated is determined, in part, by its function remains, future research exploring the basis for this association would be helpful. If this association is relatively hard-wired, as suggested by our approach, then individual differences may have functional significance. If they are relatively more culturally determined, then these findings have more implications for understanding variability and potential confusion in interpersonal communication. In support of the universal alternative, preliminary research suggests some emotions, including love and sympathy, are communicated accurately via touch in a non-United States sample (Hertenstein et al., 2006).

Future Directions

The studies presented here suggest several specific issues to address in subsequent work. To establish the connection between specific channels and categories of emotion, we placed a heavy emphasis on emotion communication through a single channel; however, such restricted communication occurs rarely in nature. Future research should examine how communicative channels operate in tandem. Tracy and Robins (2004a), for example, have begun to assess the features that differentiate between full body (i.e., body and face) displays of pride and happiness. Further, we limited our research to body, face, and touch to keep the sensory modality through which Experiment 2 participants perceived the action (vision) consistent. However, our approach allows for consideration of additional channels and suggests that such investigations would be fruitful in understanding the social-functional role of emotions.

The voice, for example, conveys emotion through words and paraverbal cues and is especially important when visual information is degraded or nonexistent (Scherer et al., 1991). Our social-functional framework makes testable predictions regarding the efficacy of the voice for conveying certain emotions: If the properties of the voice support the social function that underlies a particular type of emotion, then those emotions should be communicated effectively through the voice. For example, similar to body posture, the voice can transmit information to larger audiences across longer distances, which is useful for conveying status information to one's social group or across social groups. Indeed, social status information is communicated through the voice alone (e.g., Puts et al., 2007). Multichannel research is needed to assess whether and how having the vocal channel available changes the pattern of nonvocal channels used to display and identify emotions differing in social function.

More generally, future research should include more ecologically valid paradigms. Study 1 participants displayed emotions to a mannequin, and Study 2 participants identified emotions from video clips of Study 1 participants. Some interactions were viewed in profile, rather than from the perspective of the target, and emotions conveyed through touch were identified visually and not experienced directly. More direct (e.g., a face-on body, actual touch) would likely enhance the impact of the emotional expression, potentially enhancing differences in efficacy and focus (e.g., feeling a touch is more likely effective than watching one). One purpose of multichannel research is to better understand how and why emotions are communicated in a more naturalistic context; therefore, more naturalistic paradigms should be employed.

Conclusion

In this study, we demonstrated that differing emotions are associated with differing channels, and provided evidence that the distribution of channel preferences may be due, in part, to the social functions associated with each emotion. Findings from the present research support our hypotheses that communication efficacy for a given emotion depends on the channel through which it is conveyed, and the primary channel used to communicate an emotion is related to the social function of the emotion, because the communicative properties of that channel support the social goal underlying the emotion's communication. That is, the channel associated with a given emotion (*how* it is communicated) is guided, in part, by the social function of that emotion, or *why* the emotion is typically communicated. This integrative approach is an important step in developing a comprehensive understanding of the organization and operation of the multichannel system used to convey a wide spectrum of emotions.

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