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The Automaticity of Emotion Recognition

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Evolutionary accounts of emotion typically assume that humans evolved to quickly and efficiently recognize emotion expressions because these expressions convey fitness-enhancing messages. The present research tested this assumption in 2 studies. Specifically, the authors examined (a) how quickly perceivers could recognize expressions of anger, contempt, disgust, embarrassment, fear, happiness, pride, sadness, shame, and surprise; (b) whether accuracy is improved when perceivers deliberate about each expression's meaning (vs. respond as quickly as possible); and (c) whether accurate recognition can occur under cognitive load. Across both studies, perceivers quickly and efficiently (i.e., under cognitive load) recognized most emotion expressions, including the self-conscious emotions of pride, embarrassment, and shame. Deliberation improved accuracy in some cases, but these improvements were relatively small. Discussion focuses on the implications of these findings for the cognitive processes underlying emotion recognition.

Keywords: emotion recognition, nonverbal expression, efficiency, automaticity

Building on Darwin's (1872) seminal work on the nonverbal expression of emotion, researchers have argued that emotion expressions evolved, in part, to communicate needs that facilitate survival and reproduction. Supporting this account, a large body of research suggests that each of the so-called "basic" emotions (anger, disgust, fear, happiness, sadness, and surprise), as well as several more cognitively complex emotions (contempt, embarrassment, pride, and shame), are associated with distinct, cross-culturally recognized nonverbal expressions (Ekman, 2003; Izard, 1971; Haidt & Keltner, 1999; Tracy & Robins, 2007a).[1]

Most evolutionary accounts of emotion expressions assume that the ability to *recognize* each expression is also an evolutionary adaptation (Öhman, 2000). Logically, if expressions send fitness-enhancing messages, observers must be equipped with the cognitive capacity to accurately perceive these signals and achieve conscious awareness of the emotion conveyed. Such knowledge would assist observers in obtaining a full understanding of the situation and mentally preparing a flexible and appropriate response (Scherer, 1994). Furthermore, observers should be able to accurately recognize emotion expressions under the conditions in which they are typically displayed: briefly and with considerable surrounding noise and distraction. Thus, the emotion recognition process should be quick, and accuracy should be independent of an observer's level of attentional focus or available cognitive resources. Given that expressions are typically displayed in everyday interactions in which individuals must attend to other elements of the environment, to be adaptive in real-world situations emotion recognition should be an efficient process; that is, accurate even when observers' cognitive resources are allocated elsewhere.[2]

Yet, despite the large body of research on the nonverbal expressions associated with each emotion, we are aware of no previous study that has specifically tested whether recognition of each distinct emotion can occur quickly, efficiently (i.e., with minimal cognitive resources), and without conscious deliberation, or whether the ability to discriminate among similarly valenced emotions becomes impaired when individuals are forced to recognize emotions quickly and under cognitive load.

Several lines of research are, however, consistent with the possibility that emotion recognition is an automatic process. First, a number of studies have found that subliminally displayed emotion expressions can influence observers' behaviors without their awareness. These expressions have been shown to generate automatic facial mimicry, interfere with the perception of incongruent

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[1] Contempt also has been classified as a basic emotion (Ekman, 1992), but its expression is recognized at lower levels than all other emotions (Elfenbein & Ambady, 2002) and is typically not recognized at above-chance levels when a free-response format is used (Russell, 1991; Wagner, 2000). Furthermore, most researchers would agree that contempt is unlikely to meet all nine of Ekman's (1992) criteria for basic emotions; for example, there is no direct evidence that any animal other than humans experience contempt.

[2] Other evolutionary accounts hold that emotion expressions did not evolve to communicate senders' emotional states, but rather that expressions are intentionally displayed by senders for the purpose of social communication (e.g., Fridlund, 1994; Parkinson, 2005; Russell, Bachorowksi, & Fernandez-Dols, 2003; see Kappas, 1997, for a review of this issue). However, given that automatic emotion recognition could occur either because recognition is an innate ability (as the Ekman, 1992, view would suggest) or because recognition is learned and automatized early in life (as the Fridlund view might suggest), the present research does not address these competing hypotheses.

emotion words, and influence subsequent behavioral choices and judgments (Dimberg & Thunberg, 1998; Dimberg, Thunberg, & Elmehed, 2000; Niedenthal, 1990; Stenberg, Wiking, & Dahl, 1998; Winkielman, Berridge, & Wilbarger, 2005). These findings suggest that at some level, observers can obtain knowledge of emotion expressions' meaning without awareness of the expressions, and this knowledge is fairly specific to the content of the emotion portrayed; for example, subliminal presentation of negative expressions leads perceivers to subsequently judge a beverage less favorably (Winkielman et al., 2005). Second, distinct brain responses have been found to occur in response to distinct, subliminally presented expressions. For example, greater amygdala activation has been found in response to fearful versus happy expressions (Whalen et al., 1998).

Third, a handful of studies have examined the conscious recognition of briefly displayed (i.e., less than 8 s) emotion expressions and shown that observers can accurately identify several distinct emotions—including anger, disgust, fear, happiness, sadness, and surprise—when they are provided with unlimited time to respond (Ducci, 1981; Kirouac & Dore, 1983; McAndrew, 1986). Given that the expressions presented in these studies were not followed by a "mask" (i.e., presentation of another stimulus that corrodes any residue of the target expression in mental imagery), participants would have been able to use mental imagery to recognize the expressions after they were no longer displayed onscreen, making it difficult to know how quickly recognition occurred. In the few studies that used this methodology but also masked stimuli (Kirouac & Dore, 1984; Matsumoto & Ekman, 2004), participants accurately recognized expressions displayed at very brief latencies (maximum durations ranged from 50 ms to 200 ms). However, in both studies participants were given an unlimited amount of time to respond; and responses were assessed in a nonautomatic fashion by asking participants to press one of six keys that represented each emotion (Kirouac & Dore, 1984), to choose the best option from a list of seven emotion words, or to rate the extent to which each expression conveyed each of seven emotions (Matsumoto & Ekman, 2004). To assess the speed of the recognition process, studies must limit both the display and the response time, and participants must be able to respond in an automatic fashion (i.e., press keys without needing to think through what each key represents). In the few studies that have met these requirements, participants have been found to quickly and accurately distinguish between emotions that differ in valence (e.g., anger vs. happiness; Kestenbaum & Nelson, 1992; Stanners, Byrd, & Gabriel, 1985), but these researchers did not examine whether participants could automatically discriminate among similarly valenced emotions (e.g., anger vs. sadness).

To summarize, previous studies either (a) contrasted only positive versus negative emotions or (b) did not restrict the time allotted for participants to respond, thereby allowing participants to make use of mental imagery or respond in a thoughtful manner. Thus, no previous study has tested how quickly observers can recognize and distinguish among similarly valenced emotions when expressions are shown only briefly and participants are forced to respond quickly. It remains unclear whether, for example, observers can quickly determine that an ally or foe is showing anger rather than fear. From an evolutionary perspective, this question is critical, given that these two emotions send very different messages about how the perceiver should behave (i.e., prepare to fight vs. flee). In addition, no previous studies have examined how quickly the cognitively complex emotions such as contempt, embarrassment, pride, and shame can be recognized. Finally, no previous studies have addressed the question of whether accurate recognition can occur efficiently; that is, whether recognition can occur when cognitive resources are depleted.

The Present Research

We tested whether a broad range of emotion expressions can be recognized and discriminated from each other quickly, efficiently, and without deliberation, as would be predicted by an evolutionary account. We did so using expressions that have been verified to represent each emotion according to the Emotion-Facial Action Coding Scheme (EM-FACS; Ekman & Rosenberg, 1997; Ekman & Friesen, 1978) and a research design that restricts both the latency of the stimulus presentation and participants' responses. The present research also tests whether emotion recognition can occur under cognitive load; that is, whether it is an efficient process.

In Study 1, we examined emotion recognition for the small set of basic emotions found by Ekman and colleagues (Ekman & Friesen, 1971; Ekman, Sorenson, & Friesen, 1969) to be universally recognized (anger, disgust, fear, happiness, sadness, and surprise), as well as for two more cognitively complex emotions: contempt and pride, which also have cross-culturally recognized nonverbal expressions (Ekman & Friesen, 1986; Tracy & Robins, 2007a). In Study 2, we replicated Study 1 but included two additional cognitively complex emotions with recognizable expressions: embarrassment and shame (Izard, 1971; Keltner, 1995).

One novel feature of the present research is that three of the complex emotions we examined—embarrassment, pride, and shame—belong to the unique class of "self-conscious" emotions. These emotions emerge later in the course of development than the basic emotions, most likely because their experience requires a higher level of cognitive capacities, including the ability to self-reflect and to understand others' mental states (Izard, Ackerman, & Schultz, 1999; Lagattuta & Thompson, 2007; Tracy & Robins, 2007b). All three of these emotions have been associated with cross-culturally recognized expressions (Haidt & Keltner, 1999; Izard, 1971; Tracy & Robins, 2007a), but the evidence for their universality is, in some cases, not as strong as for the basic emotions. The present research is the first to examine recognition of all emotion expressions known to generalize across cultures (at some level) under speeded and distracting conditions.

Study 1

Study 1 tested whether accurate recognition of anger, contempt, disgust, fear, happiness, pride, sadness, and surprise can occur quickly, efficiently, and without deliberation. Participants were asked to identify and discriminate among these expressions under one of three conditions: (a) a fast condition, in which participants viewed and responded to each expression as quickly as possible and were forced to respond within a restricted time period; (b) a deliberated condition, in which participants were encouraged to take their time and deliberate about their response to each expression; and (c) a cognitive load condition, in which participants were distracted while viewing and responding to each expression. By restricting the exposure and response times in Conditions 1 and 3, we were able to assess how quickly individuals can perceive and consciously identify each distinct emotion. By including a deliberated condition, we were able to test whether recognition rates are improved when participants directly allocate their cognitive resources to the task compared with when they are prevented from doing so.

Method

Participants and procedure. One hundred one undergraduate students (65% women) participated in exchange for course credit. Participants were assigned to one of three conditions: fast (n = 26), deliberated (n = 48), or cognitive load (n = 27).[3] In all conditions, participants viewed photos of emotion expressions displayed on a 17-in. (43.18-cm) computer monitor approximately 12 in. (30.48 cm) from their faces. They responded to each expression by pressing one of two keys, *J* or *F*, representing "yes" and "no," and were instructed to keep their index fingers on the relevant keys at all times. The *J* key was clearly marked with a green sticker and the *F* key was clearly marked with a red sticker, so that participants who moved their hands during the experiment could easily and quickly replace their fingers.

Expressions of the eight emotions—anger, contempt, disgust, fear, happiness, pride, sadness, and surprise—were shown in eight blocks of 22 photos each. Each block was assigned a different target emotion, and participants determined whether each expression in the block did or did not represent the target emotion for that block (e.g., anger in the anger block). Before viewing each block, participants were informed of that block's target emotion. The order of photos within each block, and the order of blocks, were randomized across participants. In the fast condition, participants were instructed,

> As you view each photo, decide as quickly as you can whether or not the target emotion is being expressed. Make sure to respond quickly. A good way to do this is to use your intuition—just go with your first impression.

The question "Is this anger [contempt, disgust, fear, happiness, pride, sadness, surprise]?" was also displayed in a large (32-pt) font above each photo on the screen to prompt participants and remind them of the target emotion. However, participants did not need to read the target question to respond because it was identical throughout the block. Each photo appeared on screen for a maximum of 1,000 ms; it disappeared as soon as participants responded and was replaced by the next photo. If participants did not respond within 1,000 ms, no response was recorded and a message appeared on screen telling participants to respond more quickly. We chose 1,000 ms as the stimulus duration and maximum response time because pilot testing demonstrated that this time frame forced participants to respond as quickly as possible but did not cause them to disengage from the task out of frustration with its difficulty.

In the deliberated condition, participants were instructed to "think carefully about whether or not the target emotion is being shown. You will have plenty of time to really think through your decision." Each expression remained on screen for 8,000 ms, and participants were prevented from responding during this period; pilot testing demonstrated that 8,000 ms was more than enough time for participants to generate a thoughtful response (when instructed to take as long as they want to respond, virtually all participants respond within a few seconds). After 8,000 ms, the photo was replaced with the question "Was that anger [contempt, disgust, fear, happiness, pride, sadness, surprise]?" displayed in a large (32-pt) font in the center of the screen. Participants completed the trial by pressing the "yes" or "no" key at any time.

In the cognitive load condition, participants were given the same instructions as in the fast condition but were also told,

> Before you see each set of photos, you will see a number flash on the screen. We want to test whether you can remember this number throughout the whole task. When you see the number, say it aloud twice. This will help you remember it. After each set of photos is complete, you will be asked to recall the number.

Expressions and target emotion prompts were displayed in the same manner as in the fast condition, but before the start of each block, participants viewed a seven-digit number on screen, and experimenters verified that they read the number aloud twice. Participants were asked to recall and enter the number at the end of each block.[4] Similar dual-task cognitive load manipulations (e.g., asking participants to rehearse a six-digit or eight-digit number while viewing a single stimulus or a set of stimuli; Bargh & Tota, 1988; Gilbert & Osbourne, 1989) have been used effectively in studies examining the automaticity of social judgments, such as perceptions of others; of note, these studies found that the number-memory task distracted attention from the primary judgment task even though the two tasks were unrelated (Bargh & Chartrand, 2000). Each expression remained on screen for 1,500 ms, which was the total time allotted to view each photo and respond. The time duration was increased for this condition from the fast condition because pilot testing demonstrated that participants became frustrated when given only 1,000 ms and asked to remember a seven-digit number. We felt it was important that participants complete the study with minimal emotional reaction to the task, given that this could influence their ability to accurately recognize emotions (e.g., participants in a frustrated or angry mood may show higher levels of recognition for anger expressions and lower levels of recognition for happy expressions; Blairy, Herrera, & Hess, 1999). Thus, we took precautions to ensure that the task was not overly taxing for participants; however, this meant in-

[3] The deliberated condition was considerably longer than the other two conditions because of the longer length of time each stimulus was presented, so we divided it into two separate conditions of equal length. This division meant that each participant in the deliberated condition viewed only half of the blocks of expressions (four blocks out of eight, with each block including all expressions), but their total time participating was much closer to the total time of participants in the fast and cognitive load conditions. One of the subconditions of the deliberated condition included 23 participants and showed blocks with target emotions of contempt, happiness, pride, and surprise; the other subcondition included 25 participants and blocks with target emotions of anger, disgust, fear, and sadness. In Study 2, participants in the first subcondition also viewed a fifth block with the target emotion of embarrassment, and participants in the second subcondition also viewed a fifth block with the target emotion of shame. In all cases, order of the blocks was randomized between participants, as was the presentation of expressions within each block. Results are combined across all participants in this condition.

[4] Recognition rates and mean response latencies in the cognitive load condition did not differ when participants who failed to correctly recall the target number in each emotion block (i.e., made more than three errors) were removed from that block. This held across both studies.

creasing the time duration in the cognitive load condition from the no-load fast condition, thereby making it more difficult to interpret differences in response latencies between the two conditions. For this reason, we do not test whether response latencies differ between the fast and the load conditions, but do compare accuracy rates between the two conditions. However, given that any observed differences could reflect either the difference in load or the difference in the amount of exposure–response time, we focus primarily on comparisons between both of these conditions and the deliberated condition—comparisons that are most relevant to the goals of the research.

Stimuli. Each block consisted of 22 photos: 8 showing the target emotion expression for that block (e.g., anger if participants were asked in that block whether each expression represented anger) and 14 showing each of the seven other emotion expressions twice each (displayed once by each of two targets). All photos were taken from the waist up. Two targets (a male and a female Caucasian) wore identical white shirts and posed in front of a plain blue background. Posing instructions for anger, contempt, disgust, fear, happiness (i.e., the Duchenne smile that includes Action Units 6 and 12), sadness, and surprise were based on the directed facial action task (Ekman, Levenson, & Friesen, 1983). Erika Rosenberg, a leading expert in the Facial Action Coding System (FACS; Ekman & Friesen, 1978) and certified FACS coder, verified that each expression was correctly posed and signified the correct emotion, based on the EM-FACS (Ekman & Rosenberg, 1997). Pride expressions were posed on the basis of previous research (Tracy & Robins, 2004), and Rosenberg verified that these expressions included all facial and body actions relevant to pride. All expressions were later FACS coded by a different certified FACS coder; Table 1 shows all action units that were posed for each expression.

For each emotion, an alternate expression that included the body and the face was also posed. These alternate expressions were theoretically derived on the basis of consensual ideas about each emotion, but in most cases have not been empirically demonstrated to generate reliable recognition for each emotion. Specifically, the additional movements for each emotion were (a) hands in fists for anger, in preparation to fight; (b) head tilted slightly forward for disgust, to suggest that the individual might become sick; (c) hands raised to protect the body with shoulders pulled in and held rigid for fear; (d) head tilted slightly forward and shoulders slumped for sadness (Boone & Cunningham, 1998); (e) head tilted slightly back for contempt (Rosenberg & Ekman, 1995); (f) a less intense (i.e., non-Duchenne) smile for happiness that included raised lip corners but no movement of the *orbicular occuli* muscles surrounding the eyes (and no body movement for either version of happiness); and (g) arms raised with palms outstretched for surprise.

The alternate expressions were included to decrease the number of times each photo was repeated without making the blocks unduly short in length. However, given our goal of assessing participants' ability to quickly recognize each established basic emotion expression, results were analyzed only for the EM-FACS–verified, original versions of each expression. In the case of pride, there are two reliably recognized versions of the expression, both of which include the body (in one, arms are raised above the head with hands in fists, and in the other, arms are akimbo with hands on the hips). Thus, analyses for pride were based on the mean of recognition rates across both versions. For the nontarget emotions in each block (e.g., the anger expressions in a disgust target block), one of the photos portrayed the alternate expression and one portrayed the standard expression; we varied which human target showed each version (alternate or standard) between blocks. For the target emotion in each block, each of four photos were repeated twice: the female target posing the standard version of the emotion (no body), the male target posing the standard version of the emotion (no body), and each target posing the alternate version. Only the former two expressions (shown twice) were included in analyses; mean hit rates for these four photos were operationalized as accuracy rates.

Results

How quick is emotion recognition? In the fast condition, the mean recognition rate across all emotions, 78%, was significantly greater than chance (i.e., 50%; $p < .05$), based on the binomial test. Mean recognition rates for each emotion ranged from 47% (contempt) to 88% (happiness), and all were significantly greater than chance ($ps < .05$), except for contempt (see Figure 1 for means).

To determine how quickly perceivers can accurately recognize each expression, we next examined mean response latencies for

Table 1
Action Units Portrayed in Each Emotion Expression Posed, Based on the Emotion-Facial Action Coding Scheme (Ekman & Rosenberg, 1997)

Emotion expression	Action units: Female	Action units: Male
Anger	4 + 7 + 17 + 24	4 + 7 + 17 + 23
Disgust	4 + 7 + 9 + 16 + 19 + 25 + 26	4 + 7 + 9 + 16 + 19 + 25 + 26
Fear	1 + 2 + 4 + 5 + 15 + 16 + 21 + 25 + 27 + 58	1 + 2 + 4 + 5 + 25 + 26 + 58
Happiness	6 + 7 + 12 + 25	6 + 7 + 12 + 25
Sadness	1 + 4 + 7 + 15 + 16 + 17 + 21	1 + 4 + 15
Surprise	1 + 2 + 5 + 25 + 27 + 38	1 + 2 + 5 + 25 + 26 + 38
Contempt	7 + R10	7 + R10 + 25
Pride	12 + 53	12 + 53
Shame	15 + 43 + 54	43 + 54
Embarrassment	6 + 14 + 24 + 43 + 51 + 54	14 + 43 + 52 + 54

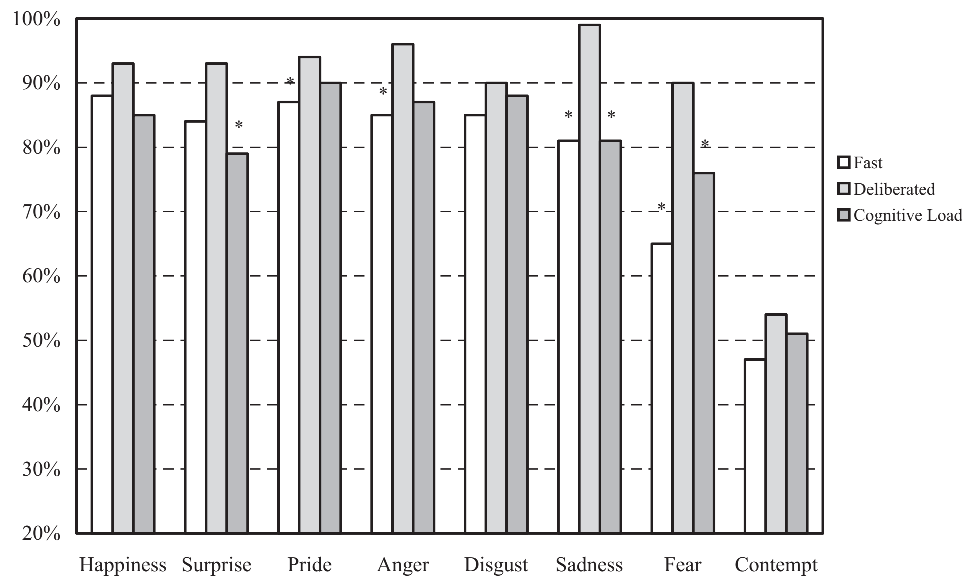

Figure 1. Mean recognition rates in the fast, deliberated, and cognitive load conditions: Study 1. Differences between the fast and cognitive load conditions are difficult to interpret because the maximum response time allotted was 1,000 ms in the fast condition and 1,500 ms in the cognitive load condition; these differing time frames could have promoted differences in recognition levels. Thus, the only significant differences presented here are those that emerged between the deliberated condition and each of the other two conditions. $N = 101$. $^{*}p < .05$.

each emotion in the fast condition, for accurate responders only.[5] The mean response latency across all emotions was 602 ms (range = 544 for happiness to 669 for contempt; see Figure 2 for means for each emotion). Mean latencies for the happy and surprise expressions were significantly faster than for the fear, $t(29) = 2.85$ and $t(33) = 2.38$, and for contempt, $t(15) = 2.47$ and $t(17) = 2.16$, $ps < .05$, expressions, but no other differences among emotions emerged.

To determine whether accurate recognition can occur even more quickly, we next examined recognition rates among subsamples of participants who responded within 600 ms for each expression. On the basis of binomial tests, all emotions except fear (66%, *ns*) and contempt (37%, *ns*) were recognized significantly better than chance (50%) within the 600-ms latency (overall $M = 80\%$, $p < .05$; see Figure 3 for mean frequencies for each emotion). These results suggest that participants could discriminate among similarly valenced emotions (e.g., could determine that the anger expression was anger and not disgust) within 600 ms.

However, it is also possible that accuracy rates were high when participants responded quickly because they were simply pressing the "yes" key for any negative emotion expression when asked about any negative emotion target. To address this issue, we examined false alarm rates (i.e., the proportion of participants who responded "yes" to an expression that did not represent the target emotion) for all participants in the fast condition. Results showed that mean false alarm rates (for each expression, averaged across all possible misidentifications) were fairly low (overall $M = 15\%$) and relatively similar across emotions (range = 10%–25%; see Table 2). In no case was a mean false alarm rate significantly greater than chance (50%, $p < .05$), and in only one case was a specific false alarm rate for a specific expression significantly greater than chance ($p < .05$): One of the two pride expressions (with arms akimbo) was labeled as happiness by 81% of participants (a result that is not particularly surprising given that the pride expression includes a smile).[6] In general, however, the overall low level of false alarms, especially for the negative emotions, suggests that participants did not tend to mislabel each expression as the target emotion (which the design of the study would allow them to do while still maintaining high hit rates).

Does deliberation improve recognition? To test whether accuracy is improved when observers deliberate over an expression's meaning, we compared recognition rates in the fast and deliberated conditions. If discriminating among emotions is a cognitively taxing process, it should be improved when participants are encouraged to focus on each expression and deliberate about the correct response. For several expressions, the recognition rates were higher in the deliberated relative to the fast condition: anger, $t(47) = 2.40$, 11% increase, $p < .05$; fear, $t(47) = 3.60$, 25% increase, $p < .05$; sadness, $t(47) = 3.58$, 18% increase, $p < .05$; and pride, $t(49) = 2.42$, 7% increase, $p < .05$ (see Figure 1 for means).[7] In contrast, for contempt, disgust, happiness, and surprise, there was no difference in accuracy

[5] In all conditions of both studies, before examining response latencies we trimmed the data such that responses made in less than 200 ms (fewer than 1% of all responses in both studies) were excluded and treated as missing data. Bargh and Chartrand (2000) have argued that responses made within this brief latency should be treated as meaningless error.

[6] Because of the study's design, false alarm rates and recognition rates were independent. That is, a false alarm rate of 81% does not mean that only 19% of participants accurately identified the emotion (in fact, the false alarm rate and the recognition rate could both be 100%).

[7] Throughout the article, percentage increases refer to the number of percentage points a particular frequency increased or decreased between conditions. That is, these are not percentages of a previously mentioned frequency.

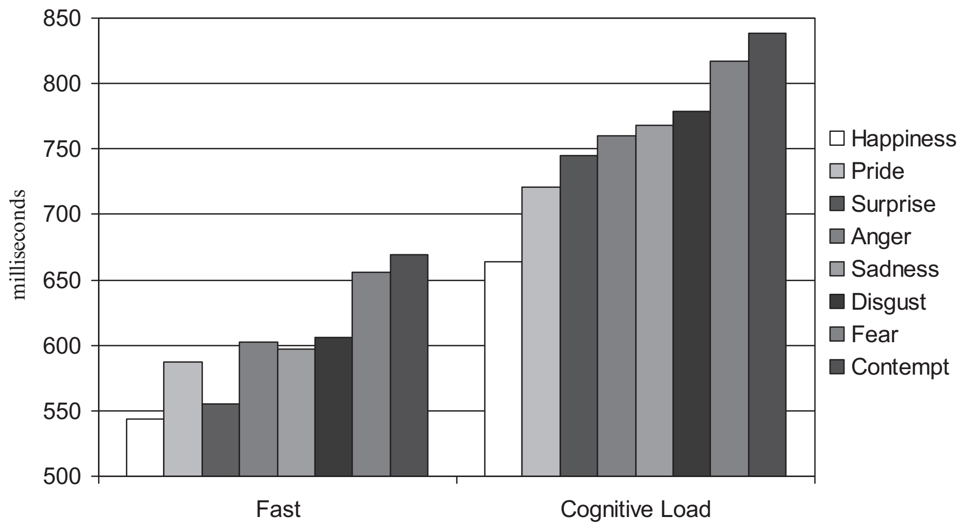

Figure 2. Mean response latencies in the fast and cognitive load conditions, for accurate responders only: Study 1. Differences between conditions are difficult to interpret because the maximum response time allotted was 1,000 ms in the fast condition and 1,500 ms in the cognitive load condition. $N = 53$.

between the two conditions, $t(49) = 0.84$, $t(47) = 1.68$, $t(49) = 1.21$, $t(49) = 0.71$, respectively, *ns* (see Figure 1).

We next examined false alarm rates in the deliberated condition. Most of the rates were fairly low (overall $M = 11\%$; see Table 2), and in no case was a mean false alarm rate significantly greater than chance (50%, $p < .05$). In three cases, the false alarm rate for a specific emotion was significantly greater than chance ($p < .05$): Anger was labeled as contempt by 76% of participants, and the two pride expressions were labeled as happiness by 88% and 84% of participants, respectively. Given that participants did not make these mistakes because they were responding quickly or under cognitive load, similar errors would likely be found in typical recognition studies using nonspeeded responding, if these studies permitted participants to label expressions as more than a single emotion.

To test whether deliberation influenced participants' ability to correctly determine that a particular expression was *not* a partic-

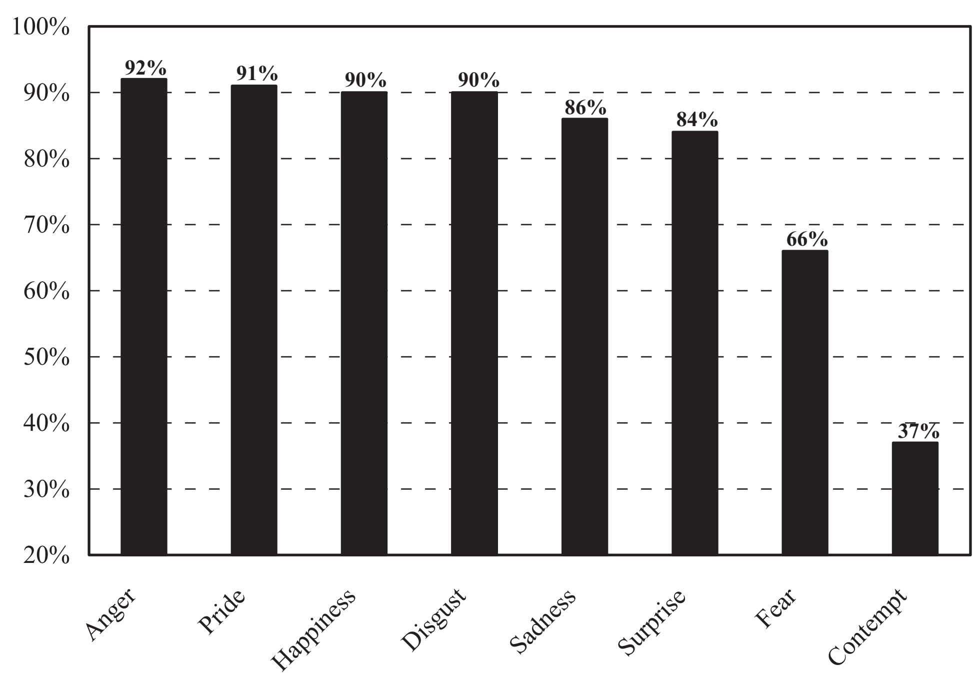

Figure 3. Mean recognition rates for participants who responded within 600 ms in the fast condition: Study 1. All rates are significantly greater than chance, except fear and contempt. Mean $N = 14$ (range = 9–18).

Table 2
Mean False Alarm Rates in the Fast, Deliberated, and Cognitive Load Conditions

Emotion expression	Fast condition (%)		Deliberated condition (%)		Cognitive load condition (%)	
	Study 1	Study 2	Study 1	Study 2	Study 1	Study 2
Anger	25	18	17	13	19	18
Disgust	20	16	11	7	18	8
Fear	18	24	16	25	16	17
Happiness	10	15	9	10	11	6
Sadness	18	15	7	16	8	13
Surprise	16	15	11	11	16	10
Contempt	12	17	4	11	11	10
Pride	17	16	16	13	17	9
Shame		13		20		19
Embarrassment		14		19		12

Note. Mean false alarm rates did not differ significantly ($p < .05$) across conditions for any emotion.

ular target emotion (i.e., make correct rejections), we compared false alarm rates in the deliberated versus fast conditions. No differences emerged (see Table 2 for means), and 0.10, for anger, disgust, happiness, sadness, surprise contempt, and pride, respectively, all *ns* (see Table 2 for means). Thus, participants who deliberated were no more likely than participants who responded quickly to correctly reject the suggestion that these expressions actually represented other emotions, despite the fact that deliberators were somewhat better at accurately recognizing several of them (anger, fear, sadness, and pride).

Is emotion recognition efficient? To determine whether recognition is an efficient process, we examined recognition rates in the cognitive load condition. Mean accuracy across emotions was 80%, significantly greater than chance ($p < .05$) based on the binomial test, and this held for every specific emotion except contempt (51%, *ns*; see Figure 1 for all means). We next examined mean response latencies for each emotion for accurate responders only, to determine how quickly observers can accurately recognize each expression under cognitive load. The mean response latency across emotions was 762 ms. Mean latencies for happy expressions differed significantly from mean latencies for fear, $t(40) = 2.03$, $p < .05$, but no other differences emerged (see Figure 2).

To determine whether accurate recognition can occur even more quickly under cognitive load, we next examined recognition rates among subsamples of participants who responded to each expression within 600 ms. On the basis of binomial tests, anger ($M =$ 100%), disgust ($M = 96\%$), happiness ($M = 90\%$), and pride ($M =$ 90%) were recognized significantly better than chance ($p < .05$) within this brief latency. In contrast, contempt ($M = 48\%$, *ns*), fear ($M = 80\%$, *ns*), sadness ($M = 81\%$, *ns*), and surprise ($M = 64\%$, *ns*) were not recognized significantly better than chance within the 600-ms latency, in most cases because mean *n*s were too low (for these four expressions, only 4–8 individuals responded within 600 ms). These results suggest that participants could discriminate among some of the similarly valenced emotions (e.g., happy vs. pride and anger vs. disgust) in less than 600 ms while under cognitive load, but not all.

We next compared accuracy rates in the cognitive load and fast conditions and found no difference for any emotion, $t(51) = 0.47$, 0.41, 0.70, 1.45, 0.63, 0.36, 0.04, and 0.80, for anger, contempt, disgust, fear, happiness, pride, sadness, and surprise, respectively, all *ns*. However, a comparison of accuracy rates in the cognitive load and deliberated conditions revealed that accuracy was higher for fear, $t(48) = 2.45$, 14% increase, $p < .05$; sadness, $t(48) =$ 5.26, 18% increase, $p < .05$; and surprise, $t(50) = 2.41$, 14% increase, $p < .05$, in the deliberated condition, suggesting that the recognition of these emotions was somewhat impaired under cognitive load. In contrast, recognition rates for anger, contempt, disgust, happiness, and pride were no worse under cognitive load than when participants deliberated, $t(40) = 1.88$, $t(50) = 0.32$, $t(40) = 0.45$, $t(50) = 1.58$, and $t(50) = 1.22$, respectively, all *ns*.

We next examined false alarm rates in the cognitive load condition. Most of the rates were fairly low (overall $M = 14\%$, see Table 2 for means for each expression), and in no case was a mean false alarm rate significantly greater than chance ($p < .05$). In two cases, the false alarm rates for specific emotions were significantly greater than chance ($p < .05$): Surprise was labeled as fear by 74% of participants, and the pride expression (with arms raised) was labeled as happiness by 70% of participants. A comparison of the overall false alarm rates between the cognitive load, fast, and deliberated conditions showed that in all cases, rates were comparable; no significant differences in mean rates emerged.

Discussion

The findings from Study 1 suggest that with the exception of contempt, emotion expressions can be accurately recognized when participants are forced to respond quickly and under cognitive load. Several findings support this conclusion: Accuracy rates for anger, disgust, fear, happiness, pride, sadness, and surprise were significantly greater than chance in the fast and cognitive load conditions; mean response latencies for accurate responders were below 700 ms for all of these emotions and below 650 ms for all except fear; and all emotions except fear were accurately recognized better than chance by those participants who responded within 600 ms.

However, in several cases emotions were better recognized when participants deliberated; accuracy rates were higher for anger, fear, pride, and sadness in the deliberated versus fast condition and higher for fear, sadness, and surprise in the deliberated versus cognitive load condition. However, with the exception of fear, these differences were not particularly large, and combined with the finding that each of these emotions can be recognized accurately under speeded and distracted conditions, they do not indicate that recognition of these emotions *requires* complex cognitive processes. Rather, such processes seem to improve participants' ability to recognize these four emotions. For disgust and happiness, the absence of a difference between conditions reduces the likelihood that recognition is a cognitively taxing process.

The fact that a difference emerged for anger and pride but not surprise in the deliberated versus fast condition, whereas the opposite pattern emerged in the deliberated versus cognitive load condition, raises questions about the level of attention required to recognize anger, surprise, and pride (e.g., why can individuals recognize anger equally well under cognitive load as when deliberating, but not when responding quickly?) In contrast, recognition of fear and sadness seem to be more unambiguously impaired when cognitive resources are depleted.

Overall, false alarms were fairly low, but there were several exceptions. In particular, pride expressions were fairly frequently mislabeled as happiness, but the fact that this mistake occurred across conditions suggests that it was not a result of speeded or distracted processing. Furthermore, overall false alarm rates for the pride expression were markedly low; excluding happiness false alarms, pride was incorrectly labeled as other emotions only 6% of the time participants had the opportunity to do so, across conditions. Given that the pride expression includes the major feature of the happiness expression (the smile) and that pride is typically accompanied by positive affect, which laypeople often define as "happiness," it is not surprising that some participants labeled the pride expression as happiness when given the opportunity to do to so and not forced to choose between pride and happiness. Another false alarm that occurred in the deliberated condition, the mislabeling of anger as contempt, may also have resulted from participants assuming that angry targets felt contemptuous. However, this result is equally likely to be part of a larger problem with the contempt expression: It was not recognized better than chance in any condition, even when participants deliberated. The final significant false alarm was for surprise, which was frequently mislabeled as fear under cognitive load. Although this mistake did not occur to such a large extent in the other two conditions, it was a prominent error (56% in the deliberated condition and 61% in the fast condition, both *ns*) and is consistent with previous research showing that individuals across cultures tend to mistake surprise for fear (e.g., Ekman et al., 1969). This false alarm could, in fact, represent an adaptive advantage, given the similarity of the two expressions (eyes wide) and the relative costs of making this mistake versus missing an actual fear expression.

Despite the evolutionary importance of recognizing fear, fear was the emotion, other than contempt, whose recognition suffered most under speeded and loaded conditions. Fear was not recognized better than chance within 600 ms and was recognized more slowly than happiness in the fast and cognitive load conditions. Although these findings seem inconsistent with the evolutionary expectation that fear's survival-relevant message should be most quickly recognized, they are consistent with previous research showing that responses to negatively valenced stimuli (e.g., words and expressions) tend to be slower than responses to positively valenced stimuli when tasks require observers to categorize stimuli (Ducci, 1981; Eastwood, Smilek, & Merikle, 2003; Hugenberg, 2005; Kirita & Endo, 1995; Leppanen, Tenhunen, & Heitanen, 2003; Stenberg et al., 1998). In contrast, when participants must simply perceive stimuli without making any cognitive judgments about them (i.e., press a button when the stimulus is perceived), responses to negative stimuli tend to be quicker than responses to positive stimuli, as one might expect (Hugenberg, 2005; Leppanen et al., 2003; Öhman, Lundqvist, & Esteves, 2001). This discrepancy suggests that fear might be perceived quickly and automatically, but its urgent message ("danger!") may be a distracting source of interference that inhibits categorization (Dijksterhuis & Aarts, 2003; Eastwood et al., 2003; Hugenberg, 2005; Leppanen et al., 2003).

However, it is not clear whether this distinction is restricted to fear versus happiness or is more likely to be a generalized negative versus positive valence effect. In previous research, this distinction has emerged between responses to happiness and a range of negative emotions, but these studies have not examined whether it holds for other positive emotions, such as pride. In the present research, happiness was recognized most quickly and accurately and had the lowest false alarm rate, whereas pride was not significantly more quickly recognized than fear or any other negative emotion. These findings thus suggest that there may be something unique about happiness, rather than a generalized valence effect that produces quicker recognition for positive emotions.[8] We further examine this issue in Study 2.

One question not addressed by Study 1 is whether fast and efficient recognition applies only to the eight emotions we examined. We found no differences, on the whole, between pride and the less cognitively complex emotions, but contempt—another emotion that may be more cognitively complex—was clearly less well recognized than the more basic emotions. High recognition for pride may have been due, in part, to its positive valence, so it remains unclear whether negative emotions that are more cognitively complex and possibly less biologically based (i.e., more culturally constructed) than the original six, such as embarrassment and shame, can be quickly and efficiently recognized. In fact, from an evolutionary perspective, it is not clear that the adaptive benefits of recognizing socially complex emotions like contempt or embarrassment are as crucial as the benefits of quickly and efficiently recognizing an emotion like fear or anger.

Study 2

In Study 2, we sought to replicate and extend the findings of Study 1 by including two additional cognitively complex social emotions: embarrassment and shame.

Method

Participants and procedure. One hundred thirty-two undergraduate students (71% women) participated in exchange for course credit (36 were assigned to the fast condition, 64 to the deliberated condition, and 32 to the cognitive load condition). The procedure was the same as in Study 1, except that two additional blocks of stimuli were added to each condition for the two newly included emotions, embarrassment and shame.

Stimuli. Embarrassment and shame expressions were posed by the same male and female targets who posed the emotion expressions for Study 1; all 10 emotion expressions were included in Study 2. Embarrassment and shame expressions were posed on the basis of previous research (Heerey, Keltner, & Capps, 2003), and Rosenberg verified that these expressions included the facial and head actions relevant to these two emotions. As in Study 1, alternate embarrassment and shame expressions were also posed; these included the body and the face. Specifically, the alternate embarrassment and shame expressions both included a slumped posture (i.e., shoulders pulled inward, chest relaxed, and body leaning forward) and the head tilt downward that is part of the previously verified version of each expression. As in Study 1,

[8] It is also possible that the latencies for pride recognition were more similar to latencies for recognition of several negative emotions because pride is not an unambiguously positive emotion. Pride has two distinct facets, one of which is positive and one of which is more negative, and both of which are associated with the same nonverbal expression (Tracy & Robins, 2007b).

results were analyzed only for the version of each expression that has previously been reliably associated with each particular emotion.

Results

How quick is emotion recognition? As in Study 1, overall recognition in the fast condition ($M = 81\%$) was significantly greater than chance (50%, ps $< .05$), based on the binomial test, and this held for each specific emotion except contempt ($M = 47\%$, *ns*; see Figure 4 for means for each emotion). An examination of mean response latencies for each emotion, for accurate responders only, showed that the overall mean latency was 593 ms (range = 534 ms for happiness to 664 ms for fear; see Figure 5), 9 ms below the mean latency in the fast condition in Study 1.

To further explore the difference between the response latency for happiness and fear that emerged in Study 1, we compared mean latencies for happiness expressions with mean latencies for each other emotion. Happiness latencies differed significantly from latencies for each of the negative basic emotions, $t(53) = 2.66$, $t(53) = 2.44$, $t(34) = 3.42$, $t(56) = 2.79$, and $t(24) = 3.41$, for anger, disgust, fear, sadness, and contempt, respectively, all ps $<$ .05, but not from latencies for any of the self-conscious emotions or surprise. To test whether these differences were unique to happiness or could be attributed to a positive–negative valence effect, we compared the mean latency for pride ($M = 562$) with each other latency. Pride was recognized more quickly than fear, $t(39) = 2.35$, and contempt, $t(28) = 2.40$, both ps $< .05$, but not any other emotion. Shame was also recognized more quickly than fear, $t(40) = 2.02$, and contempt, $t(29) = 2.08$, both ps $< .05$. The only other significant difference was that surprise was recognized more quickly than contempt, $t(30) = 2.08$, $p < .05$. Thus, happiness was the only emotion that was recognized more quickly than all negative basic emotions, but it was not recognized more quickly than *every* emotion, nor was it the only positive emotion that was recognized more quickly than some other emotions. In contrast, fear and contempt were the only emotions that were recognized significantly more slowly than both positive emotions and shame.

We next examined recognition rates for the subsamples of participants who responded to each expression within 600 ms. All emotions except contempt (42%, *ns*) and fear (72%, *ns*) were recognized significantly greater than chance within this latency (overall $M = 81\%$, $p < .05$; see Figure 6 for means for each emotion), suggesting that all three complex self-conscious emotions can be recognized and discriminated very quickly. These results replicate the finding from Study 1 that fear and contempt are the only emotions that cannot be recognized within 600 ms.

An examination of false alarm rates in the fast condition showed that mean rates (for each expression, across all possible misidentifications) were fairly low ($M = 16\%$) and relatively similar across emotions (see Table 2). In no case was a mean false alarm rate significantly greater than chance ($p < .05$), and in only one case was a false alarm for a particular emotion expression significantly greater than chance: The pride expression (arms akimbo) was labeled as happiness by 84% of participants ($p < .05$). For the remainder of emotions, false alarm rates were not significantly greater than chance, and in most cases they were below 50%.

Does deliberation improve recognition? We next compared recognition rates in the fast and deliberated conditions. Accuracy rates were higher in the deliberated condition for anger, $t(66) = 2.76$, 11% increase; pride, $t(66) = 3.61$, 8% increase; and surprise, $t(66) = 2.19$, 8% increase, all ps $< .05$ (see Figure 4 for means). In contrast, accuracy rates for contempt, disgust, fear, sadness,

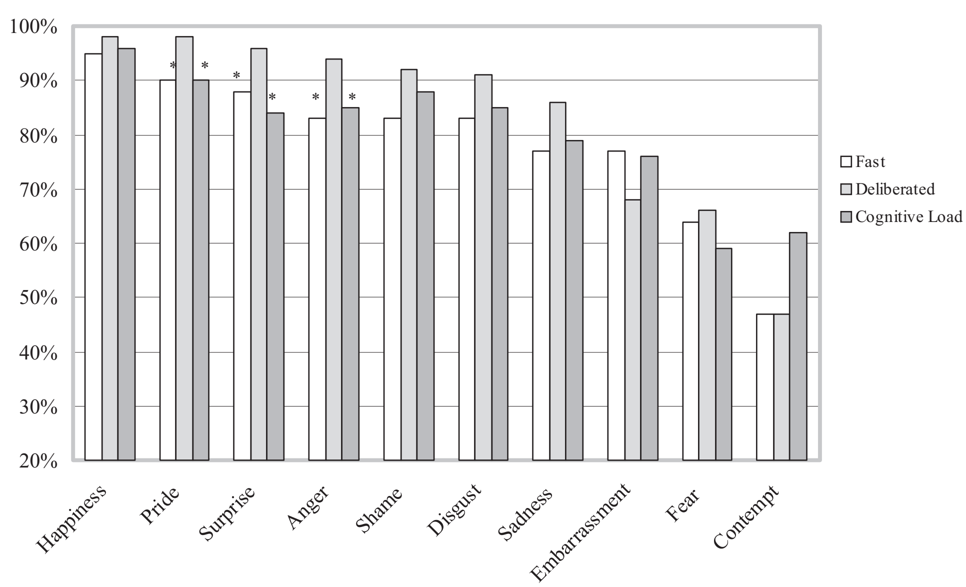

Figure 4. Mean recognition rates in the fast, deliberated, and cognitive load conditions: Study 2. Differences between the fast and cognitive load conditions are difficult to interpret because the maximum response time allotted was 1,000 ms in the fast condition and 1,500 ms in the cognitive load condition. Thus, the only significant differences presented here are those that emerged between the deliberated condition and each of the other two conditions. $N = 132$. $^{*}p < .05$.

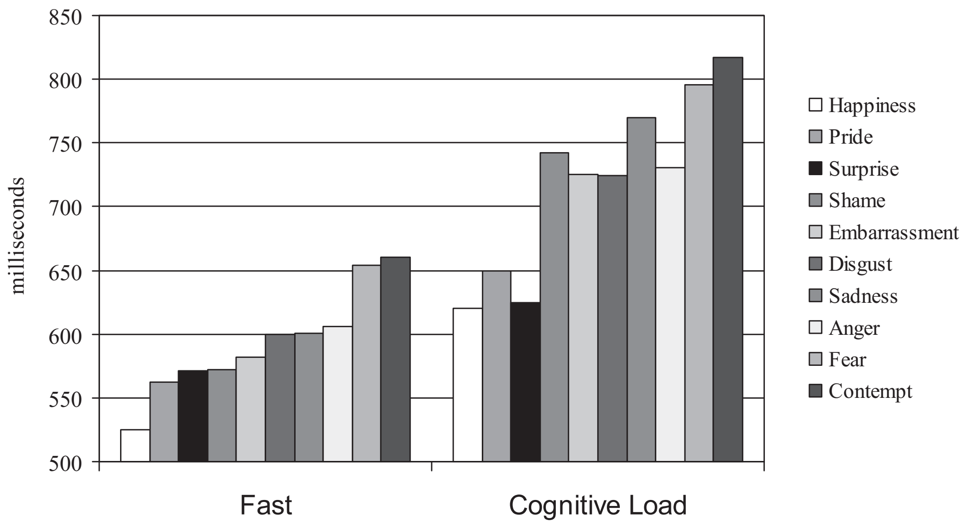

Figure 5. Mean response latencies in the fast and cognitive load conditions, for accurate responders only: Study 2. Differences between conditions are difficult to interpret because the maximum response time allotted was 1,000 ms in the fast condition and 1,500 ms in the cognitive load condition. $N = 64$.

embarrassment, and shame did not differ between the two conditions, $ts(66) = 0.04$, 1.64, 0.22, 1.50, 1.18, and 1.57, respectively, *ns* (see Figure 4). To test whether deliberation influenced participants' ability to correctly determine that each expression was *not* a particular target emotion (i.e., make correct rejections), we compared false alarm rates in the fast and deliberated conditions. No differences emerged, all $ts < 1$ except for disgust, $t = 1.18$, *ns* (see Table 2 for means), suggesting that deliberating did not improve participants' ability to correctly determine that a particular expression does not represent a target emotion, and this held for the complex emotions. As in Study 1, in no case was a mean false alarm in the deliberated condition rate significantly greater than chance ($p < .05$), but in several cases a particular expression was labeled as a particular incorrect emotion at a greater-than-chance frequency: Pride was mislabeled as happiness (84%); fear, as sadness (67%); surprise, as fear (70%); and shame, as both sadness (80%) and embarrassment (72%, all $ps < .05$).

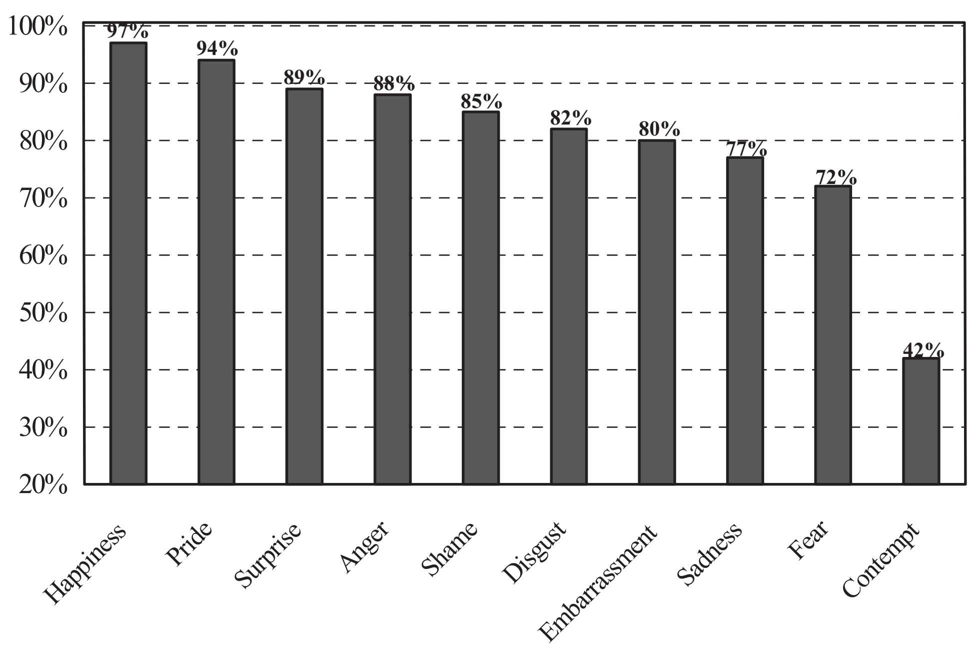

Figure 6. Mean recognition rates for participants who responded within 600 ms in the fast condition: Study 2. All rates are significantly greater than chance except fear and contempt. Mean $N = 20$ (range = 17–26).

Is emotion recognition efficient? As in Study 1, overall accuracy ($M = 81\%$) in the cognitive load condition was significantly greater than chance ($p < .05$), and this held for each specific emotion except fear and contempt (see Figure 4 for means). The mean response latency for accurate responders was 720 ms, 42 ms lower than the mean latency in the cognitive load condition in Study 1. Happiness, pride, and surprise expressions were recognized more quickly than those of contempt, $t(41)$s = 3.29, $t(37) = 3.26$, and $t(39) = 2.90$, respectively; fear, $t(35) = 3.47$, $t(32) = 2.66$, and $t(34) = 2.31$, respectively; and sadness, $t(53) = 2.78$, $t(50) = 2.74$, and $t(49) = 2.33$, respectively; all ps $< .05$. Happiness was also more quickly recognized than anger, $t(54) = 2.01$, and both happiness and surprise were recognized more quickly than shame, $t(54) = 2.08$ and $t(51) = 2.03$, respectively, all ps $<.05$. No other differences in response latencies emerged.

We next examined recognition rates among the subsamples of participants who responded to each expression within 600 ms, under cognitive load. On the basis of binomial tests, disgust ($M = 80\%$), happiness ($M = 100\%$), pride ($M = 90\%$), surprise ($M = 90\%$), embarrassment ($M = 86\%$), and shame ($M = 88\%$) expressions were recognized significantly better than chance ($p < .05$). In contrast, anger ($M = 74\%$), contempt ($M = 45\%$), fear ($M = 50\%$), and sadness ($M = 63\%$) expressions were not accurately recognized within the 600-ms latency. These results suggest that participants could recognize the complex self-conscious emotions in very brief latencies, even when cognitively taxed.

We next compared accuracy rates in the cognitive load versus fast conditions and found no difference for any emotion, all ts $<$ 1, except for contempt, $t(66) = 1.81$, and shame, $t(66) = 1.01$, both *ns*, suggesting that recognition was not impaired any further by the addition of a cognitive load, even for the complex emotions. However, several differences emerged between the cognitive load and deliberated conditions: Accuracy was higher in the deliberated condition for anger, $t(62) = 2.26$, 9% increase; pride, $t(62) = 2.56$, 8% increase; and surprise, $t(62) = 2.71$, 12% increase, all ps $<$ .05, replicating the comparisons between the fast and deliberated conditions and suggesting that the recognition of these three emotions was slightly impaired under distracted and speeded responding. In contrast, recognition rates for contempt, disgust, fear, happiness, sadness, embarrassment, and shame were no worse under cognitive load than when participants deliberated.

False alarm rates in the cognitive load condition were fairly low (see Table 2), and in no case was a mean false alarm rate significantly greater than chance ($p < .05$). However, as was found in the deliberated condition, the shame expression was mislabeled as sadness by 72% of participants ($p < .05$). Mean false alarm rates were comparable across conditions; no significant differences were found among the fast, deliberated, and cognitive load conditions for any emotion.

Discussion

The findings from Study 2 generally replicated the findings from Study 1. In both studies, all emotion expressions except contempt were recognized accurately, quickly, and efficiently (i.e., under cognitive load). With only a few exceptions, accuracy was not substantially improved by deliberation. There were, however, a few discrepancies between the two studies. First, Study 2 failed to replicate the finding that deliberation improves recognition of fear and sadness. However, in Study 2, fear recognition was not particularly high in any of the three conditions (Ms = 64% in the fast condition, 66% in the deliberated condition, and 59% in the cognitive load condition), although it was significantly greater than chance in all three. Second, in Study 2 but not Study 1, the recognition rates for anger, surprise, and pride were lower in the fast and cognitive load conditions compared with the deliberated condition, suggesting that recognition of these three emotions may, in fact, benefit from directed cognitive resources. However, these differences were fairly small, especially for pride, which was recognized by 90% of participants in the fast and cognitive load conditions, but near ceiling (98%) in the deliberated condition. The fact that these differences did not replicate across studies also suggests that they are not robust effects.

Finally, the findings from Study 2 allow us to add two more emotions to those found in Study 1 to be accurately recognized under fast and cognitive load conditions. Embarrassment and shame were recognized equally as well regardless of whether participants responded quickly, deliberated, or were distracted by a cognitive load. Shame was somewhat frequently mislabeled, usually as sadness, but this false alarm may be due to participants viewing shame expressions as conveying both shame and sadness, given that the two emotions likely co-occur in most circumstances and share an important feature (eye gaze downward).

General Discussion

The findings from the present research address several questions about the process of emotion recognition. First, both studies suggest that overall, emotion expressions can be accurately recognized and discriminated from each other very quickly (i.e., within 600 ms), and under cognitive load. Results from the false alarm rate analyses suggest that participants did not identify emotion expressions under speeded or cognitive load conditions by simply responding "yes" to all expressions displayed. Rather, even while cognitively taxed, participants accurately recognized most emotions and accurately rejected most false suggestions. These findings held for the basic emotions and for the cognitively complex, self-conscious emotions of embarrassment, pride, and shame.

However, there are several caveats to this conclusion. First, contempt was not recognized better than chance in any condition, suggesting that its expression is difficult to recognize even when cognitive resources are directly allocated to the task. This finding is consistent with previous studies that have failed to find above-chance recognition of contempt (e.g., Elfenbein & Ambady, 2002; Russell, 1991; Tracy & Robins, 2007b; Wagner, 2000). One possible explanation is that contempt recognition may be hindered by college students' unfamiliarity with the word *contempt*; studies have shown that recognition is improved by providing contextual information about the emotion (Matsumoto & Ekman, 2004, but see Wagner, 2000). Other studies have found that contempt is recognized at higher rates when a head tilt is added to the facial movements in the standard expression (Izard & Haynes, 1988; Rosenberg & Ekman, 1995); this finding fits with the suggestion that all complex emotion expressions involve the head or body in addition to the facial musculature (Tracy & Robins, in press). For the other complex emotions, however, the results do not suggest that their recognition requires greater cognitive resources than the recognition of more basic emotions; in fact, pride and shame were recognized more quickly than fear, and in Study 2 under cognitive load, pride was recognized more quickly than sadness.

A second caveat is that for anger, pride, and surprise, accuracy was somewhat improved by deliberation, when compared with at least one of the two fast conditions. All three emotions were reliably recognized under conditions of minimal cognitive resources, at rates comparable to those typically found in nonspeeded conditions (Elfenbein & Ambady, 2002; Tracy & Robins, 2004), and pride was recognized accurately within 600 ms even under cognitive load, but participants who were given time and encouraged to deliberate about the meaning of these three expressions showed slightly improved recognition—although not consistently so (across both studies and speeded–load conditions, mean increases under deliberation for these three emotions ranged from 7% for pride to 11% for surprise). This suggests that although extensive cognitive resources are not necessary to recognize these emotions, the addition of such resources can improve accuracy for some perceivers.

Third, although fear was recognized better than chance in both studies, and in Study 2 was recognized equally well across all three conditions, it was not well recognized by those participants who responded within 600 ms in either study. Fear was also recognized significantly more slowly than several emotions. This finding highlights a distinction between fear and the other emotions, which (except for contempt) were accurately recognized within 600 ms and were not consistently among the slowest recognized. This difference may be the result, as previously suggested, of interference created by the fear expression, which might inhibit the recognition process by orienting perceivers to potential danger. Consistent with this interpretation, fear was recognized more slowly than both positive emotions (happiness and pride) and the one emotion of ambiguous valence, surprise, in the cognitive load condition in Study 2. However, future studies must further address this issue before we can rule out other possible interpretations, such as unique features of the fear expression that might make it particularly difficult to recognize.

One possible interpretation is that fear is an intensely negative emotion, and the findings from both studies suggest that negative emotions—especially negative basic emotions—are in general recognized less accurately and quickly than positive emotions. By including the pride expression, the present research was able to take a new look at this distinction, previously found between happiness and a range of negative emotions. In Study 1, pride recognition appeared to be no different from the recognition of several negative emotions, and there was little reason to suspect that participants' ability to more quickly and accurately recognize happiness was a valence effect. In Study 2, however, this was not as clearly the case. Happiness and pride were recognized more quickly than fear, sadness, and contempt in at least one of the two speeded conditions. However, happiness was the only emotion that was also more quickly recognized than anger and disgust, suggesting that there is something unique about the happiness expression. Shame was also recognized more quickly than fear and contempt, so we cannot infer a generalized positive valence effect, but it is noteworthy that pride and surprise—the only emotion that is not clearly positive or negative—were consistently the most quickly recognized expressions, after happiness.

The fact that across studies happiness expressions were generally recognized more quickly than negative basic emotion expressions—the expressions that likely evolved to send urgent, survival-oriented messages—but not more quickly than the negative social emotions (embarrassment and shame), which likely evolved to send more social, less urgent messages, is consistent with the theory that negative basic emotions are distracting (Pratto & John, 1991). That is, when participants see anger, disgust, fear, and sadness expressions, rather than immediately reach a conscious understanding of the expression and press the correct key, their cognitive resources may be immediately allocated to a more important task: finding the source of the threat. This interpretation would not explain why happiness, in particular, is so quickly recognized, but it does provide a possible explanation for why the negative basic emotions were recognized less accurately and more slowly in the fast and cognitive load conditions.

However, the positive–negative valence distinction could also be due to the need to discriminate among four to six different negative emotions versus only two positive emotions, if emotion recognition occurs through two sequential steps: first determining the valence of the expression and then discriminating among similarly valenced expressions. Future studies could address this issue by comparing recognition rates for only two negative emotions with two positive emotions, although participants may still use a mental process that requires them to discard false options they know exist, even if those options are not part of the experimental procedure. It is also possible that the difference between positive and negative emotions is due to the actual reliability of each signal, rather than its positivity or negativity, or the number of options available. Happiness, pride, and surprise are typically recognized at the highest rates of any emotions, across cultures, suggesting that their expressions may be particularly clear signals (Elfenbein & Ambady, 2002; Tracy & Robins, in press). This clarity would likely be reflected in quick, accurate, and efficient recognition.

Implications

The present studies add to our knowledge of emotion recognition in several ways. As the first studies to systematically examine recognition of all known emotion expressions under speeded and distracting conditions, our findings demonstrate that each distinct emotion expression, except contempt, can be recognized and discriminated quickly and efficiently. Even under cognitively taxing conditions, participants made clear distinctions among similarly valenced emotions, and they did so quickly (in fact, when responding quickly, participants seemed less likely to show a false alarm response bias than when deliberating, although overall differences were not significant). By demonstrating that emotion recognition can occur under constraints that are likely to be present in the real world, these findings support evolutionary accounts of emotion recognition.

A second novel contribution of the present research is the finding that all three self-conscious emotions known to have nonverbal expressions were recognized as quickly and efficiently as the previously established basic emotion expressions, such as anger and sadness (and more so than fear). Despite the fact that the experience of self-conscious emotions requires greater cognitive complexity, the ability to recognize them seems as likely to be an evolved capacity of the mind as it is for the basic emotions.

Third, the greater speed in processing positive than negative expressions, found in several previous studies (e.g., Ducci, 1981; Kestenbaum & Nelson, 1992; Kirouac & Dore, 1983; Hugenberg, 2005; Leppanen et al., 2003; Stenberg et al., 1998), was demonstrated to extend to another positive emotion besides happiness: pride. Previous studies addressing this issue have included only a single positive emotion expression (happiness), so it has been unclear whether these effects are specific to happiness or reflect a broader distinction between positively and negatively valenced emotions. Our findings for the pride expression, particularly from Study 2, are somewhat consistent with the latter conclusion. However, our findings also suggest that two processes may be involved: one that promotes a general positive versus negative emotion distinction in speed and accuracy, and one that promotes the particularly quick and accurate recognition of happiness specifically.

Limitations and Future Directions

Several results were inconsistent across studies and thus require replication. For example, further research is needed to determine whether deliberation improves accuracy for fear and sadness. In addition, several specific limitations of our research design should be addressed in future work. Although we were able to examine recognition rates among subgroups of participants who responded to each expression within 600 ms, future studies should limit the duration of the stimulus presentation and time allotted for responses to this brief window to determine precisely how quickly individuals can recognize each emotion expression. A related issue concerns the fact that in our deliberated condition, participants viewed expressions for a lengthy duration (8 s) and had unlimited time to respond. Thus, we cannot be sure whether differences that emerged between this condition and the other two conditions were due to the longer viewing period, the longer response time, or both. To fully tease apart these possibilities, future studies should separately and systematically manipulate the viewing and response times. However, given that the differences we found between maximally different conditions (restricted exposure and restricted response time vs. essentially unrestricted exposure and unrestricted response time) tended to be fairly small, it is unlikely that recognition rates in our fast condition would differ substantially from recognition rates in either intermediary condition (restricted exposure and unrestricted response time or unrestricted exposure and restricted response time).

A second limitation is that although we included all 10 emotions for which there is at least some evidence of cross-cultural recognition, these expressions were portrayed by only two targets, both Caucasian, so questions remain about the extent to which our findings generalize to targets of other ethnicities. Hugenberg and Bodenhausen (2003) found that targets' race can influence perceivers' ability to recognize emotions, such that Black targets showing ambiguous expressions are more readily perceived as showing anger than are White targets showing the same expressions when perceivers are high in racism. Thus, the recognition rates found here in the fast and cognitive load conditions may vary depending on the race of the target and racism level of the perceiver. If the positive–negative valence distinction is due to interference from the threat signal associated with negative emotions, this distinction might be exacerbated when negative expressions are shown by targets who seem particularly threatening, either because their race is stereotypically associated with threat or because of other target-specific features (e.g., size, clothing, etc.; Hugenberg, 2005).

In a related vein, future research should replicate these findings for perceivers from other cultures. Previous research has suggested that for the most part, the emotion expressions we included are accurately recognized by individuals from different cultures, at least when these individuals are given unlimited time to do so. However, we do not know whether cross-cultural recognition would be as accurate when perceivers are forced to respond quickly or under cognitive load. Addressing this issue may be relevant to extant controversies about the universality of emotion expressions. If, in contrast to the Darwinian view, expressions are universal because they have spread from culture to culture through cross-cultural transmission, then the recognition process may require greater cognitive resources for individuals living in cultures in which expressions did not originate. Future studies that apply the present methods to cross-cultural research may help address questions about the universality of emotion expressions and the validity of recently proposed resolutions to this issue, such as dialect theory (Elfenbein, Beaupre, & Levesque, 2007). If the in-group bias in emotion recognition is the result of culture-specific dialects (Elfenbein & Ambady, 2002), then the recognition of out-group emotions may be particularly impaired when cognitive resources are limited.

Finally, given that both studies used a forced-choice response format, we cannot be sure that emotion recognition occurs as quickly and efficiently in real-life conditions, in which participants are not presented with emotion word options when interpreting the expressions of others. On the other hand, real-world recognition may occur more quickly than was found here, given that in the real world there is no need for the motor cortex to generate a button press that demonstrates recognition, as was the case in the present research. Future studies could address both of these issues by combining the present methodology with a more open-ended, free-response format that does not require motor responses, perhaps one that uses voice recognition software and asks participants to say emotion labels aloud as they view expressions.

Conclusions

More broadly, these findings are informative about the cognitive processes that underlie emotion recognition. Some time ago, Bargh (1994) argued that automatic social processes are marked by "four horsemen": lack of awareness, lack of intention, lack of control, and efficiency. Although more recent work has suggested that not all automatic processes must share all of these features (Okon-Singer, Tzelgov, & Henik, 2007), it is nonetheless informative to use this perspective to help understand the ways in which a given mental process is, and is not, automatic. In the case of emotion recognition, previous studies demonstrating that subliminal expressions influence subsequent behaviors suggest that at some level, the content of expressions can be perceived without intention and without awareness (Dimberg et al., 2000; Niedenthal, 1990; Winkielman & Berridge, 2004). Other studies demonstrating that expressions interfere with the processing of incongruent stimuli suggest that at some level, emotion recognition cannot be controlled (Stenberg et al., 1998). The findings from the present research suggest that conscious awareness of each expression's meaning can be reached without attentional focus and with only limited cognitive resources—suggesting that emotion recognition meets the requirement of the fourth horseman: It is efficient. In fact, the greater number of significant false alarms that occurred when participants deliberated than when they responded quickly or under cognitive load (in Study 2) suggests that an important part of recognition, the correct rejection of false suggestions, may in fact be impaired when attentional resources are directed toward the task. In this regard, emotion recognition may be one of the many social judgments that benefits from a lack of directed attention (Patterson & Stockbridge, 1998; Wilson & Schooler, 1991).

If this is the case, we are fortunate that in the everyday conditions under which emotions are typically displayed, perceivers do not have time to elaborately interpret each expression in such a way that false alarms become likely. For certain emotions, a small but significant proportion of perceivers may consequently be less likely to accurately identify their expressions than they would if they deliberated. However, the present findings suggest that the majority of individuals do succeed in accurately recognizing expressions under real-world constraints. Thus, a suggestion made by Darwin (1872) long before psychologists reached an understanding of automaticity seems to be correct: "So many shades of expression are instantly recognized without any conscious process of analysis on our parts" (p. 359).

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