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Are Emotions Natural Kinds After All? Rethinking the Issue of Response Coherence

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Abstract

The synchronized co-activation of multiple responses—motivational, behavioral, and physiological—has been taken as a defining feature of emotion. Such response coherence has been observed inconsistently however, and this has led some to view emotion programs as lacking biological reality. Yet, response coherence is not always expected or desirable if an emotion program is to carry out its adaptive function. Rather, the hallmark of emotion is the capacity to orchestrate multiple mechanisms adaptively—responses will co-activate in stereotypical fashion or not depending on how the emotion orchestrator interacts with the situation. Nevertheless, might responses cohere in the general case where input variables are specified minimally? Here we focus on shame as a case study. We measure participants' responses regarding each of 27 socially devalued actions and personal characteristics. We observe internal and external coherence: The intensities of felt shame and of various motivations of shame (hiding, lying, destroying evidence, and threatening witnesses) vary in proportion (*i*) to one another, and (*ii*) to the degree to which audiences devalue the disgraced individual—the threat shame defends against. These responses cohere both within and between the United States and India. Further, alternative explanations involving the low-level variable of arousal do not seem to account for these results, suggesting that coherence is imparted by a shame system. These findings indicate that coherence can be observed at multiple levels and raise the possibility that emotion programs orchestrate responses, even in those situations where coherence is low.

Keywords

emotion, valuation, response coherence, adaptationism, culture

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Coherence or stereotypy in the outputs of multiple mechanisms—affective, motivational, cognitive, physiological, and behavioral—has been taken as a defining feature of emotion systems (Ekman, 1992; Fogel et al., 1992; Izard, 1994; Panksepp, 1994; Scherer, 2000; Tomkins, 1962). For instance, it has been argued that "emotions are embodied and manifest in uniquely recognizable, and stereotyped, behavioral patterns of facial expression, comportment, and autonomic arousal" (Dolan, 2002, p. 1191). If so, then the multiple responses under emotion control should co-occur coherently—with similar direction and intensity—when emotions are activated (Barrett, 2006). To give an example, it is expected that each of the responses hypothesized to be under anger control (e.g., anger feeling, anger facial expression, increased heart rate, aggression) is in fact delivered when the anger system is activated, and moreover, that each response varies in direction and intensity in sync with the other responses from one situation to the next. For instance, if the feeling of anger is more intense in situation A than in situation B, then the facial expression of anger, heart rate, and aggression too would be more intense, or higher, in situation A than in situation B, if there is response coherence. However, the existing evidence indicates that response coherence occurs inconsistently (Hollenstein & Crowell, 2014).

Establishing coherence in emotion, or its absence, is complicated because coherence is an elusive criterion. For instance, it is not clear how much coherence is enough coherence for something to qualify as an emotion. Nor is it clear what is the time interval within which responses should cohere (Evers et al., 2014; Hollenstein & Lanteigne, 2014; Lang, 1988;

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Wilhelm & Roth, 2001). More fundamentally, the assumption that it is responses that should cohere under emotion is far from self-evident (Reisenzein, 2000); we return to this issue below.

Still, the evidence is mixed. Some reports show response coherence (Dan-Glauser & Gross, 2013; Levenson et al., 1990; Matsumoto et al., 2007; Rosenberg & Ekman, 1994; see Lang et al., 1993). Other reports show coherence in some responses but not others (Evers et al., 2014; Mandler & Kremen, 1958; Marks & Huson, 1973; Mauss et al., 2005; Underwood & Bjornstad, 2001). Yet other reports show little or no coherence (Barrett et al., 2019; Bradley & Lang, 2000; Durán et al., 2017; Fernández-Dols et al., 1997; Landis, 1924; see Siegel et al., 2018).

This inconsistency has prompted various explanations. Some explanations attempt to reconcile emotion programs with low response coherence. Perhaps coherence is observed inconsistently because of methodological issues: failure to adequately elicit emotion in the laboratory, measurement error, oversight of micro-expressions, differences in the latencies of different responses, and ethical considerations preventing researchers from eliciting emotions at very high intensities, which might increase response coherence (Hollenstein & Lanteigne, 2014). Alternatively, emotion programs may exist but fail to cohere reliably if coherence arises only in certain contexts (Durán et al., 2017; Hollenstein & Lanteigne, 2014). This has led to the search for general moderators that might increase or decrease response coherence: gender (Hastings et al., 2009; Lang et al., 1993), presence or absence of behavioral problems (Hastings et al., 2009), trait social anxiety (Mauss et al., 2004), deliberate efforts to regulate an emotion (Butler et al., 2014), individualist vs. collectivist orientation of the individual (Matsumoto & Kupperbusch, 2001), intensity of emotion (Mauss et al., 2005; Rosenberg & Ekman, 1994; Tassinary & Cacioppo, 1992), and cultural scripts that modulate the expressivity of emotion (Shweder, 1985).

Another possibility, however, is simply that emotion programs lack biological reality. Indeed, from inconsistent response coherence, and from limited specificity (Barrett et al., 2019; Lindquist et al., 2012; Siegel et al., 2018), some researchers have concluded that there are no dedicated emotion programs in the mind–brain. According to one proponent of this argument:

> The frequent failure to observe such clustering is explained in several different ways. (. . .) Although any of these explanations may be correct, an equally plausible explanation is that scientists have failed to observe stable and reliable response clusters because they are not really there. Projectable property clusters may not exist because emotions may not be natural kinds. (Barrett, 2006, p. 34)

According to Barrett and colleagues' theory of constructed emotion, emotion episodes emerge when the individual applies emotion concepts to categorize interoceptive sensations involved in allostasis and cues from the external environment (Barrett, 2014, 2017). The resulting emotion episodes are highly idiosyncratic. This is because emotion episodes are constructed in particular contexts and in particular cultures with particular languages (Jackson et al., 2019; Romney et al., 1997) by particular individuals with varying levels of skill to interpret their own affect and who can therefore conceptualize their own affect with varying degrees of granularity (Barrett, 2004). A close look at the data shows that the populations of emotion episodes (e.g., the population of anger episodes) are too heterogeneous and nonspecific to assume that they result from dedicated emotion mechanisms (Barrett, 2006). Therefore, from the standpoint of constructed emotion theory, what is biologically real in emotion is an array of neurocognitive systems (e.g., the ones that generate internal signals of valence and arousal and emotion-related concepts) and their interactions, as well as the emotion *episodes* that result from those interactions, *but not specialized emotion programs with coordinating functions* (Barrett, 2006; Barrett & Russell, 2015; see also Fridlund, 2017; Ortony & Turner, 1990; Schachter & Singer, 1962). Thus, emotion programs are not natural kinds.

Currently, the affective sciences are at an impasse. On the one hand, the fact that responses cohere inconsistently has weakened the hypothesis that coherence is a defining feature of emotion. On the other hand, the hypothesis that emotion phenomena emerge from the interaction of neurocognitive systems that are not themselves emotion systems (Barrett, 2006; Barrett & Russell, 2015)—that orchestrating emotion programs lack biological reality—can explain variation in emotion across situations, individuals, and cultures (Boiger et al., 2013; Crivelli et al., 2016; Gendron et al., 2014a, 2014b), but has a hard time accounting for the fact that in addition to differences there are similarities in emotion, across situations, individuals, and cultures, including industrial societies (Cowen et al., 2019, 2021; Durkee et al., 2019; Scherer & Wallbott, 1994; Sell, Sznycer, Al-Shawaf, et al., 2017; Sznycer et al., 2012; Sznycer, Al-Shawaf, et al., 2017; Sznycer, Tooby, et al., 2016; Tracy & Matsumoto, 2008), small-scale societies (Scelza et al., 2020; Sznycer, Xygalatas, Alami, et al., 2018; Sznycer, Xygalatas, Agey, et al., 2018), and throughout history (Cowen & Keltner, 2020; Sznycer & Patrick, 2020).

We suggest that progress can be made if we consider that emotion programs exist in the brain and have adaptive functions, yet response coherence is not a feature of emotion—because coherence is not always expected or desirable if an emotion program is to carry out its adaptive function. Instead, the hallmark of emotion is the capacity to orchestrate multiple mechanisms adaptively, in ways that would promote the emotion program's own replication—on average, and under the ancestral selective regime that tailored the program.

Consider the hypothesis that emotions evolved because they reliably solved adaptive problems: predator fear, to limit the threat of being preyed on; shame, to limit the threat of being devalued by others; jealousy, to prevent the loss of mates and friends to rivals; disgust, to avoid pathogenic matter and sexual contact with individuals of low sexual value; anger, to bargain for better treatment (Al-Shawaf & Lewis, 2017; Buss, 2000; Ekman, 1992; Gilbert, 1998; Krems et al., 2020; Lieberman

et al., 2007; Öhman & Mineka, 2001; Sell et al., 2009; Sell & Sznycer, in press; Sznycer et al., in press; Tooby & Cosmides, 1990b; Tybur et al., 2013); and so on.

To solve adaptive problems, emotion programs coordinate the operation of multiple neurocognitive mechanisms. The information-processing structure and content of these mechanisms are jointly shaped over development by genes and environmental inputs. Importantly, the operation of these mechanisms is constrained (and enabled) by the mechanisms' pre-existing structure and content (Tooby & Cosmides, 1990b). Furthermore, emotions are constrained in their operation by limited time, limited computational power, and partial and imperfect information about the present and future states of the world (Simon, 1967). Finally, phylogenetic constraints and tradeoffs with selection acting at other loci, among other constraints, limit how much optimality natural selection can build into adaptations, including emotion adaptations (Al-Shawaf & Zreik, 2018; Dawkins, 1982). Because of these constraints, emotions are gambits which do not and cannot yield true optimality. Nevertheless, these gambits can be potent, because they retain and leverage in prospect those means that over evolutionary time tended to solve adaptive problems reliably and efficiently (Sznycer, Cosmides, & Tooby, 2017; Tooby & Cosmides, 2008). Emotions are evolved guesses, constrained in multiple ways, and so stereotypy and coherence in emotion responses are expected.

The pull toward coherence is not total, however. This is because the best-response to an adaptive problem in one class of situations may be sub-optimal or positively detrimental in a different class of situations (Tooby & Cosmides, 1990b; see also Clore & Ortony, 2013; Kreibig, 2010; Rozin et al., 1994). Importantly, the generation of a best-response may require coherence in some situations (e.g., a 70% increase in the intensity of each of the outputs under emotion control), and lack of coherence in other situations (e.g., increases in the intensities of some outputs, decreases in the intensities of other outputs). Thus, emotion programs may not deliver coherent responses across all situations.

Consider: The fight-or-flight system is more contingent (or conditional) and less response-coherent than a hypothetical, non-existing fight-*and*-flight system—one that coherently delivers both fight and flight when activated. But the existing fight-or-flight system is arguably more adaptive (Cannon, 1932; Fanselow, 1994). The family of fight-or-flight systems is the evolved answer to the question: How best to avoid being preyed on? The answer to this question is: It depends. Anti-predator responses in various non-human animal species are adjusted within individuals from moment to moment to respond adaptively, based on cues, to multiple variables: predator presence (Watt et al., 1997), distance from predator (Blanchard et al., 1989; Fanselow, 1994), distance from cover (Caraco et al., 1980), predator approach speed (Ydenberg & Dill, 1986) and direction (Burger & Gochfeld, 1990), predator size (Helfman, 1989) and type (T. Price et al., 2015; Seyfarth et al., 1980; Sherman, 1985), amount of time available to respond (Barrett & Finlay, 2018), and many others.

The ubiquity of contingencies in anti-predator behaviors—and other behaviors (Cronk et al., 2017; Giraldeau & Caraco, 2018; Krebs & Davies, 2009)—suggests that human emotions too may embody contingencies, including decouplings across the various outputs under emotion control. Further, the anti-predator examples noted above suggest that invariances in behavior-regulation systems are expected at the level of their adaptive functions, and in their information-processing structures, but not in the particular responses that these systems mobilize from one situation or individual to the next.

Thus, two things may be true of emotions. First, emotions may be invariant in their adaptive functions and their information-processing structures. And second, emotions may not be designed to achieve response coherence; instead, emotions may be designed to adaptively match different inputs to different outputs (vs. the same outputs), and this may lead to varying degrees of response coherence across situations and individuals. A hypothetical emotion program with a handful of open parameters may have dozens of modes of operation and display low coherence from one situation to the next, and yet this hypothetical emotion may solve adaptive problems effectively and efficiently. Indeed, modern evolutionary biology recognizes that adaptations can deliver variable outputs throughout development to better match the variable demands posed by the adaptation's relevant environment (Del Giudice et al., 2011; Stearns & Hoekstra, 2000; Williams, 1966). (Note that there are additional reasons why response coherence may be low, including (1) noise in the internal or external transmission of information, and (2) the ability of human emotions (a) to be mobilized in decoupled mode by the anticipation or recollection of events (Anderson & Adolphs, 2014; Bechara et al., 2000) and (b) to behaviorally realize tactics (e.g., remove incriminating evidence) in ways that can be highly context- and culture-specific (e.g., delete tweet, hide weapon; Buss, 1991; Lukaszewski et al., 2020; Scrivner et al., in press).

In sum, the argument is that the hallmark of emotion programs is the capacity to orchestrate responses adaptively (Al-Shawaf et al., 2016; Cosmides & Tooby, 2000; Scarantino, 2015; Sznycer et al., 2017; Tooby & Cosmides, 1990b; Tooby et al., 2008) rather than response coherence across situations and individuals. Adaptive orchestration may call for response coherence in some contexts and for low coherence or dis-coherence in other contexts (see Stemmler & Wacker, 2010; Quigley & Barrett, 2014; see also Lewis et al., 2017; Tooby & Cosmides, 1990a). If this is true, then limited coherence by itself would not deny the biological reality of emotion programs (cf. Barrett, 2006). The biological reality of emotion programs would be questionable, however, if the human mind–brain lacks the capacity to orchestrate responses adaptively.

Shame

Consider shame—the case study of the present paper. Humans disvalue and shun individuals who are poor social partners (Hales et al., 2016; Kurzban & Leary, 2001; Sznycer et al., 2019). This would have selected, on the recipient's end, for

adaptations to minimize the transmission of negative information about the self and the cost of any ensuing devaluation when negative information spreads. Shame appears to be a primary defense against the threat of being devalued by others (Gilbert, 1997, 1998; Gilbert & McGuire, 1998; Leary et al., 2001; Sznycer, 2010, 2019; Sznycer et al., in press).

The responses mobilized by shame can minimize the threat of being devalued. One of these is an internal signal—felt shame—that is aversive (MacDonald & Leary, 2005; Tangney et al., 1992) and is experienced as having a defective and powerless self (Lindsay-Hartz, 1984; Tangney et al., 1996). The feeling of shame appears to serve an interpersonal function: The intensity of felt shame closely tracks the magnitude of social devaluation expressed by others on an event-by-event basis (Cohen et al., 2020; Durkee et al., 2019; Sznycer & Patrick, 2020; Sznycer, Tooby, et al., 2016; Sznycer, Xygalatas, Agey, et al., 2018; see also Leary et al., 1995); this may allow the shame system to precisely modulate its various anti-devaluation measures so that they are neither insufficient nor excessive relative to the specific devaluative threat being faced.

There are many anti-devaluation measures that shame can mobilize. These include: Interrupting actions that might lead to being devalued (De Hooge et al., 2008; Fehr & Gachter, 2000), concealing or destroying damaging information (Sznycer et al., 2015), and hiding (Frijda et al., 1989; Roseman et al., 1994; Wicker et al., 1983), which can make it difficult for audiences to identify or punish the wrongdoer. Other shame measures include increased cortisol (Dickerson et al., 2008; Gruenewald et al., 2004; see Gruenewald et al., 2006; Lewis & Ramsay, 2002) and increased cytokine activity (Dickerson et al., 2009; Slavich et al., 2010), which may be advantageous if devaluation is followed by aggression and injury or infection. Shame can also produce a characteristic display of submission featuring slumped posture and gaze avoidance (Fessler, 1999; Weisfeld & Dillon, 2012), which deters attacks by conveying tolerance of reduced status (De Jong, 1999; Gilbert, 1997; Keltner et al., 1997; J. S. Price & Sloman, 1987; Semin & Manstead, 1982).

Although response coherence has not been studied extensively in the case of shame (existing shame evidence, see: Ahmed et al., 2010; Negrao et al., 2005; Matsumoto et al., 2007), it is possible that shame will reveal the general pattern of inconsistent coherence observed in other emotions. But any presence or absence of response coherence in shame (and in other emotions) may be incidental and subordinate to adaptive orchestration.

To see why, consider an action that directly enhances your welfare but diminishes the welfare of others. Theft, for example. The act of stealing may indicate to others that you are an exploitative partner and cause others to correspondingly decrease the weight they attach to your welfare, making them less likely to help you and more likely to harm you subsequently. The prospect or actuality of this devaluation—the eliciting condition of shame—will activate the shame system. However, the precise mode of operation of shame (and incidentally, the precise degree of response coherence in shame) will depend on how the shame system interacts with the situation. For illustration, consider three hypothetical shame responses: (1) the cessation of discrediting actions, (2) the delivery of excuses, and (3) the delivery of the shame display. If you are caught stealing red-handed the shame program may operate in such a way that the act of stealing is interrupted, excuses are delivered, and the shame display is delivered. By contrast, if you are by yourself, stealing, and hear that someone is approaching who hasn't (yet) seen you stealing, shame may similarly interrupt the act of stealing but deliver neither excuses nor the shame display—because in this second situation the excuses and the shame display would give yourself away rather than defeat devaluation (De Jong et al., 2003; Sznycer, 2010). (We note that various other shame responses too appear to be adaptively modulated to the situation; Crost et al., 2008; Declerck et al., 2014; De Hooge et al., 2011; Zhu et al., 2019).

In the two theft examples noted above, response coherence is higher in the former situation than in the latter situation. However, by the more relevant criterion of adaptive orchestration, the operation of shame is equally cost-effective in both situations *despite (owing to) coherence being lower in the latter situation*. By hypothesis, shame coordinates the operation of multiple adaptations to defeat the threat of being devalued, and whether or not shame mandates its prototypical display, its modal behavior, its modal physiology, or its modal cognition in a given situation (as interpreted by evolved situation detectors) will depend on the aggregate ancestral payoffs for parameterizing those systems in that manner in that situation.

From Coherence to Orchestration, and Back

To ascertain adaptive orchestration it is necessary to: (*i*) identify an adaptive problem and a candidate emotion system that might have evolved to solve it, and (*ii*) establish whether, when the organism encounters indications that it is facing that adaptive problem, multiple lower-level mechanisms reliably switch to delivering outputs that would have contributed ancestrally to the solution of that adaptive problem. Additionally, if a candidate emotion is believed to have more than one mode of operation, it is necessary to: (*iii*) establish whether different manifestations of the adaptive problem (e.g., others have seen you taking a disgraceful action and they have devalued you vs. you are taking a disgraceful action but others have not seen you yet) reliably lead to different vectors of (mechanism) settings, and (*iv*) establish whether the different vectors of settings would have solved their corresponding manifestations of the adaptive problem more effectively than they would have solved the other manifestations (e.g., does the response "feign normalcy" occur more frequently when others are approaching you but have not yet seen you taking a disgraceful action than when others saw you taking a disgraceful action and devalued you?).

Knowing whether and how the mind–brain matches different situations and inputs to different outputs is critical for the hypothesis of adaptive orchestration. Unfortunately, however, whereas the emotion literature is large, detailed knowledge about this type of input–output contingencies is still scarce.

There are reports of contingency in emotion (regarding shame, for example: De Hooge et al., 2011; Leach & Cidam, 2015; Zhu et al., 2019). But the existing reports focus on few inputs and few outputs. The kind of comprehensive map of how emotion—any emotion—matches inputs to outputs across situations (what is needed to evaluate the hypothesis of adaptive orchestration) is yet to be theorized and elucidated.

Because of this void, here we return to the simpler question of response coherence. We sidestep the more relevant but unknown question of matching different inputs to different outputs. Instead, here we ask whether coherence in outputs is observed in the general case where input variables are specified minimally.

We give study participants skeletal information about core actions and personal characteristics that might elicit shame but otherwise provide little or no information about situational variables that do seem to moderate the operation of shame: the presence or absence of an audience (Robertson et al., 2018; Smith et al., 2002); the characteristics of the audience (e.g., size; demographic characteristics; relative status; the values held by audiences; see Seta et al., 1989); the degree of knowledge the audience has about the individual's disreputable action or characteristics (Thomas et al., 2018; Zhu et al., 2019); and the way audiences actually respond (Dickerson et al., 2008). Absent information about these modifiers, we might observe response coherence in shame.

Predictions

If an emotion orchestrator is part of the human mind–brain and the orchestrator has authority over responses *a*, *b*, and *c*, the following will come to pass.

Prediction 1: In some situations, responses *a*, *b*, and *c* will be mobilized in proportion to one another intensity-wise, and in the direction or manner that is mandated by the orchestrator. This is a prediction about internal response coherence. Although, to reiterate, from a functional standpoint coherence (or lack of coherence) is incidental to orchestration.

Previous emotion research on response coherence has focused on *internal* response coherence. An adaptationist framework can explain why internal coherence occurs—because the various responses under emotion control may have each been selected to balance the competing demands of effectiveness and economy, and thus to be mobilized to a degree that is just right. But in addition, an adaptationist framework can generate novel predictions regarding coherence. Next, we outline some of these.

Prediction 2: In some situations, responses *a*, *b*, and *c* will be mobilized in proportion to the magnitude of the adaptive problem the emotion orchestrator is designed to solve. This is because a response can better perform its function if it is mobilized in proportion to the magnitude of the relevant problem—to a degree that is neither insufficient nor excessive. This is a prediction about external coherence between emotion responses on the one hand and the elicitor of the emotion on the other hand.

Prediction 3: In some situations, internal and external coherence will be observed within cultures worldwide. If emotion orchestrators are part of a human nature that is shared across cultures, then conditions that lead to (orchestrator-driven) response coherence in one culture will tend to also lead to response coherence in other cultures, even when those are mutually remote in culture-space.

Prediction 4: Coherence may be observed between cultures. For example, the more a personal characteristic is considered disgraceful by an audience in culture 1, the more individuals who possess that characteristic may display shame response *a* (and *b* and *c*) in culture 2. Shame appears to be tuned to how various actions and personal characteristics are appraised in the individual's own *local* social ecology (Rodriguez Mosquera et al., 2008; Sznycer, Tooby, et al., 2016). This is expected, because the devaluative threat that shame needs to counteract is a function of the particular actions and personal characteristics that *one's fellow group members* find unattractive, anger-producing, or immoral. Shame's sensitivity to local values militates against finding coherence between cultures. Nevertheless, despite the primacy of the local context in emotion (Elfenbein & Ambady, 2002, 2003; Romney et al., 2000; Scherer & Wallbott, 1994; Wierzbicka, 1998), if there are universals in the way people evaluate other people, then some actions or traits that are viewed as attractive, virtuous, odd, anger-provoking, immoral, or outrageous will be similar across cultures. Indeed, evidence suggests some cross-cultural commonality in the things that people value or disvalue in other people (Awad et al., 2020; Brown, 1991; Buss, 1989; Curry et al., 2019; Durkee et al., 2019; Fiske et al., 2007; Hanel et al., 2018; Henrich et al., 2006; Landers et al., in press; Petersen et al., 2012; Sell, Sznycer, Cosmides, et al., 2017; Shackelford et al., 2005; Sznycer, Al-Shawaf, et al., 2017; Sznycer & Cohen, 2021; Sznycer, De Smet, et al., 2016; Sznycer, Lopez Seal, et al., 2017; Sznycer & Lukaszewski, 2019; Sznycer & Patrick, 2020; Sznycer, Xygalatas, Alami, et al., 2018; Stylianou, 2003). Thus, response coherence between cultures may be expected sometimes.

Prediction 5: Internal, external, and cross-cultural coherence will arise functionally, from the operation of the emotion orchestrator, rather than from alternative causes such as low-level affect.

According to the alternative theory of constructed emotion, emotion episodes occur when the individual uses emotion concepts to categorize her own internal signals of valence (feelings of pleasure or displeasure) and arousal (the state of being excited vs. lethargic)—jointly termed core affect (Barrett, 2006; Barrett & Russell, 2015). Under this theory, any observed cross-situational, cross-individual, or cross-cultural coherence in shame episodes will stem from: (1) similarities in the relevant acts of conceptual construction, (2) similarities in valence, or (3) similarities in arousal—but not from the action of an evolved shame orchestrator that is part of human nature (which under the theory of constructed emotion does not exist). Here, we consider the possibility that coherence in shame episodes, if observed, stems not from an emotion

program (here, a shame program) but from other causes—something which has been evaluated infrequently despite its importance, as Barrett and others have argued (e.g., Barrett, 2006, 2012). More specifically, here we consider the possibility that coherence in shame, if observed, is caused by arousal.

The target motivations evaluated herein—hiding, lying, destroying evidence, and threatening a witness (see below)—pertain to actions that are agentic and arousing. Suppose the results indicate that there is response coherence. If that (hypothetical) response coherence is caused not by a devaluation-minimizing shame orchestrator (which lacks biological reality under the alternative theory of constructed emotion) but by, for example, the arousing nature of the target motivations (NB: arousal is one of the explanatory elements of the theory of constructed emotion), then the target motivations should covary in direction and intensity—should cohere—also with other arousing responses such as *communicating the discrediting event to others*. That is, here we evaluate whether coherence, if observed, can be explained by an alternative that resembles in its low-level affect (high arousal) the target motivations evaluated herein but otherwise lacks the adaptive functionality of minimizing the threat of devaluation. If the motivation to *communicate the discrediting event to others* covaries in direction and intensity with the other (target) motivations from one situation to the next, that would support the view that coherence stems from the low-level affect in the responses (and the alternative theory of constructed emotion), and not from a devaluation-minimizing shame orchestrator. We intend this as an initial test regarding the alternative theory of constructed emotion.

However, if the mind–brain is equipped with a shame orchestrator that functions to minimize the threat of devaluation, then devaluation-minimizing responses (shame feeling, hide, lie, destroy evidence, and threaten witness) will cohere with one another but will not cohere with devaluation-exacerbating responses (communicate event), even when all of these responses are similarly agentic and arousing. We note that in certain circumstances (for example, when information leakage makes it likely that others might learn about one's discrediting actions) shame can motivate confessions of the pre-emptive, self-interested sort (Sznycer et al., 2015). However, in the general case studied here the shame system is *not* expected to motivate the communication of reputationally-damaging information about the self.

In sum, from an adaptationist standpoint, response coherence can, in some situations, be observed at multiple levels: internally, externally, and cross-culturally. Moreover, response coherence will arise functionally, through the operation of an orchestrator, rather than through lower-level variables such as arousal.

Here we evaluate coherence across prospective, anticipatory shame responses. One of the core functions of the shame system is to evaluate alternative future courses of action in order to forestall or conceal those actions that might lead others to devaluate the individual. Thus, shame responses are expected to cohere with one another and with audience devaluation even in the total absence of communication between the audience (whose devaluation is the problem) and the individual guiding her choices based on the shame program. Decisions about one's actions often must be made prospectively, without any feedback regarding how others evaluate those actions. Thus, asking subjects to imagine the intensity of various shame responses in various situations is not a convenient but ecologically invalid assay of shame responses—the intensity of an anticipated shame response is precisely the variable predicted by the theory to track the magnitude of audience devaluation.

The Present Study

The present study evaluates two novel predictions derived from the adaptationist hypotheses that an emotion has an information-processing structure that (1) is well-designed to realize the adaptive function of the emotion, and (2) is cross-culturally invariant. To wit, the present study tests the novel predictions that various shame responses will cohere (*i*) with the magnitude of audience devaluation, and (*ii*) across populations that are culturally different.

We measure, for each of 27 socially devalued actions and personal characteristics, the degree to which participants (as audiences) would socially devalue a target individual if that individual took those actions or possessed those characteristics. We also measure the degree to which each of those 27 actions and characteristics, if true of participants, would produce in participants five shame responses: felt shame, as well as the motivations to: hide, lie, destroy evidence, and threaten a witness. Finally, we measure, for each of the 27 actions and characteristics, a motivation that is *not* predicted (by the adaptationist theory) to covary in the same direction as the other (target) shame responses: communicate event. Importantly, the 27 actions and characteristics are specified in skeletal form, with little or no information about various situational factors that appear to modulate the operation of shame.

By correlating the intensities of the shame responses we can determine whether they cohere with one another and with the intensity of audience devaluation in the manner that is predicted by the hypothesis that shame is an anti-devaluation emotion system. We conduct this study in two populations with disparate cultures, the United States and India, to establish whether the predicted coherence is observed within and across cultures.

Method

Procedure, stimuli, sample sizes, exclusion criteria, predictions, and analyses were preregistered before data collection began: https://aspredicted.org/p8gj6.pdf.

Participants and Procedure

Standard power analyses to determine participant sample size could not be conducted because the correlations are computed over the sample of items (fixed in quantity), not over

participants. However, pilot data suggested that 25 participants per condition per country yield adequate power. This number was supplemented to compensate for likely exclusions due to participant inattention. We assumed 30% of data exclusions due to inattention and thus we set the total number of participants to be recruited per country to 245: 35 participants per condition.

We collected data with Amazon Mechanical Turk from 246 participants (134 females) in the United States and 249 participants (67 females) in India. As per the preregistration protocol, participants were excluded from analyses if they failed to pass an attention check. Seven American participants and 50 Indian participants were excluded from analyses due to inattention. This resulted in an effective sample of 239 American participants (132 females) (age: M = 39 years, SD = 12) and 199 Indian participants (56 females) (age: M = 28 years, SD = 5).

The stimuli consist of 27 brief hypothetical scenarios, developed by Sznycer, Tooby, et al. (2016), in which someone's acts, personal characteristics, or circumstances might lead them to be viewed negatively. The scenarios were phrased at a relatively high level of abstraction (e.g., "You are not generous with others") to make it likely that their meanings would be understood across cultures.

Participants were randomly assigned to one of seven between-subjects conditions: one *devaluation* condition and six conditions relevant to shame: *shame feeling*, *hide*, *lie*, *destroy evidence*, *threaten witness*, and *communicate event*. In all seven conditions participants rated the same basic set of 27 scenarios. The main difference across conditions was a prompt, displayed immediately before the scenarios, instructing participants to interpret the scenarios in a way that would elicit either social devaluation of a target individual or one of the six shame-relevant responses.

In the devaluation condition, the prompt asked participants to imagine that the acts and traits described in the scenarios (e.g., "She is not generous with others," "She has poor table manners," "She has no idea how to load or fire a gun") are true of a target individual: an individual other than the participant who is of the same sex and age as the participant. Participants were asked to "indicate [for each scenario] how you would view this person," on scales ranging from 1 (I'd view her not negatively at all if this were true of her) to 7 (I'd view her very negatively if this were true of her). These ratings provide scenario-specific measures of the degree to which members of a given population would socially devalue the individual described in the scenarios.

In the other six conditions—shame feeling, hide, lie, destroy evidence, threaten witness, and communicate event—the prompts asked participants to imagine that the acts and traits described in the scenarios are true of the participant herself (e.g., "You are not generous with others," "You have poor table manners," "You have no idea how to load or fire a gun"), and to indicate, on scales ranging from 1 (not at all . . .) to 7 (a lot . . . / very much . . .), the degree to which they would experience shame feelings or shame-relevant motivations. Participants were asked to indicate the following. In the shame feeling condition: how much shame they would feel if those acts and traits were true of them. In the hide condition: how much they would want to hide if those things were true of them. In the lie condition: how willing they would be to lie to others by denying that those things are true of them. In the destroy evidence condition: how willing they would be to destroy evidence or clues that might tell others that those things are true of them. In the threaten witness condition: how willing they would be to threaten direct witnesses to prevent those witnesses from telling others that those things are true of them. In the communicate event condition: how willing they would be to communicate to others that those things are true of them. The scenarios in the devaluation condition on the one hand and in the six shame-relevant conditions on the other hand were identical on a scenario-by-scenario basis; the only difference was the perspective from which the acts and traits are described.

The 27 scenarios were presented in randomized order within conditions. The stimuli were presented in English in the United States and India. Full text of the condition prompts and scenarios used in the United States and India are provided in the Online Appendix Tables S1, S2 & S3.

Results

The data and analyses are available in the OSF repository: https://osf.io/ud6fx/.

Within-Country Results

First, we report the results for each country. Descriptive statistics are provided in Supplemental Tables S2 & S3.

Do participants within countries agree on how much they would devalue the target individual in these scenarios? Yes. To measure agreement among raters on how socially discrediting the 27 acts and traits are relative to one another we computed intra-class correlations (ICC) in each country. There was agreement about how devalued these acts and traits are relative to one another: United States: ICC (2,35) = .98, $P << .05$; India: ICC (2,21) = .38, $p < .05$.

Shame responses: Do participants within countries agree on the degree to which they would experience one of the five shame responses if the acts and traits described in the scenarios were true of them? In the United States there was widespread agreement about the relative intensity of shame responses the 27 acts and traits would elicit: shame feeling: ICC (2,34) = .95; hide: ICC (2,34) = .95; lie: ICC (2,33) = .88; destroy evidence: ICC (2,35) = .86; threaten witness: ICC (2,33) = .88, Ps << .05; all of the intra-class correlations in the United States remained significant after applying, as per the preregistration, a false discovery rate (FDR) correction (Benjamini & Hochberg, 1995) of $p < 0.05$. In India there was agreement about the relative intensity of shame feeling: ICC (2,33) = .78, and hide: ICC (2,31) = .65 (Ps << .05), but there was no agreement for lie: ICC (2,30) = −.01, destroy evidence: ICC (2,29) = −.10, or threaten witness: ICC (2,27) = .04. In India, the intra-class correlations of shame feeling and hide

remained significant at FDR $P < 0.05$, but the intra-class correlations of devaluation and the other shame responses did not.

Does the intensity of audience devaluation correlate positively with the intensities of the five shame responses? (Predictions 2 & 3). Yes. The intensities of social devaluation that participants expressed as audiences if 27 devalued acts and traits were true of someone else correlated positively with the intensities of: shame feeling, hide, lie, destroy evidence, and threaten witness if those 27 acts and traits were true of the participant themselves. For each of the 27 scenarios, we calculated the mean ratings of each of the five shame responses provided by participants in the shame-relevant conditions and the mean devaluation ratings provided by participants in the devaluation condition. In the United States, ratings of devaluation correlated positively with ratings of the five shame responses: shame feeling, hide, lie, destroy evidence, and threaten witness (rs = .73–.83, ps = .000001–.00002). In India too, ratings of devaluation correlated positively with ratings of the five shame responses: shame feeling, hide, lie, destroy evidence, and threaten witness (rs = .39–.74, ps = .000009–.045) (Figure 1, Figure 2, panels A, B, and Table S4).

We note that in the United States, five scenarios (#3, 7, 10, 18, 19) received extremely high devaluation ratings (Figure. 1). This raises the possibility that the positive correlations between ratings of devaluation on the one hand and ratings of the five shame responses on the other hand simply reflected a categorical discontinuity between two subsets of datapoints. Exploratory reanalysis of the United States data excluding the five extreme scenarios indicates that this possibility is unlikely, however, as devaluation still correlated positively with each of the five shame responses (rs = .39–.57, ps = .070–.006).

Recall that the ratings of devaluation, shame feeling, hide, lie, destroy evidence, and threaten witness originated from different participants. Consequently, these correlations cannot be attributed to participants matching their devaluation ratings to their shame-response ratings.

We computed Bayes Factors (BFs) to quantify the odds favoring each alternative hypothesis relative to its corresponding null hypothesis. For all the tests that follow, the alternative hypothesis stated that audience devaluation will correlate with each of the five shame responses, whereas the null hypothesis stated they would not correlate. Bayesian correlation analyses were performed using the default priors (stretched beta prior width = 1; JASP 0.10.2). In the US, the five alternative hypotheses—audience devaluation correlates with each of the five shame responses—were more likely than their corresponding null hypotheses (all $BFs_{10} > 1{,}000$). In India, three alternative hypotheses were more likely than their corresponding null hypotheses (shame feeling: $BF_{10} = 2.72 \times 10^3$; hide: $BF_{10} = 72.6$; threaten: $BF_{10} = 11.4$), but the results were indeterminate for two shame responses (lie: $BF_{10} = 1.60$; destroy: $BF_{10} = 2.79$).

Does the intensity of audience devaluation fail to correlate positively with participants' willingness to communicate negative personal information to others? (Prediction 5). Yes. In fact, ratings of devaluation correlated negatively with ratings of

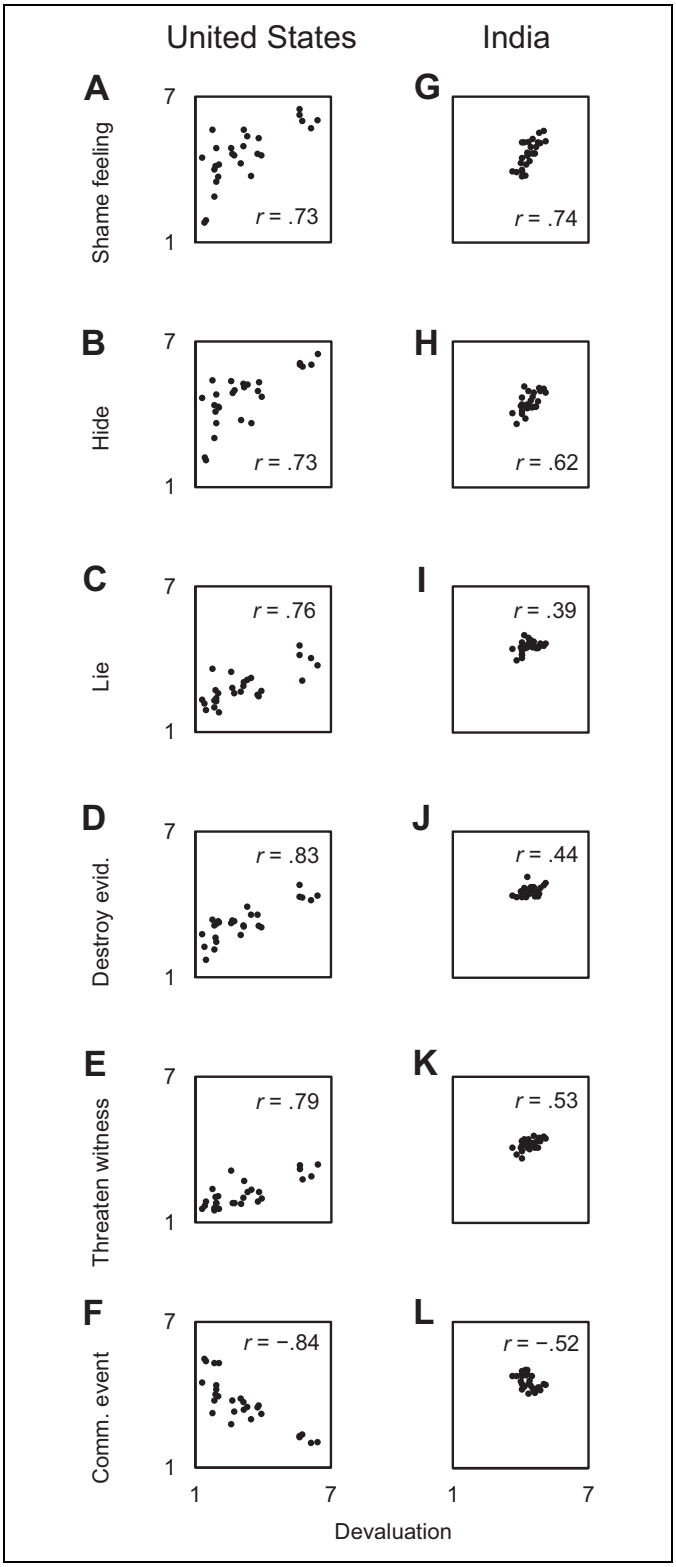

Figure. 1. Scatter plots: Intensities of shame-relevant responses as a function of devaluation, by country. *Note.* Each point represents the mean devaluation rating and mean shame-relevant response rating regarding one scenario. Ratings of devaluation, shame feeling, hide, lie, destroy evidence, threaten witness, and communicate event were given by different participants. N on which the correlations are based = number of scenarios = 27. United States data: panels A–F; India data: panels G–L.

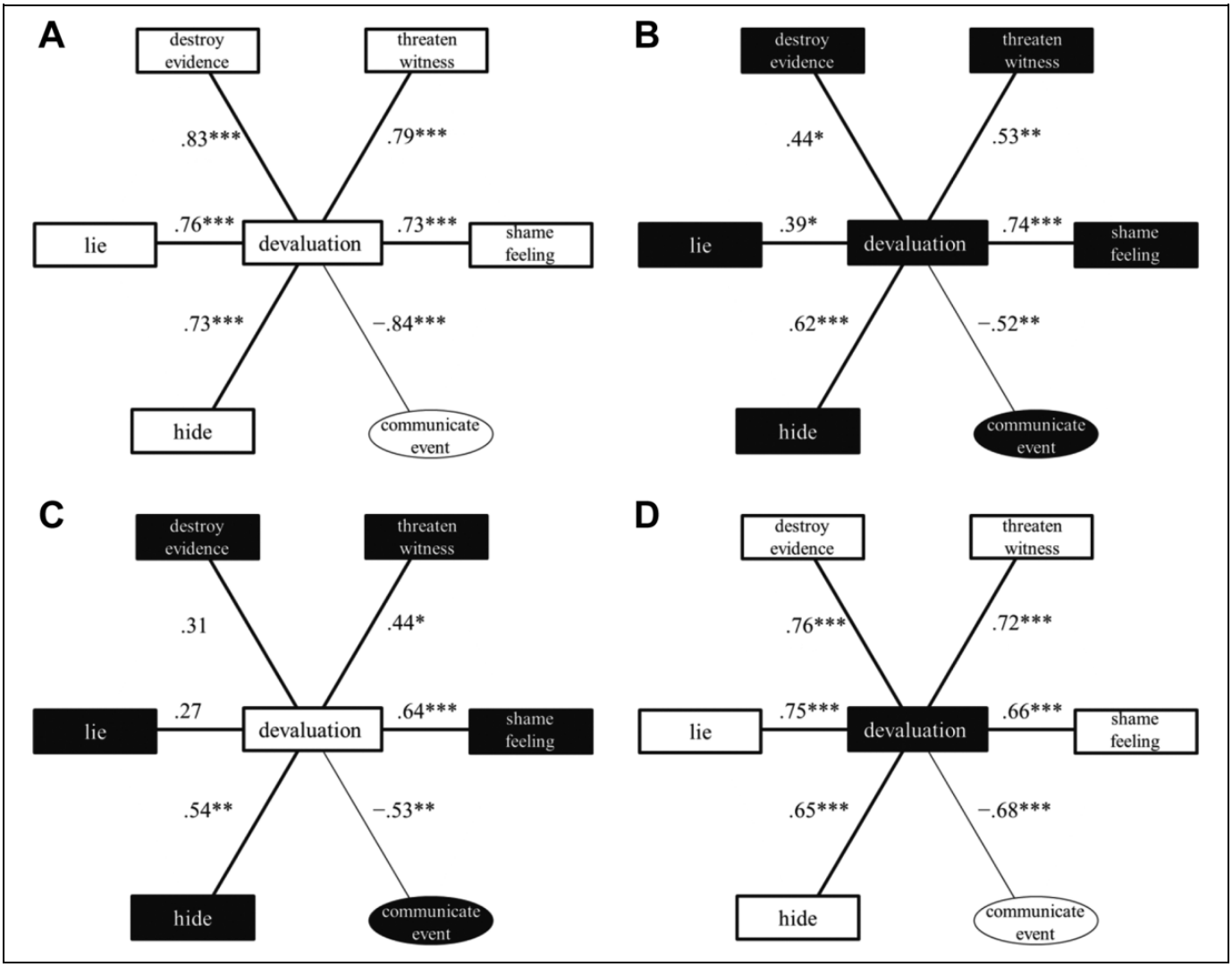

Figure. 2. Correlations between ratings of devaluation and ratings of shame feeling, hide, lie, destroy evidence, threaten witness, and communicate event, within- and between-countries. *Note.* (A) United States correlations (white shapes). (B) India correlations (black shapes). (C) Correlations between devaluation in the United States and shame-relevant responses in India. (D) Correlations between devaluation in India and shame-relevant responses in the United States. N on which the correlations are based = number of scenarios = 27. Ratings of devaluation, shame feeling, hide, lie, destroy evidence, threaten witness, and communicate event were given by different participants. ***$p < .001$; **$p < .01$; *$p < .05$.

communicate event; in the United States: $r = -.84$, $p = 10^{-7}$; in India: $r = -.52$, $p = .006$. Here, the Bayesian analyses indicated that the alternative hypothesis was more likely than the null (in the US: $BF_{10} = 4.16 \times 10^5$; in India: $BF_{10} = 8.91$).

Further, we note that in exploratory analyses, ratings of communicate event correlated *negatively* with ratings of each of the five shame responses (shame feeling, hide, lie, destroy evidence, and threaten witness); in the United States (rs = −.82 to −.88, ps = 10^{-6}–10^{-8}); in India (rs = −.07 to −.63, ps = .74–.0005).

Do the intensities of the five shame responses correlate positively with one another? (Predictions 1 & 3). Yes. In the United States, ratings of shame feeling, hide, lie, destroy evidence, and threaten witness were positively correlated with one another, with a mean $r = .80$ (SD = .09; minimum $r = .70$; maximum $r = .97$; N r values = 10); p values = 10^{-15}–.00004; all of these correlations remained significant at FDR $p < 0.05$. The alternative hypotheses were more likely than their corresponding null hypotheses for all pairs of shame responses (BFs_{10} range from 628 to 1.44×10^{13}). In India, ratings of shame feeling, hide, lie, destroy evidence, and threaten witness were positively correlated with one another, with a mean $r = .53$ (SD = .12; minimum $r = .39$; maximum $r = .80$; N r values = 10); p values = 10^{-6}–.045; all of these correlations remained significant at FDR $p < 0.05$. In India, the alternative hypotheses were more likely than their corresponding null hypotheses for eight of the ten pairs of shame responses (shame feeling–hide: $BF_{10} = 3.91 \times 10^4$; shame feeling–destroy: $BF_{10} = 5.16$; shame feeling–threaten: $BF_{10} = 13.8$; hide–lie: $BF_{10} = 14.7$; hide–destroy: $BF_{10} = 5.04$; hide–threaten: $BF_{10} = 8.45$; lie–threaten: $BF_{10} = 68.4$; destroy–threaten: $BF_{10} = 3.21$); for

the other two pairs of shame responses the results were indeterminate (shame–lie: $BF_{10} = 1.60$; lie–destroy: $BF_{10} = 2.74$).

Between-Country Results

To test for between-country agreement in devaluation, in shame responses, and in the links between devaluation and shame responses, we computed the extent to which the mean ratings of devaluation and the mean ratings of shame responses are correlated across countries.

Devaluation: Do American and Indian participants agree on how much they would devalue the target individual in these scenarios? Yes. There was between-country agreement on the degree to which a given act or trait would elicit devaluation: $r = .82$, $p = 10^{-6}$. The more American participants negatively viewed a target individual for taking a given act or possessing a given trait, the more Indian participants negatively viewed a target individual for taking those acts or possessing those traits. The alternative hypothesis that the intensity of audience devaluation would correlate between the two countries was more likely than the null of no correlation ($BF_{10} = 1.08 \times 10^5$).

Shame responses: Do American and Indian participants agree on the degree to which they would experience shame feelings and shame motivations? Yes. American and Indian participants agreed about the relative extent to which a given negative act or trait would elicit shame feeling ($r = .73$, $p = .00002$), as well as the motivations to: hide ($r = .62$, $p = .0005$), lie ($r = .42$, $p = .032$), and threaten witness ($r = .54$, $p = .004$). There was no cross-country agreement in ratings of destroy evidence, however ($r = .14$, $p = .48$). The alternative hypotheses that ratings of a shame response would correlate across the two countries (compared to the null of no correlation) was more likely for three responses (shame feeling: $BF_{10} = 1.49 \times 10^3$; hide: $BF_{10} = 72.7$; threaten witness: $BF_{10} = 13.4$), less likely for one response (destroy: $BF_{10} = .303$), and indeterminate for one other response (lie: $BF_{10} = 2.10$).

(Predictions 1 & 4). In addition, in 10 of 20 cases, a shame response in one country correlated positively with a different shame response in the other country (e.g., hide in India vs. threaten witness in the United States); mean $r = .43$ (SD = .22; minimum $r = .15$; maximum $r = .72$; N r values = 20); p values = .00003–.46 (Table S4). Of these 20 correlations, the evidence favored the alternative of a correlation relative to the null of no correlation for ten pairs (BFs_{10} between 3.3 and 1.03×10^3), was indeterminate for seven pairs (BFs_{10} between 0.38 and 1.19), and favored the null relative to the alternative for three pairs (BFs_{10} between 0.310 and 0.326).

Does intensity of devaluation in one country correlate positively with intensities of shame responses in the other country? (Predictions 2 & 4). In general, yes. Indian participants' ratings of devaluation correlated positively with American participants' ratings of shame feeling, hide, lie, destroy evidence, and threaten witness; mean $r = .71$ (SD = .05; minimum $r = .65$; maximum $r = .76$; N r values = 5); P values = .000004–.0003. Meanwhile, American participants' ratings of devaluation correlated positively with Indian participants' ratings of shame feeling ($r = .64$, $p = .0003$), hide ($r = .54$, $p = .003$), and threaten witness ($r = .44$, $p = .02$), but not with Indian participants' ratings of lie ($r = .27$, $p = .18$) or destroy evidence ($r = .31$, $p = .11$) (Figure 2, panels C, D).

The alternative hypotheses that devaluation in India correlates with each of the five shame responses in the US were more likely than the null hypotheses in all five cases ($BFs_{10} > 137$). The alternative hypotheses that devaluation in the US correlates with each of the five shame responses in India were more likely than the null hypotheses for two shame responses (shame feeling: $BF_{10} = 102$; hide: $BF_{10} = 14.5$); the results were indeterminate for the other three shame responses (lie: $BF_{10} = 0.55$; destroy: $BF_{10} = 0.79$; threaten: $BF_{10} = 2.69$).

To put this more concretely: One can accurately predict Americans' willingness to threaten witnesses of acts or traits that discredit the self from Indians' devaluation of the relevant acts or traits. Or, one can accurately predict Indians' willingness to hide if they committed acts or possessed traits that discredit the self from Americans' devaluation of the relevant acts or traits.

We note that all the cross-country correlations (devaluation vs. devaluation, shame response vs. same shame response, shame response vs. different shame response) that are significant at $p < .05$ also remain significant at FDR $p < 0.05$, except for the US lie vs. India lie correlation.

Discussion

We asked if response coherence in shame can be observed in the general case where input variables to the shame system are specified minimally. We observed internal coherence: Five shame responses—felt shame and the motivations to hide, to lie, to destroy evidence, and to threaten a witness—in general covaried with one another in direction and intensity from one event (scenario) to the next. This is in line with the internal coherence that has been documented in some (but not all) of the previous research on response coherence in emotion.

In addition, we observed two novel patterns of response coherence predicted from an adaptationist framework: external coherence and cross-cultural coherence. Regarding external coherence, five shame responses in the individual in general covaried in direction and intensity with the devaluation expressed by audiences from one event to the next. We observed internal and external coherences within the United States and India. And regarding cross-cultural coherence, five shame responses in one country in general covaried in direction and intensity both with the five shame responses and with audience devaluation in the other country from one event to the next. Importantly, the intensity of the motivation to communicate reputationally damaging information to other people—a response that involves arousal—failed to correlate positively, and in fact correlated mostly negatively, with the intensities of audience devaluation and with the five shame responses across events. This is expected if the internal, external, and cross-cultural coherence observed here reflects the operation of a shame orchestrator. But this is not expected if

response coherence in emotion stems from low-level affective variables such as arousal. Of course, the alternative evaluated here (communicate event) is but one of a large set of possible alternatives involving arousal. Thus, future research is needed to test against additional alternatives involving arousal, as well as valence and culturally-variable emotion concepts.

Adaptationist thinking suggests that the hallmark of emotion is the capacity to adaptively orchestrate multiple adaptations. And that response coherence is incidental to adaptive orchestration. Evidence on response coherence—whether positive, null, or negative—is therefore not dispositive of whether or not emotion programs are natural kinds. Notwithstanding this critical point, evidence on response coherence can be of value. Data on incidental phenomena are valuable as raw data after all, and anomalies (in affective science, inconsistent observations of response coherence across studies, for instance) can catalyze scientific progress (Kuhn, 1970). The present findings go beyond internal coherence, however. That shame responses can cohere between cultures and also externally, matching in intensity the devaluation expressed by audiences (i.e., matching in intensity the adaptive problem hypothesized to have selected for shame), suggests that shame, and perhaps other emotions (Sznycer & Cohen, 2021; Sznycer, Sell, & Dumont, 2021), are functionally specialized adaptations.

An alternative account, one that is consistent with the theory of constructed emotion, is that the cross-cultural coherences observed here were imparted by the English concept of "shame" and not by a shame neurocognitive system. This is plausible, considering that our stimuli were presented in one and the same language (English) both in the United States and in India, because emotion words have meanings that are more similar in language groups that are closer in linguistic space (Jackson et al., 2019). Similarly, the US–India similarities observed here may have stemmed from culturally-specific concepts or schemas with which people interpret their own affect in shame (see Barrett, 2014). These concepts may be similar across industrial societies such as the United States and India even when they are idiosyncratic of industrial societies; and so these concepts may be shared by our American and Indian participants even when these concepts are not universal. However, we note that previous research has shown cross-cultural commonalities in the feeling of shame across 15 small-scale societies with highly diverse subsistence bases (e.g., horticulture, pastoralism, fishing) and speaking highly diverse languages, including: Igbo, Icé-tód, Nepali, Tuvan, and Mongolian (Sznycer, Xygalatas, Agey, et al., 2018). This suggests that the cross-cultural coherences among multiple shame responses that we observed here may have been driven by an evolved shame system. Nevertheless, further inquiry is needed to determine how generalizable the present findings are across different cultures, ecologies, and language-groups.

Further research is also needed to determine whether the patterns of coherence observed here generalize to other discrediting actions and personal characteristics, to the reactive (vs. prospective) operation of shame in response to actual discrediting events, to the various cognitive, behavioral, and physiological responses that shame appears to control (other than the motivations studied here), and to responses measured within-situations and within-individuals (see Mauss et al., 2005; Reisenzein, 2000). In addition, further research is necessary to know whether and how patterns of response coherence are modulated by a host of situational variables that are relevant to shame (e.g., co-presence of an audience, characteristics of the audience, actual responses of the audience) but were not studied here.

It is important to reiterate that the kinds of comprehensive tests that are necessary to corroborate or deny the hypothesis of adaptive orchestration (for shame or for other emotions) have, to our knowledge, not been conducted yet. We suspect that mapping emotion decision trees systematically and comprehensively will be challenging. Shame, for instance, is likely to be sensitive to many input variables and to implement many contingencies. Moreover, high-order interactions between input variables are expected. The simple (hypothetical) conditional *appease (or blame or threaten) when others have seen your disgraceful action, but not when they haven't seen you* might be conditioned further by additional external and internal variables. For example, when others have seen your disgraceful action, active shame responses might be delivered in general. But there might be exceptions. Active shame responses might not be delivered when you have been seen if the individuals in the audience are few or have low physical formidability or status or if they are known to lack strategic information to grasp the true meaning of the disgraceful action.

The ontological status of emotion—perhaps the primary point of contention in the affective sciences (see, e.g., Adolphs & Anderson, 2018; Barrett, 2019; Barrett et al., 2019; Cowen et al., 2019; in press; Lange et al., 2020; Lindquist et al., 2013; Mobbs et al., 2019; Scarantino, 2015; Scherer, 2009)—remains an open question. Nevertheless, the present findings suggest that adaptationism is a promising framework to elucidate emotion.

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Supplemental Material

Supplemental material for this article is available online.

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