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Online First Publication, November 27, 2017. http://dx.doi.org/10.1037/emo0000376

CITATION
Smith, R., Killgore, W. D. S., & Lane, R. D. (2017, November 27). The Structure of Emotional Experience and Its Relation to Trait Emotional Awareness: A Theoretical Review. *Emotion*. Advance online publication. http://dx.doi.org/10.1037/emo0000376

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1528-3542/17/$12.00 http://dx.doi.org/10.1037/emo0000376

The Structure of Emotional Experience and Its Relation to Trait Emotional Awareness: A Theoretical Review

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Emotional experience (EE) and trait emotional awareness (tEA) have recently become topics of considerable experimental/theoretical interest within the cognitive and neural sciences. However, to date there has been limited empirical focus on how individual differences in the factors contributing to EE (a state-based construct) might account for differences in tEA. To promote clear, well-guided empirical research in this area, in this article we first offer a concise review of the primary factors contributing to EE. We then provide a theoretical investigation into how individual differences in these factors (i.e., differences in affective response generation, affective response representation, and conscious access) could mechanistically account for differences in tEA; we also discuss plausible origins of these individual differences in light of current empirical findings. Finally, we outline possible experiments that would support (or fail to support) the role of each factor in explaining differences in tEA—and how this added knowledge could shed light on the known link between low tEA and multiple emotion-related mental and systemic medical disorders.

Keywords: affect, emotion concepts, conscious access, trait emotional awareness, development

Emotional experience (EE) and trait emotional awareness (tEA) have recently become topics of considerable experimental/theoretical interest within the cognitive and neural sciences (Lane, Weihs, Herring, Hishaw, & Smith, 2015; Panksepp, Lane, Solms, & Smith, 2017; Smith & Lane, 2015, 2016). When an individual has an affective response, *EE* refers to the conscious experience of many different aspects of that response, such as cognitions, bodily sensations, and motivated actions—as well as the conscious recognition of that overall response as belonging to a particular emotion-concept category (“fear,” “sadness,” etc.). EE is therefore a state-related construct; it pertains to what an individual consciously experiences/recognizes in a given moment or situation. In contrast, tEA is a trait-related construct; it pertains to stable individual differences in the way people experience and understand their own affective responses. In the present article we provide a concise and accessible review of current understanding of the different factors underlying EE, with the primary aim of generating novel, testable hypotheses about how stable differences in the interactions between these factors may be capable of accounting for differences in tEA.

As will become apparent in the following discussion, it is important that EE and tEA are examined together. Briefly stated, this is because achieving theoretical clarity about tEA depends on first achieving an understanding of the many factors contributing to EE. This includes understanding (a) the mechanisms that generate an affective response, (b) the mechanisms that subsequently represent the different elements of an affective response, and (c) the mechanisms that determine when each of these different represented elements is (and is not) consciously experienced/recognized in a given situation. In “The Determinants and Structure of Emotional Experience” section, we therefore first briefly review these different factors, and how they each contribute to EE. This section includes a concise summary of a neuro-cognitive model of conscious and unconscious emotion processing that we have articulated and defended in greater detail within several previous articles (Panksepp et al., 2017; Smith & Lane, 2015, 2016; Smith, Thayer, Khalsa, & Lane, 2017). It is therefore not presented here as a novel contribution, and we only review the aspects of this larger model that are most relevant to the study of tEA. The interested reader is therefore referred to the previously cited articles for more detail regarding this model.

In the “Trait Emotional Awareness” section to follow, we illustrate how individual differences in tEA may arise as a result of multiple different EE-related factors and their interactions. As these possible mechanistic explanations have yet to be articulated, this empirically grounded theoretical exploration constitutes an important initial step in guiding the design of experiments capable of shedding light on the subset of these possible mechanisms that are actually in operation. As such, we also provide suggestions for possible experiments that could support the explanatory power of each potential mechanism. In the concluding section, we provide a brief discussion of implications and future directions, which follow from the overall model of EE and tEA emerging from our discussion.

The Determinants and Structure of Emotional Experience

In this section we discuss three factors that contribute to EE:

1. The processes that generate an affective response.
2. The multiple aspects of an affective response that are subsequently represented in the brain.

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3. The mechanisms that determine which of these represented aspects of an affective response become consciously experienced on a given occasion.

As mentioned in the preceding text, we discuss each of these topics in more detail within extensive reviews elsewhere (Lane, Weihs, et al., 2015; Panksepp et al., 2017; Smith & Lane, 2015, 2016; Smith, Thayer, et al., 2017), and the reader is referred to these articles for a more thorough treatment of available evidence. Here we instead attempt to provide a focused and accessible overview of these topics in order to facilitate discussion of the potential mechanisms underlying individual differences in tEA.

Affect Generation Processes (AGPs)

Presumably, an affective response must first occur before it can be experienced. On the basis of this intuitive assumption, before it is possible to fully understand EE, one will first need to have a grasp on both what an affective response is and how it is generated. As we have done previously (Smith & Lane, 2016), we will here treat the generation of an affective response as involving a coordinated change in two broad domains.[1] The first is an automatic change in one's body state (facial expression, body posture, muscle tension, heart rate, respiration, circulating hormone levels, etc.). The second is an automatic change in one's cognitive/attentional state (changes in motivation, attention, memory, perception, decision making, etc.). These changes are "automatic" in the sense that they are quick, effortless, and typically not experienced as under voluntary/intentional control (for a broader discussion of automatic cognitive and affective processes, see Kahneman, 2011). A considerable amount of research has gone into examining the cognitive/neural mechanisms underlying the automatic initiation of such coordinated state changes, and it now appears there are a number of ways this can occur (e.g., reviewed in Scherer, 2009).

First, it appears that evolutionary pressures can endow an organism with the innate ability to initiate affective responses to particular patterns of sensory input. Thus, there is a class of stimuli (tissue damage, loud noises, sexual behavior, etc.) that are capable of triggering an affective response in the absence of previous learning or extensive perceptual processing (Brosch, Sander, & Scherer, 2007; LeDoux, 1996, 2012; Öhman, 1986; Whalen et al., 2004). Simple associative learning processes (e.g., classical conditioning) can also allow new stimuli to take on this same property. For example, a previously neutral sound can begin to trigger an affective response if repeatedly paired with an innately pleasant or unpleasant stimulus. Whether innate or learned, the AGPs in question ("stimulus-driven AGPs") allow sensory input to trigger aspects of an affective response without requiring extensive cognitive/perceptual processing (Grandjean et al., 2005; Pourtois, Grandjean, Sander, & Vuilleumier, 2004; Vuilleumier, 2005). In other words, the cognitive/conceptual meaning of a stimulus need not always explicitly mediate affective responses to sensory stimuli (Tomkins, 2009).

A second class of AGPs, however, does involve cognitive/conceptual representations as mediators. These mediating representations are typically referred to as *situational appraisals*, and so we refer to this class of processes as *appraisal-driven AGPs*.[2] As thoroughly reviewed elsewhere (Brosch & Sander, 2013; Lazarus & Smith, 1993; Moors, 2013; Moors, Ellsworth, Scherer, & Frijda, 2013; Scherer, 2009), there are many different appraisal dimensions with this type of link to affect generation. These dimensions include (but are not limited to) appraising whether a perceived situation is: novel or familiar, relevant or irrelevant to one's current concerns, congruent or incongruent with one's current goals, in or out of one's control, and consistent or inconsistent with one's norms and values.

Such appraisal representations need not necessarily be consciously experienced (discussed further subsequently; Scherer, 2005); however, if they are experienced as conscious thoughts then they can be seen as one important aspect of an EE. In addition, however, they can (whether conscious or not) play a role in generating an affective response. The basic idea is that perceptual representations of one's current situation—or of a remembered/imagined situation—can be automatically appraised/evaluated along each of these conceptual dimensions; depending on the pattern of appraisals across these dimensions, different types/aspects of affective responses can be generated.

It is important to highlight that these appraisal mechanisms are posited to take hierarchically linked perceptual representations as input (Smith & Lane, 2016). These perceptual representations can be thought of as supplying a multilevel "description" of a remembered, current, or imagined situation. Thus, if this internal situational description were incorrect/incomplete, then the affective responses generated by appraisal mechanisms would also be expected to be inappropriate/maladaptive (Kaiser & Scherer, 1998). For example, consider two individuals who are in the same objective situation (involving receiving criticism from their employer); however, because of a combination of innate, developmental, and past experiential differences, these two individuals arrive at different internal descriptions of that situation. Assume the first individual's description can be verbalized as "My boss just criticized me, and is very likely to fire me soon no matter what I do." As such, appraisal mechanisms would likely evaluate this description as "goal-incongruent" and "out of my control," leading this individual to have an intense, negatively valenced affective response. Assume the second individual's description can instead be verbalized as "my boss just gave me some constructive criticism, and will most likely allow me to keep my job as long as I act on it." This internal description would instead be appraised as "within my control," leading this second individual to have a less intense affective response than the first individual. This example highlights how the way an individual interprets a current, remembered, or imagined situation (i.e., their "internal description") can have an important influence on how it is evaluated by automatic appraisal mechanisms, and ultimately on the affective response generated.

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[1] To be clear, coordinated changes in these domains can occur in nonaffective contexts as well (getting up from a chair, searching for a lost item, etc.). However, as discussed in the following text, we consider such responses to be "affective" when they are elicited in response to (a) stimuli that are innately relevant to an organism's survival/reproduction, (b) stimuli that acquire this relevance via associative learning processes, or (c) more complex appraisal processes that evaluate situations with respect to the goals, norms, and values of the individual, and other related dimensions relevant to affect/emotion.

[2] Although, to be clear, some authors have also referred to *low-level appraisals*, which correspond to the stimulus-driven affect generation processes discussed in the previous paragraph (e.g., Scherer, 2009).

It is worth noting that the term *appraisal* is sometimes used (e.g., in studies of cognitive reappraisal) to refer to the internally represented description (implemented by hierarchical perceptual representations) that we have just described; here, however, we distinguish between this type of descriptive internal representation and its subsequent evaluation (by appraisal-driven AGPs) along the types of formal appraisal dimensions listed previously. This important distinction between description and evaluation can be illustrated by returning to the example case of the first individual, who interpreted his situation as "My boss just criticized me and is very likely to fire me soon no matter what I do." The key insight is that this same description could lead to very different evaluations by appraisal mechanisms (and to very different affective responses) depending on an individual's goals, concerns, norms, values, and so forth (e.g., see Scherer & Brosch, 2009; Scherer & Ceschi, 2000, 1997; van Reekum & Scherer, 1997). For example, although we implicitly assumed the individual had the goal of keeping his job (and therefore stated that the quoted description would be appraised as "goal-incongruent"), this was just one possibility. If, on the other hand, this individual actually had the goal of losing his job, then this same description would have been evaluated as goal-congruent, likely leading to a positively valenced affective response instead. This example illustrates why it is important to keep the distinction clear between an individual's descriptive interpretation of their situation and its subsequent evaluation across formal appraisal dimensions, because these can have separate and distinct influences on subsequent affect.

The neural basis of both types of AGPs discussed previously, and of the perceptual representations they interact with, is not fully understood. However, it appears that a large number of subcortical nuclei within the brainstem, midbrain, hypothalamus, and amygdala (among others) play an important role in proximally initiating changes to the autonomic, somatic, and endocrine/immune state of the body (e.g., via efferent signaling to different branches of the peripheral nervous system; Smith & Lane, 2015; Smith, Thayer, et al., 2017). Portions of the orbitofrontal and ventromedial prefrontal cortex have also been suggested to interact with many of these subcortical nuclei to form a "limbic network" subserving visceromotor control (i.e., among other related functions; see Barrett & Satpute, 2013). Some of these nuclei also release neuromodulators widely throughout the brain (e.g., norepinephrine, acetylcholine, dopamine, serotonin), the influence of which appears to play an important role in initiating cognitive/attentional state changes (motivating the selection of some actions over others, biasing attention/memory to some percepts/memories over others, etc.; Mather, Clewett, Sakaki, & Harley, 2016; Pessoa, 2013). As illustrated in Figure 1A, stimulus-driven AGPs may involve fairly direct interactions between the brain's perceptual systems and some of these limbic network regions associated with "response generation."

According to recent reviews (Brosch & Sander, 2013; Smith & Lane, 2015), appraisal-driven AGPs also draw on many additional cortical (e.g., cingulate cortex, prefrontal cortex, orbitofrontal cortex, and lateral/medial temporal cortex regions) and subcortical regions (e.g., hippocampus, amygdala, ventral striatum). These additional regions appear to be required to infer/represent appraisal dimensions, and may subsequently initiate an affective response via interaction with the limbic network "response generation" structures listed previously (as also shown in Figure 1A). Some of these regions are also known to contribute to the brain's "default mode network"; this network is broadly implicated in abstract conceptualization processes (Barrett & Satpute, 2013), which may be necessary for cognitively complex appraisals (e.g., goal-congruence; see Grandjean & Scherer, 2008; Sander et al., 2005).

A full review of current work on the neural basis of situational appraisal is beyond the scope of the present article. However, there is a considerable body of work on this topic linking limbic network and default mode network structures to specific appraisal dimensions, and a few prominent examples deserve mention. First, the orbitofrontal cortex, amygdala, hippocampus, and surrounding medial temporal cortex have been implicated in the quick (i.e., beginning around 100 ms) and automatic evaluation of novelty (Blackford, Buckholtz, Avery, & Zald, 2010; Brown & Bashir, 2002; Kumaran & Maguire, 2007; Ranganath & Rainer, 2003; Schwartz et al., 2003). The amygdala has been further implicated in quick appraisals of concern-relevance (i.e., beginning around 140 ms; Brosch, Coppin, Scherer, Schwartz, & Sander, 2011; LaBar et al., 2001), and such appraisals also appear to become more refined with longer processing time (Brosch, Pourtois, & Sander, 2010; Cunningham & Zelazo, 2007; Cunningham, Zelazo, Packer, & Van Bavel, 2007; Oya, Kawasaki, Howard, & Adolphs, 2002). Appraisals of goal-congruence have been linked in part to anterior cingulate regions, which have been shown to play a role in generating negative affect and arousal in response to conflict and error detection (beginning around 340 ms to 380 ms; Botvinick, Cohen, & Carter, 2004; Van Veen & Carter, 2002). Appraisals regarding agency/control appear to draw on sensorimotor processes that compare predicted and actual outcomes of motor commands (Seidel et al., 2010; Sperduti, Delaveau, Fossati, & Nadel, 2011) and on social–cognitive processes (involving the medial prefrontal cortex and temporo-parietal junction, among other regions) used to infer the desires and intentions of others (beginning between 450 ms and 800 ms after stimulus onset; McCleery, Surtees, Graham, Richards, & Apperly, 2011; Van Overwalle, 2009). Finally, previous work has also linked appraisals involving personal values and social norms to regions of medial prefrontal cortex, dorsal striatum, and anterior temporal lobe regions (Brosch, Coppin, Schwartz, & Sander, 2012; Knoch, Pascual-Leone, Meyer, Treyer, & Fehr, 2006; Zahn et al., 2007).

On the basis of the differences in time-course and informational complexity associated with these and other related appraisal dimensions, it has been argued that appraisal operates via hierarchical, iterative processing loops in the brain—with affective responses sculpted and adjusted dynamically over time as more complex information (requiring additional computational processing) becomes available (Brosch & Sander, 2013; Smith & Lane, 2015). This conception also fits well with more recent "predictive coding" models of neural computation and emotion that we and others have proposed (Barrett & Simmons, 2015; Pezzulo, Rigoli, & Friston, 2015; Seth & Friston, 2016; Seth, 2013; Smith, Thayer, et al., 2017), which suggests that both perception and control of the body operate via a hierarchical, iterative process of prediction-error minimization. These models assume that the brain is constantly attempting to predict sensory input before it is received, based on a multilevel, generative internal model of the world; this internal model is then continuously revised and updated on the basis of detected deviations between these predictions and sensory input (i.e., prediction-error). In this framework, AGPs can there-

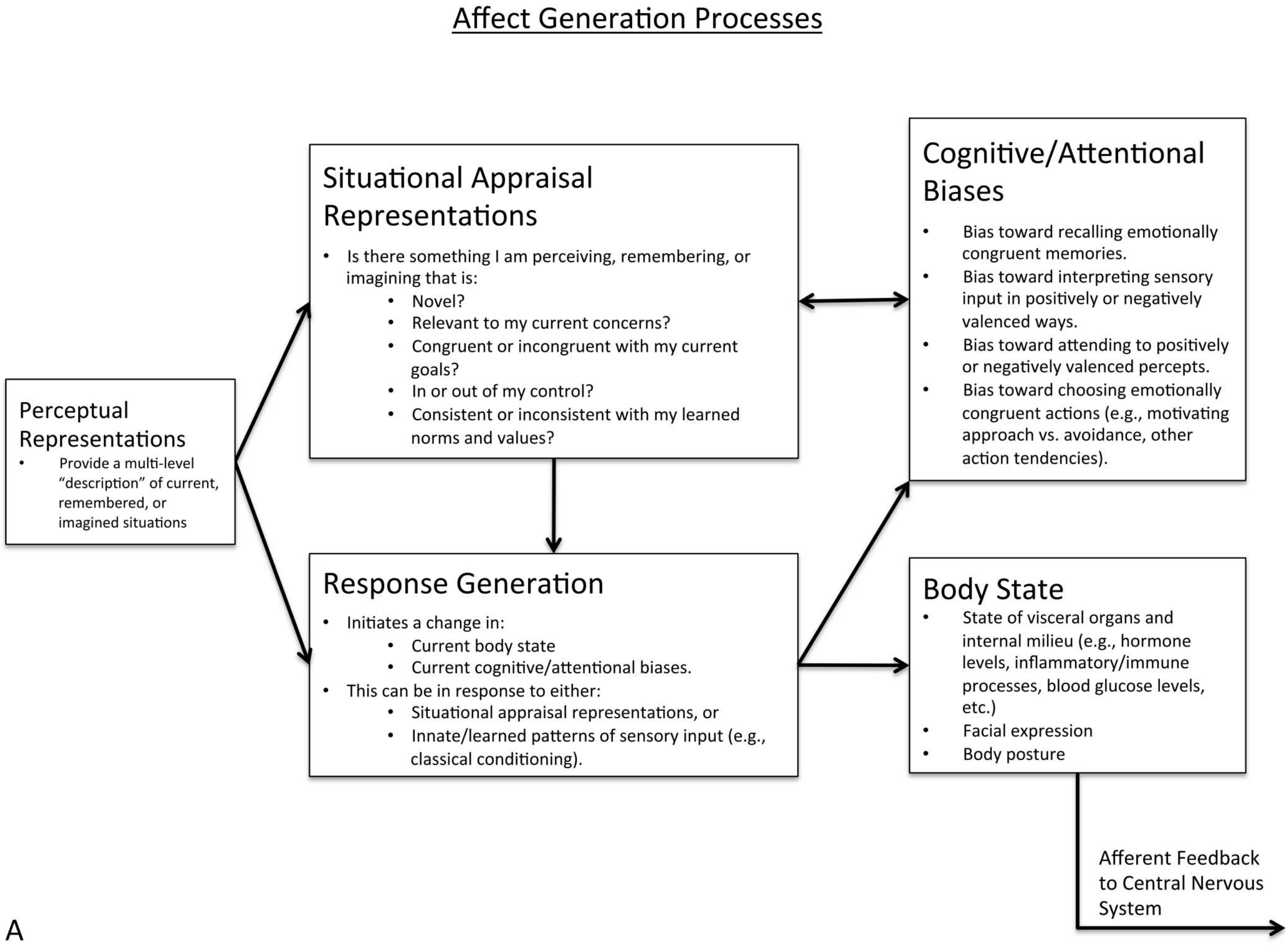

Figure 1. (A) Schematic illustration of the affective response generation processes described in the text, which appear to involve interactions between cortical sensory systems (perceptual representations), the default mode network (situation conceptualization and situational appraisal representations), and the limbic network (situational appraisals and response generation). (B) Illustration of the different aspects of an affective response that are subsequently represented in the brain, and which may (or may not) be consciously experienced/recognized in a given instance. For clarity, the important top-down influences on each of these representations (e.g., reflecting prior beliefs/expectations; discussed in the main text) have not been explicitly depicted. Dotted lines indicate information flow that depends on a representation being selected for global broadcasting—leading to conscious experience and flexible use in goal-directed decision-making processes. As described in the text, valenced body state representations appear to involve the salience network, limbic network, and somatomotor network (i.e., which also contributes to control of skeletomotor action), whereas emotion concept representations further draw on the default mode network. Cognitive control mechanisms appear to involve the executive control network.

fore be understood to involve the following processing steps: (a) sensory input from the world induces a set of prediction-error signals; (b) the brain's internal model is iteratively adjusted over time until it settles on a hierarchically linked set of perceptions, beliefs, and appraisals that minimize these error signals across all these levels of description (i.e., reflecting a weighted combination of prior [top-down] predictions/expectations and current [bottom-up] sensory input); and (c) these updated representations (i.e., the updated internal situational description and its evaluation along the different appraisal dimensions) then engage new top-down prediction signals pertaining to the appropriate state of the body (i.e., interoceptive/proprioceptive predictions) and that of other brain systems. In predictive coding models, these top-down predictions can act as control signals that adjust skeletal muscle, visceral activity, and the strength of interactions between different neural systems based on the content of appraisals and the predicted cognitive/physiological resources needed to effectively deal with the represented situation (Clark, 2015). For example, an appraisal of novelty would predict the need for a fast orienting response and pupil dilation (i.e., to take in more information), whereas an appraisal of goal-incongruence would predict the need for increased heart rate and increased blood-glucose levels (i.e., to facilitate action aimed at changing the situation; for a

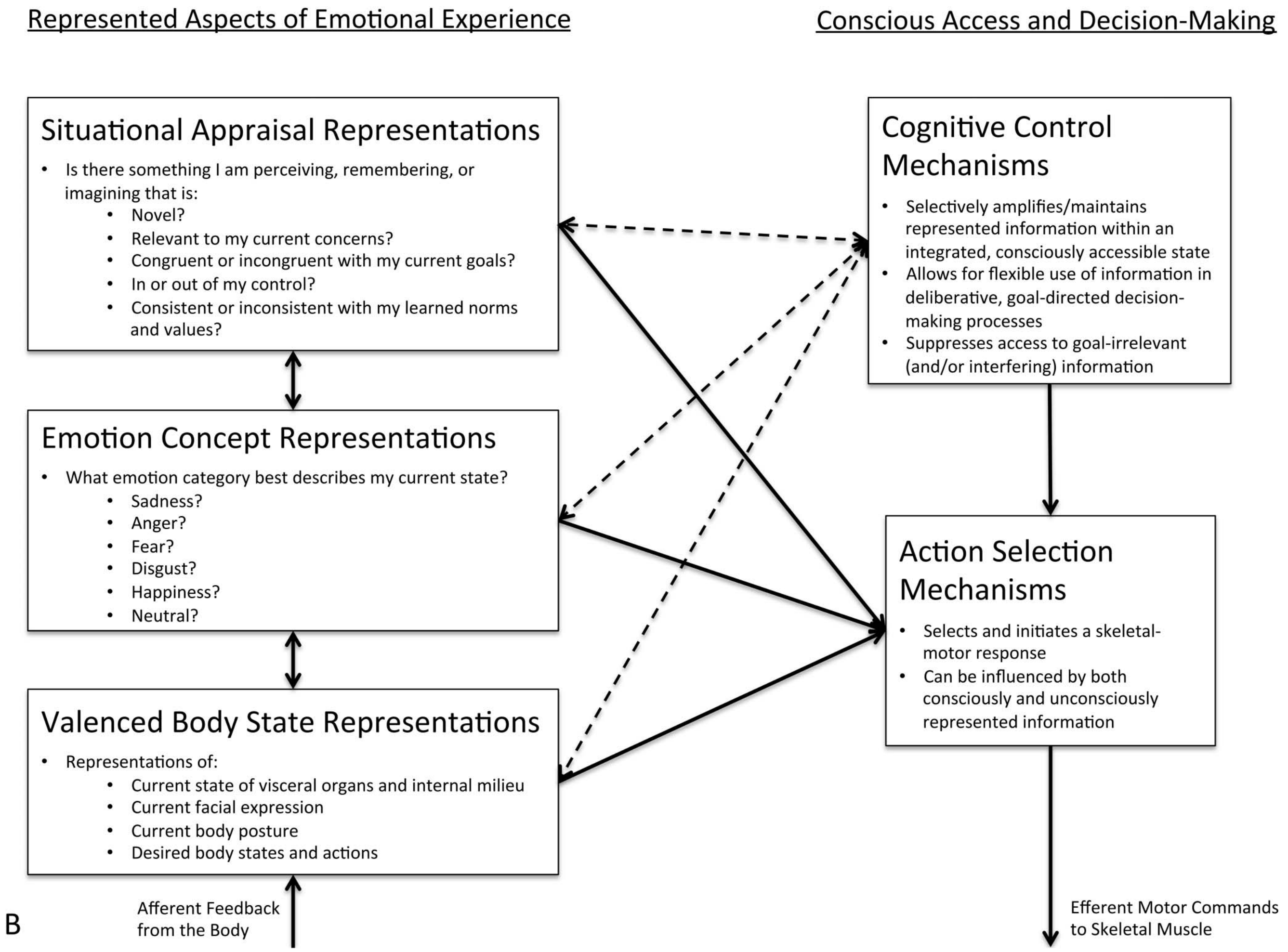

Figure 1 (continued)

full list of responses linked to different appraisal dimensions, see Scherer, 2009).

It is important to highlight here that a very large set of possible appraisal combinations could occur depending on the situation and on previous beliefs/expectations. As discussed elsewhere (Scherer, 2009), this entails a very large number of possible overall (dynamic) affective responses—with no direct correspondence to any particular set of emotion categories used within a particular culture. When combined with the work on large-scale intrinsic networks discussed previously (e.g., default mode network and limbic network; Barrett & Satpute, 2013), and with recent evidence/arguments against a modular architecture within the brain (Anderson, 2014; Pessoa, 2017), the overall picture that emerges appears inconsistent with the idea that the brain contains specific circuits/systems for generating specific emotions like "anger" and "fear" (e.g., as defended by Panksepp & Biven, 2012); instead, it is much more consistent with approaches that suggest that affective reactions are generated using domain-general information processing networks, which mobilize cognitive and physiological resources based on the details of the particular context and based on previous experience and learned expectations (Barrett, 2017; Panksepp et al., 2016).

At a broad level, it is known that primary and secondary sensory cortices (e.g., primary and secondary visual cortices within the occipital lobe) represent predictions regarding low-level sensory features in the iterative process described previously (i.e., "perceptual representations"), whereas progressively more anterior structures (e.g., temporal/frontal cortex) represent predictions regarding more abstract, high-level features ("conceptual representations"; Gazzaniga, Ivry, & Mangun, 2014)—plausibly including many of the high-level appraisal dimensions previously reviewed (i.e., those reflecting goals, agency, norms, and values, and linked to default mode network structures). One further important insight provided by the recent models/experiments supporting predictive coding (and related "Bayesian brain" models) is that the format of all of these neural representations appears to be probabilistic (i.e., they represent probabilistic inferences regarding the true state of the world outside of the brain—continually revised with new sensory input as described previously; Friston, 2005, 2010; Knill & Pouget, 2004; Pouget, Dayan, & Zemel, 2000). Thus, instead of simply representing one multilevel description of a situation and its associated appraisals, it appears the brain simultaneously represents many possible descriptions/appraisals in parallel, along with an estimate of the probability that each of these descriptions/

appraisals is correct (i.e., the probability that they each capture the true state of the world). These different descriptions/appraisals do not all reach consciousness simultaneously, however; instead, and as discussed further subsequently, conscious experience/thought typically reflects (a goal-relevant subset of) whichever of these multiple representations is currently estimated as having the highest probability of being correct (Dehaene, 2014; Smith & Lane, 2016).

As we have discussed elsewhere in detail (Smith & Lane, 2016), this can allow AGPs to initiate elements of an affective reaction in response to one of the probabilistically represented descriptions/appraisals of a situation that remain unconscious. For example, studies have shown that the unconscious (subliminal) perception of a threatening stimulus can elicit physiological responses consistent with threat-related appraisals (reviewed in Kihlstrom, Mulvaney, Tobias, & Tobis, 2000); other studies have also demonstrated that, after a fear conditioning procedure, weaker conditioned responses can still be elicited by stimuli that are perceptually similar to the conditioned stimulus (i.e., there is a "generalization gradient" reflecting response intensities proportional to the degree of perceptual similarity; e.g., Greenberg et al., 2013). We have previously discussed how these and other similar findings can be accounted for if (a) conscious percepts, thoughts, and appraisals reflect the highest probability interpretations represented by the brain (which may be affectively neutral), and (b) lower probability interpretations/appraisals represented in parallel can still initiate elements of an affective reaction proportional to their estimated probability (e.g., heart rate may elevate slightly to a 20% chance of "goal-incongruence," and slightly more to a 30% chance, even if such thoughts/appraisals remain unconscious; Smith & Lane, 2016). This therefore illustrates one important way in which recent probabilistic computational approaches to understanding neural function can, when applied to AGPs, provide potential insights regarding the origin of some automatic, unconsciously generated affective responses.

Representational Elements of Emotional Experience

The next factor contributing to EE is the representation of different elements of an affective response (see Figure 1B). For example, when a body state change is initiated by AGPs, the brain will subsequently receive sensory input from the body. When this happens, the brain engages a further range of perceptual processes to arrive at probabilistic perceptual representations of how the state of the body has been altered (i.e., reflecting a weighted combination of prior top-down predictions and current bottom-up prediction-error signals, similar to that described for AGPs previously; see Smith, Thayer, et al., 2017). This includes representing changes in variables like heart rate, respiration, body posture, facial expression, skin temperature, inflammation, and circulating hormone levels (among many others; see Scherer, 2009, Table 1)—a function that appears to draw on many brain regions, including the insula, somatosensory cortex, motor cortex, and cingulate cortex, as well as several subcortical/brainstem nuclei (Barrett & Simmons, 2015; Smith & Lane, 2015; Smith, Thayer, et al., 2017). These regions contribute to the "salience network" and "somatomotor network" (as well as the limbic network discussed previously) within large-scale intrinsic network analyses (Barrett & Satpute, 2013; Yeo et al., 2011). If or when these updated body state representations become conscious (discussed further subsequently), the resulting bodily sensations also appear to play a central role in the perceptual phenomenology of an EE (Prinz, 2006). That being said, other types of perceptual phenomenology also plausibly play a role. For example, there might be noticeable changes in visual/auditory phenomenology that occur as a result of the changes in one's cognitive/attentional biases during an affective response. One might also experience a flood of memories that are congruent with that affective response, or a change in the degree to which they feel an urge to act in one way versus another.[3]

These different types of representations within sensory-motor, decision making, and episodic memory systems are, however, not the only represented aspects of an affective response. The brain also appears to engage a further level of processing when such responses occur, in order to identify their conceptual meaning. Conceptualizing an affective response can be thought of as a process (i.e., similar to the probabilistic representational processes described previously) in which that response is cognitively "placed" within one of many learned conceptual categories—such as "anger," "fear," "sadness," or "happiness." For example, upon detecting a familiar pattern of cognitive/bodily changes, the brain might represent the concept of "fear" as having a 90% chance of accounting for that pattern, while representing "sadness" as having a 5% chance, happiness a 1% chance, and so forth (i.e., implemented via the hierarchical prediction-error minimization process discussed previously; Barrett, 2017; Smith, Thayer, et al., 2017). Theoretical/empirical considerations support the idea that such categories are learned (Barrett, 2006, 2017; Widen & Russell, 2008), and these conceptual categories (and the words used to refer to them) are also known to vary somewhat between cultures

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[3] This follows from a large body of literature on emotion-cognition interactions. For example, particular emotions and emotional stimuli have been found to influence the automatic allocation of attention (Bolte, Goschke, & Kuhl, 2003; Calvo & Avero, 2005; Fredrickson, 2001; Fredrickson & Branigan, 2005; Fredrickson & Joiner, 2002; Gable & Harmon-Jones, 2008; Gasper & Clore, 2002; Harris & Pashler, 2004; Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2004; Nummenmaa, Hyönä, & Calvo, 2006). Different emotions have also been shown to affect judgment and decision making in particular ways (Bechara, Damasio, Tranel, & Damasio, 1997; Bless et al., 1996; Bless, Bohner, Schwarz, & Strack, 1990; Bodenhausen, Kramer, & Süsser, 1994; Bodenhausen, Sheppard, & Kramer, 1994; Clore, 1992; Dasgupta, McGhee, Greenwald, & Banaji, 2000; Forgas, 1995, 1998; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Griskevicius, Shiota, & Neufeld, 2010; Haidt, 2001; Keltner, Ellsworth, & Edwards, 1993; Krauth-Gruber & Ric, 2000; Lerner, Gonzalez, Small, & Fischhoff, 2003; Lerner, Small, & Loewenstein, 2004; Nygren, Isen, Taylor, & Dulin, 1996; Park & Banaji, 2000; Schwarz & Clore, 1983; Sinaceur, Heath, & Cole, 2005; Tiedens & Linton, 2001; Zarinpoush, Cooper, & Moylan, 2000). Emotional states further appear to influence creativity and other aspects of planning and problem solving (Isen, Daubman, & Nowicki, 1987; Phillips, Smith, & Gilhooly, 2002). Learning and memory, reasoning, and performance on a range of cognitive tasks also each appear negatively influenced by levels of emotional arousal that are either too high or too low (Teigen, 1994; Yerkes & Dodson, 1908). Finally, many studies have shown that changes in emotional arousal can have specific influences on long-term memory formation (Abercrombie, Kalin, Thurow, Rosenkranz, & Davidson, 2003; Ackerman et al., 2009; Adolphs, Denburg, & Tranel, 2001; Akirav & Richter-Levin, 1999; Bradley, Greenwald, Petry, & Lang, 1992; Cahill & McGaugh, 1998; Cahill, Prins, Weber, & McGaugh, 1994; Canli, Zhao, Brewer, Gabrieli, & Cahill, 2000; K. Clark, Naritoku, Smith, Browning, & Jensen, 1999; Harris & Pashler, 2005; Kensinger & Corkin, 2003; LaBar & Phelps, 1998; Mathews & Mackintosh, 2004; Schmidt, 2002) and that a person's current emotional state further promotes mood-congruent memory retrieval (Eich, 1995; L. Levine & Pizarro, 2004).

(Russell, 1991). Identifying the appropriate emotion category to describe a perceived affective response is commonly referred to as *emotion recognition* (which can be evaluated with respect to both self and others), and this process appears to draw on multiple sources of information. This includes the perceived nature of a bodily reaction (as well as felt urges to act in some ways over others); it also includes perceived aspects of the present situation as well as current appraisals (Scherer, 2009) and expectations derived from past experience (Barrett, Mesquita, & Gendron, 2011). For example, the same bodily sensations might be perceived to indicate anger in one context and disgust in another. Thus, the brain can be thought of as making a type of "all things considered" judgment about the emotion category that best fits with (i.e., best minimizes prediction-error with respect to) the combination of bodily sensations, situational appraisals, accessible memories, felt urges, and other information sources that are available in a given context. This manner of coming to an overall conceptualization of one's emotional state via consideration of all aspects of the perceived situation/response is also highly related to recent work on "situated conceptualization" (Wilson-Mendenhall, Barrett, Simmons, & Barsalou, 2011).

This self-focused emotion recognition/conceptualization process appears to draw on a set of brain regions—including (but not limited to) parts of the medial prefrontal cortex, cingulate cortex, hippocampus, and lateral temporal cortex—that make up the default mode network (e.g., Barrett & Satpute, 2013; Kalisch, Wiech, Critchley, & Dolan, 2006; Smith, Fass, & Lane, 2014). The emotion conceptualization processes implemented by this network are adaptive primarily as a result of the added expectation-based inferences that they allow. Specifically, by identifying a particular emotion concept as the one most likely to apply to a perceived affective response, a person will be able to make inferences both about its likely causes and about ways to control it (Barrett, Gross, Christensen, & Benvenuto, 2001; Kashdan, Barrett, & McKnight, 2015). For example, if a person identifies their feeling of stomach pain as part of a "sadness" response, then they may be able to infer that it relates to the recent loss of something they value or care about; they may also have a better sense of how that feeling will be expected to evolve and what they might do to help themselves feel better (e.g., seek out social support). By updating expectations, this recognition process could also lead that person to attend to, and perceive, their bodily feelings (and their exteroceptive context) in a manner more consistent with what they have learned about sadness. On the other hand, if that person failed to recognize their stomach pain as part of a "sadness" response (or as part of any "emotional" response), they may have little sense of understanding or control over it, and would perhaps instead seek medical attention to treat it (Lane, Weihs, et al., 2015).[4] Therefore, representing the emotion concept that best "fits" an affective response is adaptive in that it allows one to have appropriate expectations regarding its causes, its temporal evolution, and what can be done to control it, and this recognition process may further affect the way other elements of EE are represented via top-down, expectation-based influences.

Conscious Experience and Cognitive Control

In the previous two sections we discussed a range of probabilistic representations that can potentially contribute to emotional experience in a given situation—including representations of situational descriptions, situational appraisals, body states, and emotion concepts, as well as their influences on other factors like activated memories, subsequent visual/auditory percepts, imagined/desired states and actions, and so forth. However, on the basis of leading models of consciousness within cognitive neuroscience (Dehaene, 2014; Dehaene, Charles, King, & Marti, 2014), it is expected that each of these different representations can be activated without becoming consciously accessible. In other words, representation and conscious experience should be considered orthogonal, such that any given piece of represented information—whether in perception, memory, cognition, or action—may or may not contribute to conscious experience on a given occasion.

According to these models (e.g., Dehaene, 2014; Dehaene et al., 2006; Dehaene & Naccache, 2001; Smith, 2017), there is a distributed neural system referred to as the "global workspace network," encompassing dorsolateral prefrontal cortex, parietal cortex, and other highly connected brain regions (often referred to as *rich-club hubs* because of their strong long-range functional/structural connectivity throughout the brain; van den Heuvel & Sporns, 2011, 2013), that is responsible for selecting some (of the many) active representations in the brain for "global broadcasting" (See Figure 1B). When a given representation is "selected" for global broadcasting, the global workspace network is thought to initiate a top-down signal that amplifies/maintains that representation in a state that allows its content to be widely accessible to other cognitive systems throughout the brain (i.e., as facilitated by the strong long-range functional/structural connectivity of the associated rich-club hub regions within the brain's small-world architecture; Dehaene et al., 2014; Sporns, Honey, & Kötter, 2007; van den Heuvel, Stam, Boersma, & Hulshoff Pol, 2008; Zippo et al., 2013). This global broadcasting function is what is thought to allow a representation's content to become consciously experienced; in doing so, that content becomes reportable and can be flexibly integrated with current goals in decision making (and other large-scale processes across the brain).

For example, consider an individual who has just had a change in heart rate in response to a loud noise. If a representation of that change in heart rate was selected for global broadcasting, then the individual would consciously experience that change in heart rate; if that representation was not selected for global broadcasting, however, then the individual would not experience that change in heart rate, even though their brain would continue to represent that change unconsciously (as in cases of low interoceptive awareness; e.g., see Pollatos et al., 2005). To build on the example further, assume a higher level representation of the concept "fear" was also activated by this detected change in heart rate. If this representation was selected for global broadcasting, then the individual would consciously recognize (and could self-report) that they were feeling fear; however, if this representation was not selected for

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[4] One interesting body of work related to the misrecognition/misrepresentation of emotion pertains to threat-related arousal and sexual attraction (Dutton & Aron, 1974; Foster, Witcher, Campbell, & Green, 1998). These studies find that, when placed in anxiety-provoking situations that trigger intense bodily arousal (e.g., walking on a shaky bridge), participants can misrecognize (i.e., misrepresent) these intense bodily sensations as feelings of sexual attraction for another individual present in the situation. Thus, given the right context cues, AGPs triggered by danger can lead to affective responses that are then recognized/represented as having a conceptually different emotional meaning (i.e., attraction, instead of fear/anxiety). This also demonstrates the separability of AGPs from the subsequent processes that represent the conceptual meaning of an affective response.

global broadcasting, then that individual would not consciously recognize that they were afraid, even if their brain was unconsciously representing "fear" as the "best fit" description of their perceived change in heart rate (e.g., as in some cases of unconscious emotion; Smith & Lane, 2016). Such unconsciously represented emotion concepts can still lead to emotion-specific priming effects on cognition/behavior (Zemack-Rugar, Bettman, & Fitzsimons, 2007); however, in the absence of conscious access to the represented emotion concept, an individual would be unable to self-report on it, or otherwise incorporate it into multistep, goal-directed cognitive processes that require maintenance/manipulation within working memory (Dehaene & Sigman, 2012; Sackur & Dehaene, 2009; Zylberberg, Dehaene, Roelfsema, & Sigman, 2011).

Within global workspace models (e.g., Dehaene, 2014), multiple factors are posited to contribute to the selection process described previously. First, a representation will be more likely to be selected (i.e., to win the competition against other representations for global broadcasting) if it is attended to. Relatedly, it will be more likely to be selected if its content is relevant to current goals and concerns. Third, the magnitude of activation of that representation (which may be proportional to its estimated probability of accuracy) also appears to play an important role. In visual perception, for example, the duration of stimulus exposure needs to be long enough to drive the neural states that represent visual percepts above a minimal activation threshold, otherwise those percepts will not be experienced consciously (Dehaene et al., 2006). This threshold may in part correspond to the amount of "visual evidence" required to support a high probability estimate for the content of that representation (Mulder, van Maanen, & Forstmann, 2014). When these factors are combined, the overall prediction is that representations with high probability estimates will be more likely to become conscious than those with low estimates, and that even some representations with high estimates may not be selected for conscious access because of a lack of attention or relevance to current goals/concerns (although, as discussed previously, unconscious representations with lower probability estimates may still contribute to AGPs).

When global workspace theories are applied to the representations contributing to EE (i.e., as we have done thoroughly elsewhere; Panksepp et al., 2017; Smith & Lane, 2015, 2016), the result is a model in which one may or may not consciously experience any of the various aspects of an affective response on a given occasion. This allows EE to be highly variable in what it includes from situation to situation. For example, at one extreme, a person could consciously experience all aspects discussed previously, including the thoughts/appraisals that trigger an affective response, the subsequently represented bodily reaction, and the emotional conceptualization of that reaction (as well as provoked changes in attention, memory, perception, motivation/action, and other aspects of cognition). At the other extreme, a person's brain could, in principle, represent all of these things without the person consciously experiencing/recognizing any of it. In between these extremes, there is a range of possible combinations. For example, a person could experience an intense bodily reaction without consciously experiencing the appraisal or stimulus that triggered it. In such a situation a person also might or might not consciously experience their bodily reaction as belonging to a particular emotion-concept category (e.g., as in the hypothetical case of stomach pain and sadness described previously).

The particular combination of representations that become consciously experienced as part of an EE on a given occasion will depend on the same range of factors mentioned previously. For instance, if a person were highly distracted by an attentionally demanding task, they might fail to consciously experience an affective shift in their body state. This would also be more likely to occur if that body state shift was brief or of low intensity (i.e., as in the example of briefly displayed visual stimuli mentioned previously). As another example, a person might similarly fail to consciously notice that they have entered a happy emotional state, simply because they are engaged in an intense goal-directed activity (e.g., playing a sport) where the category of their emotional state is irrelevant to their current goals. In addition to such state-related factors, there is also a range of more stable, trait-like factors that will also contribute to the nature of an individual's emotional experiences. These factors offer potential explanations for individual differences in trait levels of emotional awareness, and are the topic of the following section.

With respect to its neural basis, the global workspace model of conscious emotion described previously also implies that emotional experience cannot be strongly localized to any one part of the brain. This is true for two reasons: (1) emotional experience contains many dissociable elements that are each represented across many brain regions (each of which could represent the aforementioned elements both consciously or unconsciously), and (2) conscious experience requires that widespread interactions (i.e., top-down attentional amplification, global broadcasting, long-range information integration) take place between the aforementioned regions and the rest of the brain (as facilitated by the global workspace network). Thus, in addition to being heterogeneous from instance to instance, emotional experience within this model should also be considered a whole-brain phenomenon (for related whole-brain views of emotional experience, see Barrett, 2017; Pessoa, 2017). This is therefore inconsistent with the suggestions of others that emotional experience might be localized to subcortical (e.g., Solms & Panksepp, 2012) or single cortical regions (e.g., Craig, 2009).

Finally, it is important to highlight that many of the goal-directed cognitive/attentional processes discussed previously in relation to conscious access are also part of a larger class of domain-general cognitive control processes, which are highly implicated in the subsequent regulation of one's emotional state (Buhle et al., 2014; Gyurak, Gross, & Etkin, 2011; Smith, Lane, et al., 2017; Smith & Lane, 2015). These cognitive control processes—which draw on the brain's "executive control network" (within functionally connected frontal-parietal regions of cortex)—are thought to play the domain-general function of (a) maintaining/manipulating represented information that is relevant to guiding goal-directed behavior, while (b) simultaneously suppressing represented information, and inhibiting associated cognitive/behavioral processes, that are irrelevant and/or would interfere with goal-directed processing/behavior (Barrett & Satpute, 2013). In addition to their influence on conscious access, such processes can also play an important role in modifying the course of emotional experience in multiple ways. For example, by intentionally manipulating the way one's current situation is represented (e.g., as in cognitive reappraisal), this can indirectly alter one's affective reaction to it (Buhle et al., 2014). As another example, one might choose to inhibit expressing an automatic affect response, which can lead to an intensification of the experienced feeling (Gross, 1998; Gross & Levenson, 1997).

Summary

In summary, EE is first influenced by AGPs, which trigger affective reactions in response to innately recognized stimuli, conditioned stimuli, or dimensional appraisals of internally represented situational descriptions (and such representations/appraisals are influenced by both sensory input and prior learning/expectation). Representations of situations and their appraisals are also an important component of EE itself. Other components of EE include representations of the many different aspects of the affective responses provoked by AGPs, including represented changes in body states, emotion concept representations, and influences on attention, memory, cognition, and action (which are also similarly influenced by prior learning/expectation). Finally, EE is influenced by which of these various representations contribute to conscious experience on a given occasion—which is in turn determined by a range of factors that lead some representations to be selected over others for global broadcasting. Thus, the different appraisals, body states, emotion concepts, and other represented aspects of an affective response may or may not be consciously experienced (and in many possible combinations) on a given occasion. Goal-directed cognitive control processes have an important influence over this selection process, as well as on the subsequent regulation of emotional feelings/behaviors.

Trait Emotional Awareness

The construct of tEA refers to a cluster of individual difference variables pertaining to the way affective responses are experienced and understood (Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990). One such variable is *abstractness*—the degree to which individuals tend to perceive/understand their affective responses in concrete/physical or abstract/psychological terms. For example, when asked about their current emotional state, a low-tEA individual might tend to say they feel “sick to their stomach” (concrete/physical), whereas a higher tEA individual may instead say they feel “sad” (abstract/psychological). Another related variable is *granularity*—the degree to which individuals conceptualize their affective responses in coarse-grained or fine-grained conceptual categories. For example, a low-tEA individual might simply say they feel “good” (coarse-grained), whereas a high-tEA individual may instead differentiate between many different types of good feelings (fine-grained), and instead say they feel either “joy” or “excitement” (or a blend of both of these) depending on contextual details. A third variable is *self–other differentiation*—the degree to which individuals can distinguish their own feelings from those of others. Here a low-tEA individual would tend to expect others to feel the same way they feel in a given situation, whereas a high-tEA individual may be better at recognizing that others may feel very differently than they do in the same situation.

There is a large body of research suggesting tEA is an important individual difference variable in the context of both physical and mental health research. As measured by the Levels of Emotional Awareness Scale (LEAS; Lane et al., 1990), higher levels of tEA have been associated with multiple adaptive cognitive/behavioral traits. This includes greater empathy ability (Barchard & Hakstian, 2004), greater emotion recognition ability (Lane et al., 1996; Lane, Sechrest, Riedel, Shapiro, & Kaszniak, 2000), greater openness to experience (Lane et al., 1990), lower impulsivity (Bréjard, Bonnet, & Pedinielli, 2012), and a greater sense of general well-being irrespective of current mood (Ciarrochi, Caputi, & Mayer, 2003). Within clinical contexts, it has further been observed that LEAS scores are significantly lower (reflecting lower tEA) in patients with borderline personality disorder (Levine, Marziali, & Hood, 1997), eating disorders (Bydlowski et al., 2005), posttraumatic stress disorder (Frewen et al., 2008), depression (Berthoz, Ouhayoun, & Parage, 2000; Donges et al., 2005), and in those with disorganized attachment style (Subic-Wrana, Beetz, Paulussen, Wiltnik, & Beutel, 2007). However, at present it is not clear which of the three tEA-related individual-differences variables—abstractness, granularity, and self–other differentiation—are most important in clinical contexts, or how separable these different variables are in practice. All three clearly contribute to how tEA is measured by the LEAS. However, it is important to distinguish between them for theoretical purposes, as they may follow from distinct underlying factors contributing to EE.

In what follows we will illustrate how these three aspects of tEA could potentially be explained by different interactions between the various factors that contribute to EE discussed previously. As none of these potentially explanatory mechanisms have previously been articulated, they also remain to be tested empirically. Thus, the following represents a theoretical exploration of possible mechanisms for the purpose of hypothesis generation. In articulating these different theoretically explanatory mechanisms for the first time, our hope is to guide the design of future studies capable of finding evidence that supports (or fails to support) the operation of each of them within individuals possessing differing levels of tEA. Only after such studies are designed, and the resulting evidence is gathered, will it be clear which of the possible mechanisms discussed subsequently make the most important contributions to this important individual difference variable.

Specifically, we focus on three major mechanisms on the basis of our review: (1) individual differences in AGPs, (2) individual differences in affective response representation, and (3) individual differences in conscious access/cognitive control. For the purposes of conceptual clarity (and clarity of exposition), we introduce and discuss these different possible mechanisms separately; we will also highlight ways in which their roles in tEA might be experimentally tested. However, it should be clear from our review that these mechanisms interact in important ways, and that these interactions should also be seen as an important topic of future research—topics that we return to within the concluding section of this article.

tEA and Differences in Affective Response Generation

The affect generation process is one intuitive factor to focus on when considering possible explanations for individual differences in tEA. Specifically, one fairly straightforward hypothesis is as follows: Individuals for whom AGPs generate a wider range of affective responses have higher tEA than individuals for whom AGPs generate a narrower range. If this were the case, it would specifically be able to account for the more fine-grained emotion categories used by high-tEA individuals (i.e., high granularity). For example, consider a case where a low-tEA individual describes negative affective responses on three occasions as all feeling "bad," whereas a higher tEA individual instead distinguishes negative responses on three occasions as "anger," "sadness," and "fear," respectively. According to the present mechanism under consideration, this would be due to the fact that AGPs in the low-tEA individual actually generated the same affective response on each of those three occasions; in contrast, AGPs in the higher tEA individual would have actually generated unique affective responses in each of those three occasions (i.e., different bodily, cognitive, and/or attentional changes). Thus, according to this possible explanation, low-tEA and high-tEA individuals would not necessarily possess individual differences in the ability to accurately recognize their own emotions. Instead, low-tEA individuals would simply tend to have less variation in their affective response generation processes, but would be recognizing and reporting the resulting responses in an accurate/appropriate manner.

This possibility could be tested by simultaneously measuring multiple aspects of different affective responses in both low-tEA and high-tEA individuals. For example, one could take normative stimuli known to reliably trigger two negative emotions (e.g., anger and fear), and then expose both low-tEA and high-tEA individuals to these stimuli. When asking them to report how they feel in response, low-tEA individuals would be expected to describe their reactions to these different stimuli in less differentiable terms (e.g., both might simply make the low-tEA individuals feel "bad"). However, if one simultaneously measured variables related to autonomic/skeletomotor responses (e.g., changes in heart rate, respiration, skin conductance, facial muscle contraction patterns, etc.), and cognitive/attentional responses (e.g., changes in attention biases, interpretation biases, motivation, etc.) to these stimuli, then it would be possible to see if these responses are actually more objectively differentiable as well. If the proposed mechanism described previously (i.e., individual differences in AGPs) plays a role in explaining differences in tEA, it would predict that measured responses in these variables to normatively anger- versus fear-eliciting stimuli would show greater within-subject differences in high-tEA individuals (i.e., correlating with the greater differences in their self-reports). In contrast, if low- and high-tEA individuals showed equivalent within-subject differences in these objectively measureable aspects of their affective responses to normative anger and fear stimuli, this would provide relatively more support for one of the other mechanisms discussed further subsequently (i.e., differences in representation or conscious access).

It is also interesting to consider the factors that might lead AGPs in one person to generate less differentiated affective responses than those in another person. While differences in stimulus-driven AGPs are theoretically possible (e.g., differences in inborn temperament; Cloninger et al., 1993), we suggest it is most plausible to focus on learned cognitive habits in descriptive situational representation (i.e., and the subsequent application of situational appraisals) as a potential source of this type of individual difference (i.e., as supported by previous work highlighting trait differences in appraisal tendencies/biases, and their ability to account for trait differences in affective responding; e.g., see Scherer, 2009; Scherer & Brosch, 2009; Scherer & Ceschi, 2000, 1997; van Reekum & Scherer, 1997). Specifically, we suggest that one reason individuals might generate less differentiated affective responses could be because they have learned to habitually interpret/describe situations in only a small number of ways. Perhaps developmental factors lead some individuals to learn to cognitively interpret/represent their situation (i.e., the "situational descriptions" discussed previously) in many subtle and nuanced ways, leading to the use of many combinations of evaluative appraisals across the dimensions described previously (and thus also leading to the generation of many different affective responses). In contrast, perhaps different developmental factors lead others to learn habits (or strong top-down expectations) for cognitively representing/describing all situations in just a few ways, leading to the habitual use of only a few appraisal combinations (and the generation of relatively fewer affective responses).

For example, consider an individual who has learned to interpret all of the actions of others as either "with me" (friend) or "against me" (foe). This type of "black and white" thinking would be expected to allow for a fairly small number of distinct appraisals and associated affective responses in interpersonal contexts. In contrast, if that individual had instead learned to think of the actions of others in more complex "shades of gray," this would allow for a greater variety of appraisals and associated affective responses (e.g., consistent with studies illustrating an influence of continuous vs. categorical thinking on social-affective responses and on amygdala/medial prefrontal activation; Master, Markman, & Dweck, 2012; Satpute et al., 2016). Thus, although the many proposed evaluative appraisal dimensions discussed previously can theoretically allow for a large number of appraisal combinations, this need not guarantee that all individuals efficiently make use of all such combinations in their own thinking.

At present, this hypothesis also remains experimentally unexamined to our knowledge. Therefore, future studies should test this possibility to determine the extent to which differences in tEA can be accounted for by differences in cognitive interpretation habits (i.e., and how they might, via interaction with appraisal-driven AGPs, lead to fewer/greater variations in the generated affective responses of low-/high-tEA individuals). This could be done, for example, by testing for significantly positive correlations between measured tEA levels and the degree of variation in self-reported situational interpretations and appraisal combinations (i.e., across a sufficiently wide range of objectively distinct contexts).

In summary, according to this first potential mechanism, lower tEA levels observed in some individuals could be explained in part by differences in AGPs. Specifically, granularity differences would be expected if AGPs in some individuals in fact generate a smaller number of differentiable affective responses. We have further suggested that a smaller number of differentiable affective responses could in turn be explained if such individuals have only learned to represent and appraise situations in oversimplified "black and white" terms.

tEA and Differences in Affective Response Representation

While the differences in affective response generation described previously offer one potential explanation for differences in tEA associated with granularity, the subsequent processes associated with hierarchically representing/describing the nature of an affective response (i.e., after it has been generated) also provide another clear mechanism that could account for this difference. In addition, these response representation processes also offer a potential explanation for differences in tEA associated with abstractness. In other words, low tEA could involve affective responses that, after being generated, simply tend to be represented in either less granular or less abstract terms.

To illustrate, consider a hypothetical situation involving two individuals, and in which the same (highly differentiated) affective response has been generated within each of them. Yet, the way their brains subsequently perceive/represent/categorize that response is highly different. Assume the first individual has come to use fine-grained, abstract/psychological conceptualizations in representing affective responses, and thus automatically categorizes feelings in highly differentiated ways (using concepts such as "angry," "jealous," "afraid," etc.). In contrast, assume the second individual has only come to conceptualize affective reactions in more coarse-grained and/or concrete/physical terms (e.g., "bad" or "sick"). The lower degree of differentiation in the second individual's perception/recognition processes would lead to lower measured levels of tEA than the first individual, and would also be expected to lead to less informed/adaptive decision making and emotion regulation abilities (i.e., because decision/regulation processes could not benefit from the added information/expectations provided by fine-grained emotion concept categories). Thus, even though the same affective response is generated in each of these individuals, higher tEA in one of them—and its adaptive benefits within later thought/action—could arise because of differences in the way that this affective response is subsequently perceived/represented.

This second possible mechanism could also be tested in several ways. First, unlike the affect generation mechanism described previously, the present mechanism under consideration would be more supported if positive correlations were not observed between tEA scores and objective measures of the variability/specificity of an individual's affective responses (changes in peripheral physiology, changes in cognitive/attentional biases, etc.). This is because, according to this mechanism, the very same affective response is represented in more fine-grained ways, and using more abstract/psychological-level concepts, in some individuals relative to others. A second way this mechanism might be tested is by independently gathering data on individual differences in emotion concept acquisition. This mechanism would be supported, for example, if individuals with higher tEA were also shown to have acquired richer, more detailed scripts and schemas for emotion words like "sad" or "afraid" (more specific and differentiated expectations about when such terms would be used, what the typical causes and effects of these feelings are, etc.). In contrast, if low- and high-tEA individuals were shown to possess equally rich emotion concept knowledge, this would not support tEA-related differences in affect representation, and would instead suggest that differences in AGPs, or differences in conscious access (discussed subsequently), may be more relevant/explanatory.

Although this possible mechanism has not yet been directly tested, there is a body of previous work suggesting a role for affect representation processes in both the granularity differences and abstractness differences underlying tEA. With respect to granularity, one study found that higher emotion granularity was associated with less activation within the salience network in response to social rejection (Kashdan et al., 2014). As this network is involved in representing somatovisceral reactions (Barrett & Satpute, 2013), this could be interpreted to suggest differences in the bodily aspects of affective response representation (although this could simply indicate the generation of a less intense affective response as well). With respect to abstractness, several studies have now investigated the neural basis of representing actions in concrete/physical terms versus in abstract/mental terms (e.g., Spunt & Adolphs, 2015; Spunt, Kemmerer, & Adolphs, 2016; Spunt & Lieberman, 2012a, 2012b; Spunt, Meyer, & Lieberman, 2015; Spunt, Satpute, & Lieberman, 2011). These studies consistently support the role of a frontal-parietal "mirror network" (involved in representing actions) in concrete/physical levels of representation; they also consistently find evidence supporting the role of default mode network regions in abstract/mental levels of representation. These findings provide important context for a recent study of tEA that asked subjects to view simple animated scenarios with social/emotional content while undergoing neuroimaging (Tavares, Barnard, & Lawrence, 2011); in this study, higher levels of tEA (higher LEAS scores) were associated with greater neural activity in one region of the default mode network linked to abstract semantic processing (i.e., left anterior temporal cortex), whereas lower levels of tEA predicted more concrete, action-oriented brain activation (i.e., in frontal premotor cortex). Thus, this study appears to support a role for differences in the abstractness of affective response representation in accounting for low- versus high tEA, but further studies are needed to target this hypothesis more specifically.

Finally, very low levels of tEA have also been studied using measures of the related construct of alexithymia—which has typically been discussed as a deficit in affective response representation (i.e., with respect to representations of emotion words [an "affective anomia"] or emotion concepts [an "affective agnosia"]; Bagby, Parker, & Taylor, 1994a, Bagby, Taylor, & Parker, 1994b; Lane, Weihs, et al., 2015). This is consistent with the fact that alexithymia is associated with restricted imaginal capacities (Sifneos, 1973), and with psychosomatic conditions in which individuals may misrecognize affective responses as somatic symptoms of another medical problem (Lane, Weihs, et al., 2015; Shipko, 1982; Taylor, Bagby, & Parker, 1997). Neuroimaging studies also tend to find abnormal neural activation in individuals with alexithymia associated with emotion perception/conceptualization, and with emotion-focused attention (i.e., within regions of the default mode network, salience network, and limbic network; e.g., Kano & Fukudo, 2013; van der Velde et al., 2013, 2015), which also appear consistent with a deficit in affective response representation. However, the role of AGPs in alexithymia deserves further attention, as it is presently unknown whether alexithymic individuals would also demonstrate less differentiated/specific affective responses (using objective measures of changes in peripheral physiology, changes in cognitive/attentional biases, changes in motivation, etc.) than typical individuals in response to a range of affective stimuli. As we will discuss next, it is also possible that individuals with alexithymia (and/or low tEA) do generate and represent differentiated affective responses, but that these representations tend to remain consciously inaccessible.

tEA and Differences in Global Broadcasting/Cognitive Control

A third mechanism that may potentially account for at least some measured differences in tEA pertains to global broadcasting mechanisms, and related cognitive control functions in the brain, that influence conscious access to represented information. To understand how such a mechanism could make further explanatory contributions, one must consider a hypothetical individual who both generates differentiated affective responses and also represents those responses in fine-grained abstract/conceptual terms. In principle, such an individual could still end up with a low score on a test of tEA if the resulting affective response representations rarely became conscious (i.e., if they were only rarely selected for global broadcasting). Therefore, if individual differences existed in conscious access to emotion-concept representations, this could also account for differences in measured levels of tEA.

In a previous article (Smith & Lane, 2016), we have discussed multiple ways (there termed *top-down mechanisms*) in which such processes could prevent conscious recognition of one's own affective responses, and the reader is referred to that article for more detail. In brief, however, each of the factors that make one representation more likely than another to win the competition for conscious access (discussed previously) could, in principle, also become part of a stable set of cognitive habits that would influence tEA. For example, recall that representations are more likely to become conscious if they are attended to and if they are goal-relevant. As such, if a person had learned to habitually attend to their emotions, or if a person had acquired a set of goals/motivations for which their own emotions were highly relevant, then such an individual would be highly likely to gain conscious access to emotion representations fairly often. On the other hand, emotion concept representations might become consciously accessible much less often on average if an individual had developed the habit of avoiding attending to their emotions, or if they had acquired a set of goals/motivations for which their own emotions were considered irrelevant or distracting. For example, some clinical disorders linked to low tEA might involve reinforced patterns of cognitive/attentional responding that involve maladaptive levels of emotion avoidance (e.g., an individual might habitually avoid attending to their own emotions because attending to emotions in the past has reliably increased the intensity of negatively valenced arousal; for more detailed examples, see Smith & Lane, 2016). Therefore, factors influencing patterns of attention, motivation, and goal updating—plausibly including personality variables, early life experiences, and other innate and learning-related variables—could have an influence on measured levels of tEA by determining the frequency with which emotion-concept representations out-compete other active representations for conscious access.

This mechanism could theoretically explain tEA differences associated with granularity, abstractness, and self–other differentiation. For example, even if an individual has the capacity to use fine-grained, abstract/psychological-level concepts to represent their affective responses, it remains possible that they have learned to habitually focus on broader or more "physical" (e.g., body-focused) ways of representing them. In such a person, representations of emotion-related bodily sensations like "muscle tension," or of emotion-related urges like "wanting to punch someone," might become conscious more easily than representations of abstract concepts like "jealousy." This difference in conscious access could therefore lead to differences in granularity and abstractness within self-reported emotional experience. To see how the cognitive control processes linked to global broadcasting and conscious access might also play a role in explaining individual differences in self–other differentiation, consider that—within global workspace models (e.g., Dehaene et al., 2006)—representations of one's own emotions are posited to be in continual competition with other representations for conscious access. As such, if one has a goal of figuring out how another individual might be feeling, then representations of one's own emotions will need to be suppressed by such control processes to avoid interference (i.e., while simultaneously amplifying/maintaining stored information about the other individual in question). Thus, individual differences in the efficacy of such cognitive control processes (which amplify goal-relevant information and suppress interfering/goal-irrelevant information) may also lead to differences in successful self–other differentiation.

In summary, aside from differences in AGPs and differences in the way affective responses are subsequently perceived/represented, we have suggested here that individual differences in global broadcasting mechanisms may also lead some individuals to attend to, and become conscious of, their emotions more often than others. This could happen if some individuals, relative to others, learn sets of norms, values, and cognitive/attentional habits that promote a greater focus on, and less avoidance of, emotion-related thoughts and feelings. As with the other possible mechanisms described previously, this mechanism remains to be examined empirically. However, it is consistent with one recent neuroimaging study that found positive correlations between tEA levels, activation of executive control network regions, and performance during a working memory task that required participants to hold emotions in mind (Smith, Lane, et al., 2017). It is also consistent with another study that found that higher granularity for positive emotions was associated with the use of more effortful deliberate/controlled cognition (and with healthier coping styles; Tugade et al., 2004).

The operation of this mechanism is also consistent with, and could be tested further using, semantic priming paradigms designed to show evidence for unconscious representation of emotion concepts in the absence of self-reported emotional feelings (e.g., Zemack-Rugar et al., 2007). For example, if lower-tEA individuals were to display evidence of differential priming for different fine-grained emotion categories (e.g., differential priming of anger vs. fear), while also being less likely to self-report feeling such emotions compared with high-tEA individuals, then this would provide evidence supporting the operation of this mechanism. A second way this mechanism might be tested is by examining the strength of the correlation between self–other differentiation ability and independent measures of cognitive control capacity (differences in working memory capacity, distractor suppression ability, inhibitory control ability, etc.). If this mechanism were in operation, one would expect that higher self–other differentiation ability should be positively associated with cognitive control capacity. A third way this mechanism might be tested is through the use of independent measures of cognitive effort/reflection. For example, future studies could examine the correlation between tEA levels and performance differences on the cognitive reflection test (Toplak, West, & Stanovich, 2014), with the hypothesis that a positive association would be present between tEA and reflectiveness. As another example, pupil dilation is a widely used indicator of cognitive effort (Piquado, Isaacowitz, & Wingfield, 2010); therefore, future studies could measure pupil dilation while individuals completed performance measures of tEA (e.g., the LEAS), and then correlate this with tEA levels. If this mechanism were in operation, one would expect that individuals with higher tEA would also show greater pupil dilation—indicating greater effortful attention/reflection while completing the tEA measure.

The Potential Origins of Individual Differences in the Mechanisms Underlying tEA

Thus far, we have described several mechanisms that, when operating in adulthood, could potentially account for individual differences in tEA—including differences in affect generation processes, differences in affect representation processes, and differences in the processes that select some representations over others for conscious access. However, we have not systematically addressed what is known regarding how these stable mechanistic differences might come about. Here we therefore briefly review what is known about the potential developmental origins of these mechanistic differences.

One initial possibility is that innate (e.g., genetic/epigenetic) factors could promote the operation of one or more of these mechanisms to a greater degree in some individuals relative to others. This possibility appears plausible in light of previous research on emotion-related personality variables. As one example, the personality variable of extroversion has been strongly linked to the intensity and frequency of positive emotional reactions (Gross, Sutton, & Ketelaar, 1998; Larsen & Ketelaar, 1989, 1991; Lucas & Baird, 2004; Lucas & Fujita, 2000; McCrae & Costa, 1991; Watson & Clark, 1997), as well as to genetic differences in the expression of dopamine receptor subtypes (that facilitate reward circuit activation)(Cohen, Young, Baek, Kessler, & Ranganath, 2005; Depue & Collins, 1999). As another example, the personality variable of neuroticism has been linked to the intensity of emotional reactions to negative stimuli (Larsen & Ketelaar, 1991), as well as to the "short" variant of the serotonin transporter gene (Munafò et al., 2003; Munafò, Clark, Roberts, & Johnstone, 2006). Both of these examples therefore suggest that genetic factors may account for some individual differences in the AGPs discussed previously—which in turn could explain differences in tEA associated with granularity.

Other personality variables, which are thought to have an innate component, have similarly been linked to affective response generation. Agreeableness, for example, has been linked to less proneness to anger (Kuppens, 2005), less intense anger when blaming others (Meier & Robinson, 2004), and more frequent/intense emotional experiences associated with love, compassion, and forgiveness (Berry, Worthington, O'Connor, Parrott, & Wade, 2005; Shiota, Keltner, & John, 2006). Conscientiousness has also been associated with less anger (Jensen-Campbell, Knack, Waldrip, & Campbell, 2007), as well as with a greater disposition toward contentment, pride, and joy (Shiota et al., 2006). Finally, the trait of "openness to experience" (OTE) has been associated with greater positive affect (even after controlling for the other personality traits discussed previously; McCrae & Costa, 1991), and specifically with feelings of awe, love, and compassion (Shiota et al., 2006). OTE has also been found to predict higher levels of tEA (Lane et al., 1990). As levels of each of these three personality traits (i.e., agreeableness, conscientiousness, and OTE) have also been negatively associated with possession of the short allele of the serotonin transporter gene (Harro et al., 2009), these observed personality-related differences in affective response generation could plausibly arise at least partially via innate factors. On the basis of these previous findings, we therefore suggest that, if innate factors play a role in explaining differences in tEA, they most likely do so via influences on the affective response generation process (although innate differences in automatic attention to emotion-cues also appear possible; e.g., see Moriuchi et al., 2017).

Another plausible hypothesis, however, is that individual differences in the operation of the EE-related mechanisms described previously, and resulting differences in tEA, could come about through learning processes that occur during development. There is now a very extensive body of literature on the development of social-emotional abilities in children, which appears to support the role of early learning. Initially, infants appear to simply display signs of distress (Dondi, Simion, & Caltran, 1999; G. Martin & Clark, 1982) and comfort (Mendes, Seidl-de-Moura, & Siqueira, 2009), suggesting fairly limited affective response generation abilities. At this early stage, the only other (potentially) affective reaction displayed by infants is the Moro reflex (in response to being dropped, hearing loud noises, and other simple cues to danger), which bears little resemblance to a prototypical fear expression (Rönnqvist, 1995). Further, although infants will also stare for longer periods of time at unexpected outcomes, the facial expression associated with surprise is not seen until nearly 2 years of age (Scherer, Zentner, & Stern, 2004). In combination with other work (Oster, Hegley, & Nagel, 1992), it therefore appears that infants start out with only a few (fairly undifferentiated) affective responses, and that these responses become more differentiated over time.[5]

This ability to generate differentiated affective reactions is constrained by both cognitive and sensorimotor limitations in infancy (Sroufe, 1996; Sternberg & Campos, 1990; Witherington, Campos, & Hertenstein, 2001). For example, an infant might be incapable of reacting with detectable anger because (a) it cannot see an anger-inducing stimulus clearly, (b) it lacks the muscular control to produce an anger expression, and/or (c) it lacks the cognitive capacity to assign blame (e.g., to represent appraisals related to agency/control). Emotions like guilt, shame, and pride also appear to require comparing one's self to abstract social standards, which infants are incapable of doing (Lewis, 1992; Lewis & Brooks-Gunn, 1979; Lewis, Sullivan, Stanger, & Weiss, 1989; Mahler, Pine, & Bergman, 1975). Thus, a learning process at both the cognitive and sensorimotor levels appears to be required before differentiated situational descriptions/appraisals, and the subsequent generation of more differentiated affective reactions, be-

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[5] This process also does not appear to end in early childhood, as self-reported bodily sensations during emotions have also been shown to gradually become more specific and differentiated between ages 6 and 17 (Hietanen, Glerean, Hari, & Nummenmaa, 2016).

comes possible (Camras, 1992; Messinger, 2002; Porter, Jones, Evans, & Robinson, 2009; Spitz, 1965).

In addition to affect generation, the ability to represent/recognize affective reactions in differentiated ways also appears to come about gradually over development. For example, even four- and 5-year-old children make many mistakes at correctly categorizing negative emotions (e.g., misrecognizing anger, fear, or disgust as sadness; Widen & Russell, 2008). Emotion categories are also known to vary by culture (Russell, 1991). This strongly suggests that learning is of primary importance in gaining the ability to recognize/represent fine-grained, culture-specific emotion categories.

Learning to adaptively generate and recognize affective reactions appears to depend in important ways on social interactions with parents as well as other children (Bower, 1977; Keltner & Haidt, 1999). When confronted with novel situations, infants appear to look to trusted caregivers to figure out what the appropriate emotional reaction should be (Klinnert, Emde, Butterfield, & Campos, 1986; Mumme, Fernald, & Herrera, 1996; Sorce, Emde, Campos, & Klinnert, 1985; Walden & Baxter, 1989), and this "social referencing" process is just one example of the many ways emotion-related expectations are learned from family members as well as peers and strangers during childhood (Fujisawa, Kutsukake, & Hasegawa, 2008; Hertenstein & Campos, 2004; Moses, Baldwin, Rosicky, & Tidball, 2001; Much, 1997). One especially important source of early emotional information is the affective/behavioral matching process observed between mother and infant (Beebe, 2003; Beebe et al., 2000; Crown, Feldstein, Jasnow, Beebe, & Jaffe, 2002; Jonsson et al., 2001; Sanefuji, 2008; Trevarthen & Hubley, 1978). This process, in which a mother feels (or is attuned to) the same emotion as a child (and conveys this behaviorally), is believed to facilitate a child's ability to learn how internal feeling states are correlated with emotion-relevant exteroceptive sensory signals (e.g., facial expressions of others; Feldman, Greenbaum, & Yirmiya, 1999; Kokkinaki, 2003). Related mental state recognition abilities are also reduced in children who were raised in orphanages without personalized parental care (Colvert et al., 2008; Yagmurlu, Berument, & Celimli, 2005), further suggesting that parent–child interactions may be of primary importance in learning to recognize/represent emotions.

The adaptive nature of such interactions is also supported by work showing that more frequent hugging, and other positive types of physical contact from parents in childhood, predict healthier relationships and lower levels of depression in adulthood (Takeuchi et al., 2010). In contrast, children with more emotionally distant caregivers tend to display behaviors associated with an "avoidant attachment style" and are more at risk for displaying antisocial behaviors at later points in their life (Burgess, Marshall, Rubin, & Fox, 2003; Isabella & Belsky, 1991). Jointly, these results support the possibility that individual differences in affect representation could arise as a result of differences in early parent–child and peer interactions, resulting in some children learning to recognize and think about emotions in more fine-grained and adaptive ways relative to others. As such early learning processes would also likely influence the way children interpret and understand the world more generally (e.g., their top-down expectations about the beliefs, values, and motivations of others), this could also have important influences on how they attend to, interpret, and appraise their surroundings—potentially leading to situation-specific differences in affective response generation and self–other differentiation abilities as well.

For example, imagine one individual had a safe, secure childhood in which parents regularly recognized his or her affective responses, labeled them with fine-grained emotion concept terms, and discussed their causes and potential ways to deal with them. Assume also that this individual's environment was sufficiently free of continuous threats to allow them the chance to attend inwardly and efficiently recognize and learn the patterns in their own perceived bodily responses (and how these tended to occur within particular situations). On the basis of the considerations described in preceding text, such experiences would likely facilitate learning to represent/categorize affective responses in highly granular, abstract conceptual terms—and therefore to higher tEA. In contrast, imagine a second individual who had a very unsafe, insecure childhood involving various types of abuse and neglect. This second individual would not benefit from the type of parental feedback that would allow them to learn to recognize and apply fine-grained, psychological terminology to their felt affective responses. As a way to monitor for the constant possibility of threat they have experienced, this second individual would also be more likely to have learned to attend exteroceptively the majority of the time. This would prevent them from attending to patterns in their internal sensations, and further hinder their ability to learn the meaning of fine-grained emotion categories. This individual would therefore be expected to have lower tEA than the first individual.

Note further that the aspects of early adversity described previously, and their general influence on learning, could also plausibly influence self–other differentiation. This is because an individual's ability to recognize that another person may feel differently than himself/herself in a particular situation requires the opportunity to first learn that this is possible. In turn, learning that this is possible plausibly requires a certain amount of social interaction with others—particularly the types of interactions where multiple people verbalize (and otherwise openly express) their thoughts and feelings about what emotions they are experiencing and why. As exposure to such experiences is often limited in the context of early adversity (e.g., the cases of childhood abuse/neglect described previously), one might therefore expect an individual who grew up in such circumstances to fall back on the default assumption that others will always feel similarly to himself or herself—leading to lower self–other differentiation ability and therefore to lower tEA.

One final source of learning-related differences in tEA may come from differences in acquired goals and values—and the resulting influence this could have on mechanisms determining conscious access to emotion-related representations. As one concrete example, there are stable gender differences observed in tEA (Barrett, Lane, Sechrest, & Schwartz, 2000), in which women tend to have higher tEA than men. Further, it is known that, across multiple cultures, parents tend to (a) encourage the expression of positive emotions more in girls than in boys and (b) encourage control of negative emotions more in boys than in girls (Chaplin, Cole, & Zahn-Waxler, 2005; Diener & Lucas, 2004). Parents also tend to discuss emotions more with their daughters than with their sons during preschool years (Fivush, Brotman, Buckner, & Goodman, 2000). Although this could clearly result in women tending to learn to recognize/represent emotions to a greater degree than men, it also likely teaches children gender-specific goals and values.

That is, women may more often learn that emotions are important to attend to, think about, and focus on as part of their life goals, whereas men may more often come to view emotions as less worthy of attention (e.g., for one study of the joint influence of motivation and gender on tEA, see Ciarrochi et al., 2005). This provides one example of a way that individual differences in tEA could come about as a result of differences in global broadcasting and conscious access. Specifically, if one person has learned that emotions are important to attend to, whereas another person has learned they are better ignored, then—all else being equal—the first individual would be expected to gain conscious access to their emotions more often than the second individual (i.e., as a result of these learned/habitual patterns of attention and allocation of cognitive effort), leading to higher scores on tests of tEA. Thus, learning different emotion-related goals/values may also influence tEA via interactions with the global broadcasting mechanisms discussed previously.

In summary, on the basis of the research reviewed here, it appears that innate factors may play a role in explaining individual differences in tEA, most plausibly via their influence on AGPs. In contrast, learning processes—and especially those associated with parent–child interactions early in development—appear as though they could plausibly influence tEA via effects on all of the mechanisms we have described. If such interactions teach children to interpret situations in more or less adaptive ways, then this would be expected to influence affective response generation. If such interactions teach children to recognize and think about emotions in more or less granular/abstract ways, then they would be expected to influence affective response representation. Finally, if such interactions teach children to value emotions differently, then this would be expected to influence the chances that representations of affective reactions would be selected for global broadcasting/conscious access (i.e., via interactions between goals/values and the allocation of cognitive effort/attention in social/emotional contexts).

Future Directions and Conclusions

In this article, we reviewed an evidence-based model of EE (i.e., summarizing our previous work; Lane, Weihs, et al., 2015; Panksepp et al., 2017; Smith & Lane, 2015, 2016; Smith, Thayer, et al., 2017), and we highlighted multiple potential mechanisms, and associated innate/developmental origins, whereby trait-differences in interactions between the factors contributing to EE might account for measured differences in tEA. As tEA (and its underlying dimension of granularity in particular) is known to be an important predictor of adaptive emotional functioning (e.g., Barchard & Hakstian, 2004; Bréjard et al., 2012; Ciarrochi et al., 2003; Kashdan et al., 2015; Lane et al., 1996, 1990, 2000; Quoidbach et al., 2014; Tugade et al., 2004), these mechanisms offer the potential for important progress toward understanding the causes of individual differences in tEA. Future studies should therefore be designed to elucidate the relative contributions of each of these possible mechanisms in accounting for such differences in trait emotional awareness. Such studies could lead to the discovery of more efficient, specific, and sensitive assessments and biomarkers for tEA as well as its different underlying dimensions (granularity, abstractness, and self–other differentiation).

This future work, as guided by the framework outlined here, may also point in the direction of mechanisms that could be taken advantage of to improve tEA (e.g., in individuals that have experienced early adversity). If such training programs could be specifically designed to target whatever mechanisms turn out to be most explanatory, this could lead to more specific, efficient, and effective interventions than those presently available (e.g., Brackett et al., 2012; Burger et al., 2016; Neumann et al., 2017). Only once the actual mechanisms in operation are known can efforts be focused on the primary contributing mechanisms to improve tEA and potentially facilitate the beneficial outcomes it has been associated with.

Finally, the framework we have outlined can further provide the necessary conceptual scaffolding to begin to clearly focus on how the different mechanistic factors under consideration could interact. That is, even though—for conceptual clarity (and clarity of exposition)—we have here treated the processes of affective response generation, affective response representation, and conscious access separately, there are a myriad of plausible ways these could each influence one another as well in a given individual. For example, state-differences in arousal level are thought to influence measures of tEA as well—such that a person will be less able to represent, and think clearly about, their own emotions when arousal is either extremely high or extremely low (Lane, Ryan, Nadel, & Greenberg, 2015). It follows that individuals who have more intense/frequent affective responses—as a result of stable differences in AGPs—would also have more difficulty learning to represent and attend to their own emotions. As this influence of arousal level is also present for cognition more generally (Teigen, 1994), it could also promote greater black and white thinking (i.e., in situational representation), which would in turn influence subsequent appraisal, affective response generation, and each of the other processes we discussed.

As another example, failing to appropriately recognize/understand one's own emotions in fine-grained terms can itself fuel heightened negative arousal as a result of misunderstanding and resultant problems with regulation and problem-solving (as described in the "short-circuit" model within Lane, Weihs, et al., 2015). For example, if one misrecognizes an affective response as a sign of a serious medical problem (e.g., mistaking anxiety-related heart palpitations for signs of a heart attack), this can trigger appraisal-driven AGPs to initiate even more intense negative affect; or if one does not differentiate between distinct negative emotion concepts (e.g., if fear, sadness, and anger are all equivalently represented as "bad"), then one would be expected to have more difficulty reasoning about the causes of these feelings or how to cope with them. These are just a few examples of ways in which an individual difference in one of the mechanisms we have discussed could promote individual differences in the other mechanisms—both in a state-dependent manner within adulthood and over the course of learning during development. Only by clearly laying out this conceptual framework can such interactions begin to receive thorough consideration in future experimental and theoretical work.

A similar advantage of this conceptual framework pertains to increasing understanding of the contributions made to tEA by domain-general neural networks (and their interactions). To illustrate, there are multiple studies that have linked higher levels of tEA to regions of the salience network and default mode network (i.e., dorsal anterior cingulate cortex and medial prefrontal cortex in particular; Smith, Alkozei, et al., 2017). Two different task-based functional neuroimaging studies have demonstrated that higher tEA scores are associated with greater activity in the dorsal anterior cingulate cortex (Lane et al., 1998; McRae, Reiman, Fort, Chen, & Lane, 2008). A third study has also shown that, during recall of life-threatening experiences, higher tEA levels were associated with greater activity in medial prefrontal cortex and rostral anterior cingulate (Frewen et al., 2008). Importantly, such findings have tended to be interpreted as evidence of differences in body state representation and emotion concept representation (Lane, Weihs, et al., 2015). However, as our review has illustrated, these medial prefrontal cortex and dorsal anterior cingulate regions are also involved in conceptualization/appraisal of one's situation, and in generating (and dynamically adjusting) affective responses. Such studies have also not examined functional connectivity with executive control network regions to examine potential differences in global broadcasting/conscious access. Thus, our framework highlights the need for more specific and targeted experiments/analyses that are able to distinguish the degree to which current neuroimaging evidence reflects one (or a combination) of the specific mechanisms we have described. As mentioned previously, it is possible that, through learning and mutual reinforcement over time, some of these mechanistic differences covary with one another (e.g., more nuanced [less "black and white"] thinking in appraisal processes might be positively correlated with higher emotion granularity—because both involve more sophisticated conceptualization processes); however, it is also certainly possible—and worth investigation—that these mechanisms can come apart (e.g., if a person had learned to represent situations, but not emotions, in a complex/differentiated manner). The present framework will therefore also facilitate the acquisition of definitive answers to such questions.

In conclusion, emotional experience is the result of many interrelated factors, including: situational representation, situational appraisal, affective response generation processes, affective response representation processes, the global broadcasting mechanisms underlying selective conscious access, and related cognitive control processes. Trait emotional awareness differences can in turn be theoretically explained in several possible ways, by positing that any one of these factors varies from person to person (i.e., while the rest are imagined to remain constant). However, it is currently unknown which of these possible sources of variation can account for the majority of observed differences in tEA—and there are also many underexamined ways in which such sources of variation might interact. Only via the design of creative future experiments can greater clarity be achieved with respect to these phenomena—which may play an essential role in improving available interventions aiming to mitigate the negative consequences of low emotional awareness.

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Received February 21, 2017
Revision received June 12, 2017
Accepted August 24, 2017 ■