

features (the body and the handle) and the object to which they belong (the teacup). Binding, therefore, is required for both perception and action.

In the domain of perception, it has been proposed that certain types of visual binding can occur without consciousness, and such unconscious binding is more fragile than conscious binding (Lin & He 2009). Given the central role of binding in perception, such an unconscious binding framework, by leveraging rich psychophysical, physiological, and computational understandings in the binding problem, could be useful for guiding us to probe the scope and limits of unconscious processing – as well as how unconscious processing interacts (binds) with conscious processing (Lin & Murray 2013). For example, certain binding processes may be more critical than others in enabling perceptual consciousness (e.g., perceiving the teacup), and they might not be the same as those critical for enabling action consciousness (e.g., lifting the teacup). The central question then becomes just what kinds of binding require consciousness and what kinds of binding do not, and to what degree – in both perception and action. Such an unconscious binding perspective provides an informative direction along which one can delineate the scope and limits of unconscious processing, the knowledge of which is indispensable if we are to understand the nature of consciousness.

Locating consciousness: We are conflicted by the role of conflict

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Abstract: What is consciousness for? Consciousness allows us to handle conflict, a promising proposal by Morsella et al. However, they provide little evidence as to why consciousness is particularly valuable in resolving conflict, nor do they limit the role of consciousness to only conflicting experiences. We attempt to clarify their possible positions and offer several solutions for how these might be formulated and tested.

Bill is expounding on the genius of Julian Jaynes (2006) and how his theory of consciousness also meshes with the view of Nicholas Humphrey (2006). I want to interject a questioning voice, but I was just about to enjoy a unique blend of hops by lifting my fresh glass of our local Santa Cruz IPA. This situation fits with Morsella et al.'s conflict – do I utter my question or bring the glass to my lips to savor the beer? The situation is not as dramatic as a driver seeing a deer jump across a mountainous road, creating a conflict of whether to continue on and risk hitting the deer or to swerve off the road. Consciousness manages these scenarios of conflict, according to Morsella et al., but they do not justify why consciousness makes the resulting behavior any easier or more adaptive.

More importantly, perhaps, the authors appear to assume that consciousness is present well before the conflict begins. Their cave example has the actor consciously perceiving the cave's opening and having the conscious experience of a noxious smell. Thus, our actor is conscious of the relevant percepts without any conflict, so consciousness cannot be limited to solving only conflict situations. Therefore, the question for Morsella et al. is whether the person is conscious of both stimuli before any conflict arises, or whether the conflict is responsible for a conscious experience of these two stimuli. If Morsella et al. really impute consciousness of fundamental percepts like seeing and smell, then they have joined the dominant camp of attributing consciousness to our direct experience of objects and events.

A more unique position would be to define the individual percepts as non-conscious, the outcome of prototypical pattern

recognition processes that could easily be performed by a zombie or automaton without consciousness. Consciousness would raise its talking head only when the individual percepts create conflict as in our examples of taste versus talk or our actor leaving or staying in the cave.

But we think that Morsella et al. won't deny that percepts are conscious. To resolve this conflict, we might turn to *Seeing Red* by Nicholas Humphrey (2006). He attributes consciousness not to percepts but to sensations created by the interaction of the senses and an experiencing actor. So for Humphrey, we have a conscious actor interacting with various percepts unconsciously until the deer jumps across the road. Would this second engagement of Humphrey's consciousness perhaps now access something from the sensorium to better deal with the conflict? If so, benefitting from the sensorium's input would seem to justify consciousness during conflict but not during individual (non-conflicting) percepts. However, we doubt it would access anything beyond the normal ongoing activity of the sensorium. It might access something from the "narratorium." That is, along with the provoked emotional shift of seeing a deer, the individual might streamline any number of narrative scenarios about what is going on and what to do about it.

In Morsella et al.'s model, it is almost certain that having a deer jumping across the road could cause a consciousness-evoking change. The driver may have been in one of those episodes that people talk about where you drive for miles with no recall of being aware of that driving. Then the deer appears. Now, for Morsella et al., one conflict might be the following: "Do I do less damage to myself and the car by swerving or by continuing on?" In Morsella et al.'s view, these competing actions that are vying for access to the motor output system bring about a moment of consciousness.

How many conflicts do we actually run into? Is conflict all that unique, infrequent, or qualitatively different? Our mindless pattern recognition solves conflicts seamlessly, as in our studies of optimal speech perception, given auditory and visible speech (erroneously called the McGurk effect because it involves much more than the field's prejudice for "illusions" given conflicting speech inputs). Conflict does not seem to unravel this form of integration as specified by the Fuzzy Logical Model of Perception (FLMP; Massaro 1998).

In an expanded 5-by-5 factorial design, for example, five levels of audible speech varying between /ba/ and /da/ were crossed with five levels of visible speech varying between the same alternatives. There were also trials that had simply a visual or an auditory syllable. The participants were instructed to identify the syllable as /ba/ or /da/. The results showed a large interaction between auditory and visual speech, a signature prediction of the FLMP. There appeared to be a natural integration of auditory and visual speech even though many of the speech events had conflicting audible and visible speech. This result might lead us to question why conflict is necessary or sufficient for consciousness.

Perhaps one could empirically test whether behaving to a single percept is all that different from behaving to conflicting percepts. This would inform whether conflict is all that is essential to engaging or creating consciousness. Recall the demonstrations of Benjamin Libet in which an actor was told to watch a clock and decide when to make an arm movement (see Obhi & Haggard 2004). She moved and then reported what time the clock was showing when she decided to move. The results revealed that an action potential in the brain occurred *before* the time she reported. We could replicate this experiment and also include a conflicting situation in which there is a conflict and the person judges when he or she decided to make one action versus another, such as move one hand versus another. For example, a right hand results in five people dying and a cure for the common cold, whereas a left hand response results in 10 people dying and a cure for cancer. The question would be whether the action potential in the brain occurs before or after the time the person reported making a decision. If the conflict situation reverses the classic

result, which would mean that the action potential occurred after the time the person reported making a decision, then we might have empirical evidence for something like consciousness influencing conflicting situations relative to non-conflicting situations.

Origins of emotional consciousness

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Abstract: While the field of emotions research has benefited from new developments in neuroscience, many theoretical questions remain unsolved. We propose that integrating our iterative reprocessing (IR) framework with the passive frame theory (PFT) may help unify competing theoretical perspectives of emotion. Specifically, we propose that PFT and the IR framework offer a point of origin for emotional experience.

The nature of emotional experience continues to captivate scientists and human society in general. With modern neuroscientific methods, there is renewed progress in uncovering mechanisms underlying emotional experience. That said, the field remains divided by fundamental, theoretical disputes and a lack of consensus on the definition of emotion or what constitutes emotional experience. We propose that integrating our iterative reprocessing (IR) framework with the passive frame theory (PFT) of consciousness may help unify competing theoretical perspectives of emotional experience. Because emotions can be conceptualized as multimodal synchronizations of component processes that direct action, we suggest here that a theory of consciousness in the service of action is informative for the understanding of emotional experience.

Basic emotion theorists propose that a limited set of basic emotions evolved as adaptive, whole body responses to environmental challenges (Ekman 1992). In contrast, psychological constructivists propose that emotions arise from the interaction of basic processes, such as interpretations of ongoing mental activity, or core affect, organized through semantic conceptualization (Barrett 2006; Russell 2003). Specifically, psychological constructivists see emotions as conceptual interpretations of core affect, defined by *valence* (positive or negative) and *arousal* (intensity), where differentiated emotions arise when states are categorized. Similarly, appraisal theorists propose that emotions arise from specific cognitive interpretations, such as whether an event is relevant to current concerns (see Ellsworth & Scherer 2003). Critically, for some (e.g., Frijda et al. 1989), *action tendencies* associated with a cognitive interpretation fundamentally constitute the emotional experience. Although these later perspectives provide formal cognitive models of emotion, they are often silent with regard to how and when these processes of interpretation arise in our subjective experience.

Our view of emotion is part of a growing consensus that the distinction between emotion and cognition is a false dichotomy (Cunningham & Kirkland 2012); if we define cognition as information processing, it follows that emotion is a type of cognition. The IR framework exploits this perspective to understand emotion as the emergent result of hierarchically organized, dynamic, neural processes (Cunningham et al. 2013). Central to this framework, information is processed through iterative cycles as individuals interact with their environment, and each iteration provides richer evaluations and more nuanced interpretation of

information being acquired. Critically, the goal of the mind is to settle into a stable, predictive, internal representation of the environment, similar to a system going from a high to low entropy state. We propose that when percepts with conflicting action tendencies arise in this iterative cycle, the entropy or degree of randomness increases (Clark 2013; Friston 2010), triggering what people label as emotion. This coincides with Morsella et al.'s proposal that conflicting representations can re-iterate through the conscious field to guide coherent action.

Importantly, the brain attempts to reduce overall entropy in its information processing in order to maintain stability. One way to maintain stability is by selecting and executing actions that resolve ongoing conflict, or emotion, which relaxes the system into a stable, lower entropy configuration. This process of conflict resolution occurs dynamically and continuously as new percepts perturb the system (Spivey 2008). This perspective links with Morsella et al.'s PFT; emotional consciousness results from the dynamics of conflicting options for action. In this sense, the only difference between consciousness and emotional consciousness is the conceptualization of the current conscious state as being emotional. We believe that PFT has implications for our understanding of emotional consciousness, whereby what we often label emotional experience emerges, at least in part, from conflicting representations that often direct voluntary action.

This perspective incorporates the role of cognitive interpretations emphasized in constructivist and appraisal models, in that conscious emotional experience is an interpretation of unconscious mental states. This view can also incorporate the role of valence and arousal used in constructive models of emotion. Rather than assuming that these are basic dimensions of core affect that get interpreted, we instead propose that components of the conflict resolution process can emerge into consciousness and be interpreted as valence and arousal. In addition, this view highlights the importance of action tendencies for emotional experience; emotions arise into consciousness in response to conflicting action tendencies, and, as conscious contents, can further guide voluntary action.

This formalization integrates with our IR framework, which emphasizes the dynamic unfolding of affective-cognitive processes. Within this framework, information is able to flow both forward and backward within hierarchical systems, where previous iterations serve as inputs to the overall process or conscious field. We propose that the origins of emotional experience lie directly within consciousness as outlined by Morsella and colleagues. We believe that PFT and the IR framework offer emotion theory a point of origin from which we might form an integrative theory of emotional experience.

Conscious olfaction: Content, function, and localization

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Abstract: The target article's emphasis on olfaction is a welcome reminder of the multimodal nature of conscious experience. Here, I explore the distinctive and even unique attributes of our sense of smell from the point of view of their bearing on and fit with a subcortical locus of sensory experience.

In outlining a conceptual framework bearing on the organization and function of consciousness, Morsella et al. highlight the olfactory system as a test-bed and challenge for consciousness theory.

A trenchant comparison between olfaction and other senses has been provided by Köster (2002). For present purposes, olfaction stands out among our exteroceptive modalities in four principal respects: