4, we suggest that one of the factors that decides whether limited processes resources are given over to empathy is whether the other person's emotions matter to us or not. (Also relevant will be the other demands on our attention [p. 85–89].) Consider in this light the findings that mirroring activity is context-sensitive. Azevedo et al. (2013) found, for example, that bilateral anterior insula activity and autonomic reactivity were greater when seeing a hand being painfully injected belonging to a person of one's own race as contrasted with a hand belonging to a member of an out-group. Whether or not we feel what the other is feeling seems to depend on the care one has for the other, a finding that is naturally explained using the ideas we just sketched from Pessoa's book.

A second point we want to briefly note is how Pessoa's network perspective requires us to rethink standard ways of understanding the human social brain. Uta and Chris Frith have suggested that the social brain in humans "has a 'theory of mind,' which enables us to predict what others are going to do on the basis of their beliefs and desires. It also has a 'mirror system' which enables us to understand others' goal and intentions and to empathise with their emotions by a mechanism of motor resonance" (Frith & Frith 2010, p. 165). Both systems are, however, conceptualized as made up of brain regions that compute specific functions. Pessoa suggests by contrast that the processes a brain region carries out will depend on the "network affiliation" it has at a particular time. Networks continuously dissolve and reform in ways that depend on the contexts in which they are functioning. If all of this is right, it is mistake to say that some set of brain regions are for mentalising or mirroring. There are networks that the brain uses in the context of social interactions, and the processing that takes place in these networks is deeply informed by what is of affective significance for the person (Schilbach et al. 2012). Sharing emotion with the other is important because it imbues our perception of the other person with affective significance.

Behavioral evidence for a continuous approach to the perception of emotionally valenced stimuli

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Abstract: Pessoa's (2013) dual competition model outlines a framework for how cognition and emotion interact at the perceptual levels and provides evidence within the field of neuroscience to support this new perspective. Here, I discuss how behavioral work fares with this new model and how visual detection is influenced by information with affective or motivational content.

Theories separating emotion from cognition are decades, maybe even centuries, old. Classic views of emotion have long proposed that each discrete emotion has dedicated neural circuitry that is activated automatically, without conscious awareness (e.g., Ekman & Cordaro 2011; Izard 2007; Panksepp 2007). More continuous, multicomponent models of emotion that allow for interactions between cognitive and affective systems have received recent attention in the literature (e.g., Coan 2010; Cunningham & Zelazo 2009; Lewis & Douglas 1998). In his Précis of *The Cognitive-Emotional Brain*, Pessoa presents a new approach to how cognition and emotion are integrated in the brain that is similar to these newer multicomponent models. His dual competition model outlines a framework for such interactions at the perceptual levels; here, I will discuss the specific aspects of his proposal that address how perception is directly influenced by information with affective or motivational content and how behavioral data might speak to his new model.

According to what Pessoa calls the "standard hypothesis," the processing of emotionally valenced stimuli occurs rapidly, automatically, and nonconsciously, independent of attention and awareness. In terms of the brain, the processing of these stimuli takes the "low-road," or a subcortical route. He presents an alternative to the standard hypothesis – the multiple waves model – suggesting that emotional stimuli engage *multiple* regions of the brain, activating both cortical and noncortical channels. Thus, the processing of emotionally valenced stimuli cannot necessarily be accounted for by one specific mechanism, and there are multiple pathways for the perception of these stimuli.

Pessoa thoroughly evaluates neuroscience research that supports both the standard hypothesis and his new model, but given that the focus of *The Cognitive-Emotional Brain* (Pessoa 2013) is indeed on the *brain*, there is very little discussion of how behavioral work can also speak to these perspectives. There is in fact a large body of work on visual attention to emotional stimuli that researchers use to debate the standard hypothesis versus alternative accounts. Countless studies have reported that both adults and more recently, preschool children, detect negative or threat-relevant stimuli, such as snakes and spiders, more quickly than a variety of neutral stimuli, such as flowers, mushrooms, frogs, and cockroaches (Flykt 2005; 2006; Hayakawa et al. 2011; Lipp 2006; Lipp & Derakshan 2005; Lipp et al. 2004; Lipp & Waters 2007; LoBue 2010; LoBue & DeLoache 2008; 2011; Masataka & Shibasaki 2012; Öhman et al. 2001a; Purkis & Lipp 2007; Soares et al. 2012; Tipples et al. 2002b. They also detect threatening or angry faces more quickly than happy, neutral, or even sad faces (Calvo et al. 2006; Eastwood et al. 2001; Esteves 1999; Fox et al. 2000; Hansen & Hansen 1988; LoBue 2009; Lundqvist & Öhman 2005; Öhman et al. 2001b; Schubo et al. 2006; Tipples et al. 2002a; Williams et al. 2005). Similar findings have been reported with human infants (LoBue & DeLoache 2010; Rakison & Derringer 2008) and nonhuman primates (Shibasaki & Kawai 2009), providing compelling evidence that humans have a perceptual bias for the rapid detection of emotional (and specifically negative or threat-relevant) stimuli.

Consistent with the standard hypothesis, many researchers have explained perceptual biases for threat via automatic, pre-attentive, or nonconscious processes, as opposed to controlled, conscious, or cognitively mediated processes. Evidence for the automaticity account comes from data suggesting that the detection of threat-relevant targets (snakes, spiders, angry faces) does not vary based on the number of distracters present in an array. In other words, whereas the detection of nonthreatening stimuli slows when the number of distracters increases from four to nine, detection of threat-relevant stimuli remains equally efficient regardless of the number of distracters present in a matrix (e.g., Eastwood & Smilek 2005; Fox et al. 2000; Öhman et al. 2001a). This suggests that individuals use parallel, or automatic search mechanisms to detect threatening stimuli, and that they use serial, or conscious search strategies to detect nonthreatening stimuli.

However, despite several studies demonstrating evidence for automatic detection of threat, others present evidence against automatic search, either by failing to demonstrate set size effects for threat-relevant stimuli or by reporting detection latencies that are too slow to represent automatic search (for a review, see Becker et al. 2011a; Horstmann & Bauland 2006). Other studies demonstrate that the advantage for threat-relevant stimuli may have nothing to do with emotional valence at all and is, instead, driven by low-level features of the targets. Indeed, specific geometric shapes, such as the "V" shaped brow characteristic of angry faces or simple curvilinear figures common to snakes are sufficient in eliciting rapid detection (Larson et al. 2007; LoBue & DeLoache 2011; LoBue & Larson 2010. Further, presenting participants with specific features of angry faces in non-face-like configurations maintains the advantage (Coelho et al. 2011; Horstmann et al. 2006), and removing or manipulating these important features eliminates it (Becker et al. 2011b).

While the controversy rages on about whether automatic versus controlled search mechanisms drive the rapid perception of emotional stimuli, most researchers acknowledge that *both* automatic and controlled processes likely play a role in threat detection (e.g, Frischen et al. 2008; Wolfe 1998). Further, research on visual attention to emotional stimuli is usually designed to test the standard hypothesis and does not allow for the study of multiple interacting pathways for rapid detection. This leaves us with the same old dichotomy that Pessoa's theory is aimed at revising – subcortical versus cortical routes, parallel versus serial search, nonconscious versus conscious processing – instead of leaving room for a continuous, more integrated explanation.

Very recent behavioral work that explicitly examines multiple pathways for the rapid detection of emotional stimuli indeed suggests that there is no single factor that effectively drives the phenomenon. In one recent study, for example, researchers attempted to examine the unique and potentially interacting roles of low-level perceptual cues, cognitive factors, and emotional state on rapid visual detection of threat. Across studies, adult participants were asked to detect low-level perceptual features of a commonly studied threat-relevant stimulus – snakes. They were asked to detect simple curvilinear (snake-like) versus equally simple rectilinear shapes in a visual search task in the absence of any threat-relevant cues. In Experiment 2, the same procedure was used, except that threat-relevant or non-threat-relevant *labels* – calling the simple shapes "snakes" or "caterpillars" – were applied to the curvilinear and rectilinear stimuli in order to examine the added role of cognition (or knowing the identity of a stimulus) in detection. Finally, in Experiment 3, a fearful or neutral emotional induction was administered to participants before they completed the visual detection task with curvilinear and rectilinear targets to examine the role that emotional state might play in rapid detection.

The results were compelling, implicating all three factors. Across all three studies, adults detected simple curvilinear shapes more quickly than simple rectilinear shapes in the absence of any threat-relevant cues, suggesting a perceptual bias for curvilinarity. Further, threat-relevant labels and a fearful emotional induction facilitated detection even further, potentially playing an additive role in rapid detection (LoBue 2014). This study – specifically designed to examine a more continuous hypothesis about the roles of perception, cognition, and emotion on rapid detection – suggests that multiple factors can lead to a bias for emotionally valenced stimuli.

Another recent study using eye-tracking technology further supports this perspective, demonstrating that the advantage for threat-relevant stimuli in visual search tasks cannot be accounted for by either bottom-up or top-down processing biases alone. In the study, researchers replicated a classic threat-detection paradigm with an eye-tracker. Adults were presented with 2 × 2 and 3 × 3 matrices of images and were told to press one button if all of the images were from a single category, and a second button if there was a discrepant image (target) in each matrix. The targets were threat-relevant (snakes and spiders) or non-threat-relevant (flowers and mushrooms) – the same photographs and procedure used in a classic, widely cited study by Öhman et al. (2001a). The results replicated previous work, demonstrating that adults detected discrepant snakes and spiders more quickly than discrepant flowers and mushrooms. Most importantly, the fixation data further suggested that a single mechanism was not solely responsible for the results.

There was indeed an advantage for snakes and spiders in perception; participants were faster to first fixate threat-relevant versus non-threat-relevant targets, suggesting (consistent with previous literature) that bottom-up processes lead to an advantage for the threat-relevant stimuli. However, there was also an advantage for snakes and spiders in behavioral responding – participants were faster to decide that discrepant threat-relevant stimuli were present after first fixating them, demonstrating that there is also a top-down advantage for threatening stimuli in detection tasks. Together, this work suggests that a bias for threat-relevant stimuli is driven by an advantage in both bottom-up and top-down processing (LoBue et al. 2014).

Together, this behavioral work adds to the body of literature reviewed by Pessoa, suggesting that the processing of emotional stimuli cannot necessarily be accounted for by one specific mechanism and that there are *multiple pathways* for the perception of emotionally valenced stimuli. As he puts it, "the fate of a biologically relevant stimulus should not be understood in terms of a 'low road' versus a 'high road,' but in terms of the 'multiple roads' that lead to the expression of observed behaviors" (Pessoa 2013, p. 79). Although some of the newer behavioral work reviewed here supports a more continuous model of emotional perception, most behavioral work to date has sought to support or refute the standard hypothesis and does not necessarily allow for multiple interacting factors in their experimental designs. Ultimately, the consideration of newer, more continuous models of emotional perception might take us further in understanding the development of emotional behavior than traditional views that promote a fundamental separation between affect and cognition.

United we stand, divided we fall: Cognition, emotion, and the *moral link* between them

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Abstract: Contrary to Greene's dual-process theory of moral judgment (Greene 2013), this commentary suggests that the network view of the brain proposed by Pessoa, in which emotion and cognition may be used as labels in the context of certain behaviors, but will not map clearly into compartmentalized pieces of the brain, could represent a better explanation of the *rationale* behind people's moral behavior.

After *revealing* the *error* of Descartes (Damasio 1994), neurosciences seem to have taken two different paths in the study of brain organization during the past two decades. On the one hand, some researchers have tried to emphasize the deep interactions between cognition and emotion by postulating an integration of the brain's networks, none of which should be intended as specifically emotional or cognitive (Feldman Barret et al. 2007; Ochsner & Gross 2005; Pessoa 2008). But, on the other hand, there has been an escalation of *manichean* points of view, according to which there are *separate systems* for emotion and cognition that seem to subtend different *modules* in the brain (Keren & Schul 2009). Specifically, in the domain of moral decision making, the *dualism* between emotion and cognition has led to a *dual-process brain* framework that has received considerable attention due to the neuroimaging works of Joshua Greene (Greene et al. 2001; 2004; for a review, see Greene 2013). The main point of Greene's theory is that, when we make moral decisions (deciding whether an act would be right or wrong), we can be automatic, fast, and *emotional*, or controlled, slow, and *rational*. In an attempt to establish a bridge between neuroimaging data and moral philosophy, Greene proposes that deontological judgments arise from areas of the brain more associated with *emotional reactions*, whereas utilitarian judgments arise from areas of the brain more associated with *cognitive control*. In this sense, deontology is an emotionally (strong) based theory that may, in some cases,