Chapter 3
From the Self to the Social Regulation of Emotion: An Evolving Psychological and Neural Model

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Imagine that you have just moved across the country to take a job as a professor at a new and exciting university. Beyond all the usual pragmatic hassles, like organizing the move, finding a place to live, and so on, perhaps the biggest challenges you will face are social and emotional. How you adaptively respond to these challenges will go a long way toward determining the ease of your transition, success in this new job, and your overall well-being. For example, you must meet and get to know all your new colleagues and their relationships to one another, including their relative differences in disposition, status, and friendship. At your new place of residence, you will meet new neighbors and come to understand their connections to one another. At your children's school, you will meet many new parents and children and will come to know the complex web of relationships that ties them all together. And while doing all of this, you must—of course—be working to keep your research program going, mentoring your students, preparing to teach new classes, and establishing your new lab.

Successfully navigating all of these social and emotional challenges requires a combination of three essential abilities. The first is the ability to appraise the personal meaning of all your new encounters and relationships and consequently experience and express the full range of appropriate emotional reactions to them. Emotions can be thought of as readouts of the relevance of people, situations, and stimuli to your goals, wants, and needs. As such, they will provide an essential guide to every aspect of your new life. The second is the ability to perceive and understand other people's behaviors, thoughts, intentions, and emotions, which is commonly referred to with the umbrella term "person perception." This ability will be invaluable to learning about every new individual that you meet—from sizing up their current emotions and thoughts to inferring their enduring dispositions and tendencies to establishing relationships with them. The third is the ability to exert top-down,

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cognitive control over both of the above, regulating your emotional responses as need be, as well as regulating the impressions you form of other people so as to ensure that they are accurate. Importantly, you can exert control not just to shape your own emotions and impressions, but those of other people as well, helping your new colleagues and friends to cope with their own social and emotional challenges.

Just as a television can produce a seemingly infinite variety of colors and images from pixels colored red, blue, and green—the variety and complexity of human social and emotional life may arise from interactions between these three essential abilities. Indeed, as illustrated in Fig. 3.1, many topics central to the study of emotion and social behavior lie at the intersection points between these three, "primary colors," including empathy, social cognition, and the self- and social regulation of emotion.

How should we organize our understanding of the psychological processes and brain mechanisms underlying these complex and intersecting abilities? A full answer to this question is beyond the scope of any single chapter—and in fact is the goal of entire disciplines like social and affective neuroscience.

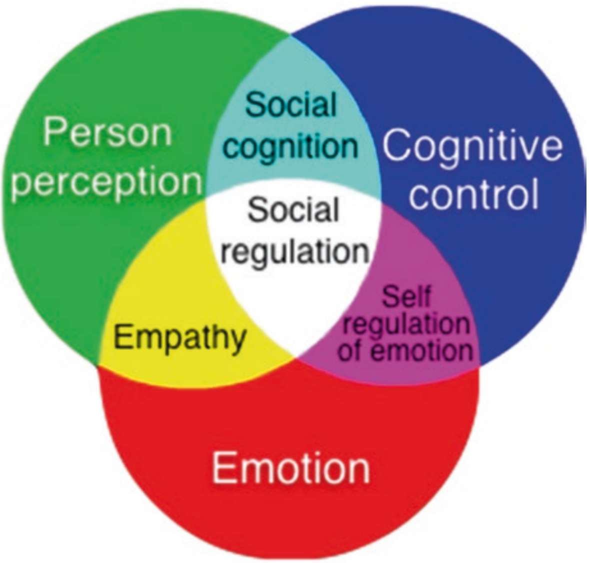

Fig. 3.1 Levels of analysis when studying social and emotional phenomena. At the behavioral level, we conceptualize person perception, cognitive control, and emotion as three "primary colors" of social and emotional life. Just as colored pixels on a screen combine in variegated ways to make a wide array of images, three core abilities can combine in varying ways to give rise to a wide array of social and emotional behaviors. The intersections of each of these domains define individual areas of research, including self-regulation and social regulation, which are the focus of this chapter. At the process level, these behavioral domains map onto varying combinations of underlying psychological processes. For illustrative purposes, these processes are grouped by the three core behavioral domains. At the neural level, each of these processes is supported by the concerted actions of cortical and subcortical brain regions

That said, the more modest goal of this chapter is to describe the development and evolution of a multilevel model of emotion and our capacity to regulate those emotions that is flexible and generalizable to a variety of contexts—ranging from the study of self-regulation to the study of the social regulation of emotion and beyond. Toward this end, the remainder of this chapter is divided into three parts. The first provides an overview of a model of the self-regulation of emotion that has been elaborated in more detail elsewhere (Braunstein, Gross, & Ochsner, 2017; Dore, Silvers, & Ochsner, 2016; Ochsner, Silvers, & Buhle, 2012). This model provides the foundation for the second section, which expands the model to the study of social forms of emotion regulation where one individual attempts to shape and change the emotions of another (Reeck, Ames, & Ochsner, 2016). The third and final section asks what lies ahead for the model and for the study of emotion regulation more generally, considering issues ranging from the continued evolution of the model and its usefulness for other areas of research (Ochsner, 2013, 2014).

The Starting Point: A Multilevel Model of the Self-Regulation of Emotion

For the past 15+ years, behavioral research on the self-regulation of emotion has been guided by James Gross's process model (Gross, 1998, 2015). According to this model, different types of emotion regulation strategies can be understood in terms of the stage of the emotion generation sequence that they impact (see white boxes, Fig. 3.2). Emotion generation proceeds when an emotion eliciting stimulus is perceived in the context of a particular situation, one attends to that stimulus or some aspects of it, they are appraised in terms of their meaning with respect to one's goals, wants, and needs, and depending on the nature of that appraisal, the various components of an emotional response are produced. Situation-focused regulatory strategies impact one's exposure and proximity to stimuli, such as when one moves away from an annoying stimulus or toward one that is desirable. Attention-focused strategies change the way one deploys selective attention to take in information that promotes desired emotional responses and ignore information that promotes undesired responses, such as when you divert your gaze during the scary part of a movie. Cognitive change-focused strategies alter the way one appraises the meaning of a stimulus, such as when you reappraise the rejection letter from a journal as an opportunity to improve the manuscript. Finally, response-focused strategies change the way one overtly expresses a motion on the face, body, and so on, such as when one abides by the British maxim to "keep a stiff upper lip" and limit the display of one's emotions.

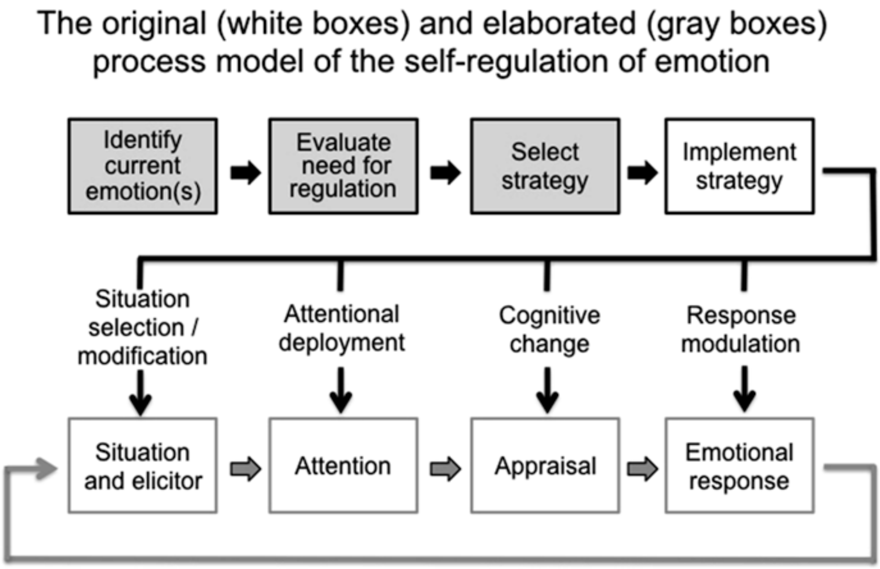

Fig. 3.2 White boxes: Elements of the original process model of emotion regulation (Gross, 1998), which described a system for classifying emotion regulation strategies in terms of the stage of an emotion generation sequence that they impact. This model spoke only to the strategies one could implement in a given situation. Gray boxes: Elements of an elaborated process model (Dore et al., 2016; Reeck et al., 2016; cf. Gross, 2015) specifying steps that logically precede the moment when one implements a strategy. One may identify the current emotional state, decide whether to regulate, and select a strategy

Proposing a Multilevel Model

Although the process model has been a powerful tool for organizing our understanding of the relationships between different types of regulatory strategies, it is silent about the neural mechanisms underlying them. To gain leverage on the nature of these mechanisms, the past decade has seen an enormous growth of functional magnetic resonance imaging (fMRI) research seeking to use patterns of brain activity to draw inferences about the psychological and neural mechanisms underlying specific strategies (Ochsner et al., 2012).

We were one of the first groups to take this approach (Ochsner, Bunge, Gross, & Gabrieli, 2002). When we began this research, late in the year 2000, virtually nothing was known about the neural systems supporting any of the emotion regulation strategies posited by the process model. We decided to start by focusing on a paradigm example of cognitive change—reappraisal—as well as attention-based strategies like distraction or selective attention. Drawing on prior work on "cold" forms of cognitive control, we proposed that strategies like reappraisal and attentional control might rely upon domain-general cognitive control systems localized in lateral prefrontal and inferior parietal cortices as well as posterior medial prefrontal cortex (mPFC) and dorsal anterior cingulate cortex (dACC) (Botvinick, Braver, Barch, Carter, & Cohen, 2001; D'Esposito, Postle, Ballard, & Lease, 1999; Miller & Cohen, 2001). Effective regulation might depend on these systems effectively modulating activity in systems that generate emotional appraisals and the various components of an ensuing response. Our initial studies supported this prediction. And ever since, the lion's share of fMRI research on emotion regulation has continued to focus on reappraisal and attentional strategies. Four different meta-analyses showed that, to date, over 60 fMRI studies (Buhle et al., 2014; Kohn et al., 2014; Morawetz, Bode, Derntl, & Heekeren, 2017; O'Driscoll, Laing, & Mason, 2014) have supported our initial proposal that prefrontal regions implement processes like working memory to keep in mind regulatory goals and strategies, as well as selection processes necessary to either pick the right way to implement a given strategy and/or limit the pull of one's initial affective response. As lateral prefrontal regions implement these control processes, posterior medial frontal regions, including the dACC, are thought to monitor the extent to which reappraisal is desirable and successful, signaling the extent to which ongoing regulation is necessary. Together, these lateral and medial control systems are thought the change the way one attends to and interprets the meaning of affective stimuli whose value is computed by largely subcortical regions, such as the amygdala—which signals the presence of goal-relevant stimuli and can trigger initial affective responses to them—and the striatum, whose ventral portions are involved in computing expectancies about the reward value of stimuli (Helion, Krueger, & Ochsner, 2019; Ochsner et al., 2012). Figure 3.3 schematically illustrates these regions.

Notably, the model posits that prefrontal control and largely subcortical affect systems can interact in multiple ways, depending on the strategy in question and one's goals when using it (Helion et al., 2019; Ochsner et al., 2012). Reappraisal,

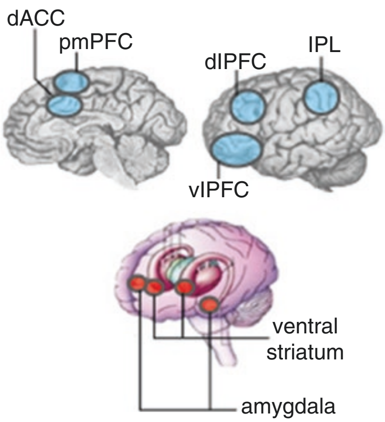

Fig. 3.3 Schematic representation of brain regions supporting reappraisal as suggested by meta-analyses. Control-related regions shown in blue, affect generation-related regions shown in pink. *dACC* dorsal anterior cingulate cortex, *pmPFC* posterior medial prefrontal cortex, *dlPFC* dorsal lateral prefrontal cortex, *vlPFC* ventral lateral prefrontal cortex, *IPC* inferior parietal cortex

for example, can be used to downregulate negative emotion by reinterpreting upsetting events in ways that lessen their emotional punch. But it also can be used to expand and embellish negative appraisals that make you feel much worse than you had initially (Ochsner, Ray, et al., 2004). This stands in contrast to other models of self-regulation that posit reciprocal and/or inhibitory relationships between cognitive control and emotion systems (Drevets & Raichle, 1998; Heatherton & Wagner, 2011; Lieberman et al., 2007; Metcalfe & Mischel, 1999). Such theories view cognition and emotion as generally antagonistic. As one comes to the fore, the other recedes. While this is surely the case some of the time—as when one uses reappraisal to downregulate emotion—we and others have documented numerous instances where cognitive control systems can be used to amplify or even wholly generate emotional responses, as when one imagines a seemingly innocuous stimulus, like the creak of a floorboard in a quiet house, might be an indication that something sinister is afoot. And as discussed elsewhere (Ochsner, 2013, 2014), control can be used in support of various other affective abilities as well. The key point is that cognitive control systems allow us to flexibly interpret and reinterpret all kinds of external sensory inputs and internal sensations, and depending on how we attend to and appraise these stimuli, different types of emotions will be produced to differing degrees (Ochsner, 2013, 2014).

Elaborating the Initial Model

While the work summarized above has helped flesh out a multilevel model of the self-regulation of emotion that connects behavior, psychological processes, and underlying brain systems, in the past few years, it has become increasingly clear that it may be the tip of the proverbial regulatory iceberg (Dore et al., 2016; Gross, 2015; Ochsner & Gross, 2014; Reeck et al., 2016).

Implementation The core idea is that the process model as initially formulated speaks only to the way in which individuals *implement* regulatory strategies and is silent about how one got to the point at which one is trying to regulate. What's more, extant laboratory techniques are not designed to test anything other than implementation. Indeed, the vast majority of them present a narrow range of aversive stimuli for which regulation might obviously be desirable, instruct/train participants how to regulate, and tell them when to regulate. In everyday life, however, all of these factors are underdetermined and may play key roles in determining whether regulation is successful. With these kinds of considerations in mind, the gray boxes in Fig. 3.2 outline three steps that we think may precede the act of implementing a given regulatory strategy (Dore et al., 2016; Reeck et al., 2016) and are described below.

Selection Prior to implementation, we believe that one must *select* a strategy from some set of alternatives that could be considered. How many strategies you consider will depend on your knowledge of the kinds of strategies that could be used, in general, and the extent to which situational cues, your regulatory goals, or other factors bring them to mind. For instance, if you are in a heated argument with a friend and want to regulate your response, should you move away (changing the nature of the emotion-eliciting situation), try to change the topic of conversation to something less conflictual (using distraction, a form of attentional control), try to reinterpret the nature of the conflict or your friend's actions in a way that makes you and them feel less upset (an instance of cognitive reappraisal), or should you simply try to mask your facial and bodily expressions of anger so that your friend can't tell how upset you are (an instance of response modulation)?

In recognition of the potential importance of selection to the regulatory process, to date, this stage has seen the most behavioral research of all the expanded stages discussed here. In upward of half a dozen studies, Sheppes and colleagues have probed the *selection* stage by asking under what circumstances people decide to reappraise as compared to distract themselves in the face of unpleasant stimuli. Across younger and older participants and across typically developing and current or formerly clinical populations (e.g., remitted bipolar or a current borderline diagnosis), they have found that distraction is more often chosen for the most intensely aversive experiences whereas reappraisal is chosen for less intense aversive experiences (Hay, Sheppes, Gross, & Gruber, 2015; Sauer et al., 2016; Scheibe, Sheppes, & Staudinger, 2015; Sheppes et al., 2014; Sheppes & Levin, 2013; Sheppes, Scheibe, Suri, & Gross, 2011; Suri, Sheppes, & Gross, 2013).

Evaluation Prior to strategy selection, it is necessary to *evaluate* whether or not regulation is needed at all. In some circumstances, it may be wholly appropriate to experience even intensely negative emotions, such as when one is appropriately angry with an insult, experiences grief at a funeral, is afraid of a high-risk investment opportunity, or is faced with a situation or emotion that is too ambiguous or too intense to be regulated. In such circumstances, it might be wise to wait until your emotions calm down or the situation becomes clearer before thinking again about whether regulation is called for. What's more, attempting to downregulate your emotions may sometimes prove counterproductive. Recent research suggests, for example, that individuals high in self-control may take unwarranted risks in situations where they should heed their fears of failure or loss (Konnikova, 2013). Similarly, reappraisal may be most beneficial in situations that cannot be controlled, where other types of strategies might not be possible and rethinking the meaning of what is happening may be the best option. Iris Mauss and colleagues have found this to be true in lab situations that are less controllable as well as in everyday life situations faced by low SES individuals who may have less control over life stressors than do high SES individuals (Mauss et al., 2011; Troy, Ford, McRae, Zarolia, & Mauss, 2017; Troy, Shallcross, & Mauss, 2013).

Identification Finally, in order to decide whether or not your current emotional state needs to be regulated, there has to be some internal representation of that current state. Note that this representation may in many circumstances be conscious—as when you introspectively assess how you are feeling and realize you are anxious and afraid prior to giving a very important talk—but in others the representation of your current state can be non-conscious, as when regulatory systems take as inputs the outputs of emotional response systems and implement regulatory actions outside your awareness. In such cases, regulation is guided by non-conscious goals and processes that may engage the lateral and dorsal medial prefrontal systems mentioned above (Lau & Passingham, 2007), but they may also depend on ventral medial prefrontal regions important for learning the affective values of stimuli and how those values change within different spatiotemporal contexts (see Braunstein et al., 2017 for more discussion).

Neuroscience Research on the Expanded Model

While behavioral studies have increasingly begun recognizing the potential importance of these additional regulatory steps, neuroscience research has yet to significantly take up their investigation. Below we offer what currently is known about the brain systems supporting each stage, including detailing our lab's initial forays into studying the evaluation and identification stages.

Selection Above we discussed the work by Sheppes and colleagues showing that distraction versus reappraisal is preferentially chosen more for high versus low intensity aversive experiences (Sheppes et al., 2011; Sheppes et al., 2014; Sheppes & Levin, 2013; Suri et al., 2013). While there are many possible reasons for this, one explanation may be that highly arousing and aversive experiences can trigger a series of both fast and slow stress-related responses. Fast responses include changes in the neurotransmitter profiles of prefrontal cortex, and slow responses include cortisol release that modulates energy metabolism and amygdala encoding (Arnsten, 2015; Peters, McEwen, & Friston, 2017; Sapolsky, 2015). Extant animal work with rodent models dovetails with recent functional imaging and stress studies in humans to suggest that, together, these responses may diminish prefrontal capacity in the face of acute stressors while at the same time enhancing amygdala responsivity (Maier, 2015; van Ast et al., 2016). Behaviorally, these neural effects can lead to riskier choices (Uy & Galvan, 2017), reduced model-based learning (Otto, Raio, Chiang, Phelps, & Daw, 2013), and reduced ability to reappraise stimuli eliciting conditioned fear responses (Raio, Orederu, Palazzolo, Shurick, & Phelps, 2013; Raio & Phelps, 2015). Over time, exposure to chronic stressors can rework cortical-subcortical pathways to make these changes long-lasting, resulting, for example, in greater amygdala responses in individuals exposed to chronic long-term stressors (Muscatell et al., 2015). Similar effects can be seen in individuals who faced a single severe stressor only 1 month prior (Reynaud et al., 2015).

To the extent that reappraisal depends critically on the integrity of prefrontal systems and their ability to communicate with the amygdala, choosing to reappraise in the face of a highly aversive situation may not always be optimal, especially when given the choice to distract oneself instead. It is worth noting, however, that individual differences in stress reactivity and cognitive control capacity will loom large for these and all other stages of the expanded regulation model. For example, although stress can diminish prefrontally dependent working memory performance (Oei, Everaerd, Elzinga, van Well, & Bermond, 2006), individuals with greater working memory capacity (as measured by operation span) may be better able to resist the effects of stress on cognitive performance (Otto et al., 2013). Future work should ask whether individuals with greater cognitive control capacity may be more likely to choose strategies like reappraisal that depend on the kinds of prefrontal resources disrupted by stress.

Evaluation In our laboratory, we recently studied the *evaluation* stage using fMRI. We wanted to know what brain- and behavior-based variables would predict one's choice to reappraise as compared to just allowing the more natural response when faced with unpleasant events. To study this, we devised a two-part procedure (see Fig. 3.4). First, we presented participants with a set of neutral and moderate to high arousal aversive images, asking them to rate how they felt in response to each one. Whole-brain fMRI data were collected during this exposure phase. Then, in a second, choice phase that took place outside the scanner, participants were once again presented with all of these images and asked if they wanted to simply look at the image (and respond naturally) or regulate their response to the image using reappraisal. Based on these choices, we could bin the imaging data from initial presentation to differentiate activity for images to which participants chose to respond naturally versus reappraise. This allowed us to first identify activity in specific regions that predicted whether or not a given individual would subsequently regulate the response. To address this question, we focused on regions of interest (ROIs) in prefrontal cortex and amygdala that are involved in reappraisal, as identified in our 2014 meta-analysis (Buhle et al., 2014). We found that, when one first encountered an aversive image, activity in all of these regions predicted greater likelihood of an individual reappraising that image—and this finding generalized to predicting choices for similar novel aversive images as well. The fact that individuals showing prefrontal and amygdala activation were more likely to subsequently choose to reappraise raises the possibility that the amygdala response to an aversive image triggers prefrontal engagement, which in turn predicts a choice to regulate down the road. We tested this mediational relationship and found it to be significant (schematically illustrated in Fig. 3.5). We also compared relative strength with which brain-based (prefrontal and amygdala activity) and behavior-based (self-reported affect) variables could predict subsequent regulation choices. Notably, prefrontal activity was the single strongest predictor, and models that took into account both brain and behavior variables achieved high levels of accuracy for predicting which individuals are most likely to regulate when faced with aversive events.

We then turned to the question of whether or not we can predict the aversive images for which regulation was most likely to be chosen. Here, we again focused analyses on ROIs from our 2014 meta-analysis (Buhle et al., 2014), but this time performed a pattern expression analysis. This analysis asks to what extent, during the presentation of a given image, the whole brain pattern of activity is similar to the

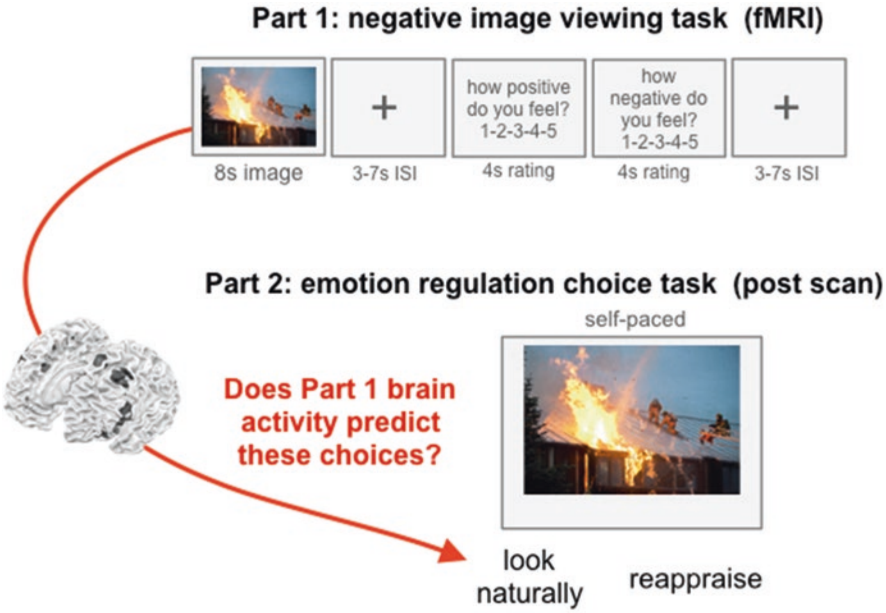

Fig. 3.4 Design of fMRI study exploring brain systems involved in evaluating the need to regulate aversive emotion (Dore, Morris, Burr, Picard, & Ochsner, 2017; Dore, Weber, & Ochsner, 2017)

whole brain reappraisal pattern from our meta-analysis. We found that the greater the expression of this reappraisal pattern in response to a given image, the more likely an individual was to later choose to reappraise their response to it. We then asked which variables—brain- or behavior-based—were the best predictors of choices to reappraise. We found that reappraisal pattern expression and average levels of activity in prefrontal and amygdala ROIs were the single best predictors and that models that took into account both brain and behavior variables again were the best predictors of choices to reappraise a given image. Together, these data suggest that when one first encounters an image, affect systems, like the amygdala, signal the presence of a goal-relevant stimuli (in this case, potential threats). That response recruits prefrontal activity to help interpret the meaning of the image. If one judges the stimulus to require regulation (in this case, to be sufficiently aversive), then one will be more likely to decide to reappraise.

Identification We have also begun investigating the identification stage to ask how it works and what are the consequences of introspectively identifying your emotions in different ways. We and others have previously shown that dorsal medial prefrontal cortex (dmPFC) is critically involved in attention to and awareness of one's internal emotional state (Lane, Fink, Chau, & Dolan, 1997; Ochsner, Knierim, et al., 2004; Phan et al., 2003; Taylor, Phan, Decker, & Liberzon, 2003), whereas regions of lateral PFC were important for selecting among competing alternative labels for those states (Lieberman et al., 2007; Satpute, Badre, & Ochsner, 2014; Satpute, Shu,

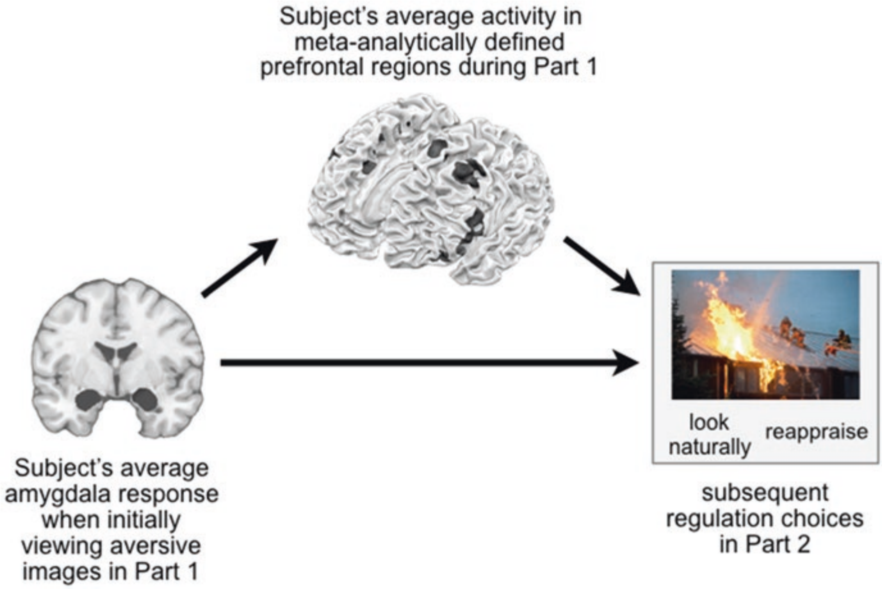

Fig. 3.5 A key result from Dore et al. (2017) and Dore, Weber, and Ochsner (2017)—using imaging data collected during initial Part 1 exposure to images (see Fig. 3.4), we could predict which individual participants would later (Part 2) choose to regulate emotion. Specifically, participants showing greater amygdala activation were more likely to engage prefrontal systems (presumably to help appraise the meaning of the images) and then later on choose to reappraise. Note that given that *stronger* rather than *weaker* amygdala responses predict subsequent regulation choices, it is unlikely that participants are already reappraising during initial Part 1 uninstructed exposure. Instead, PFC activity likely reflects cognitive processes related to evaluating image meaning (i.e., appraisal) whose engagement predicts the choice to regulate later on

Weber, Roy, & Ochsner, 2013). We have described the dorsomedial region as being important for a high or abstract level of representation for knowledge about mental states including emotional ones (Ochsner & Gross, 2014). The everyday language of emotion—I am happy, I am angry, I am sad, etc.—invokes a set of conceptual categories that can generalize across people and situations. We can use these terms to describe our own emotions, those of our friends, family, and so on, across a variety of circumstances. In this sense, being able to "recognize" our emotions has a lot in common with the recognition of objects in the world. To identify that an object sitting at the end of a conference table during a meeting is a cell phone rather than something else, we draw on high level, abstract knowledge of the form of objects that is viewpoint- and exemplar-irrelevant (Kosslyn, 1994). That is, it does not matter at what angle you view the phone and which specific phone it happens to be (an iPhone, Samsung smartphone, flip phone, etc.); in all cases, you know it is a phone. Identifying your emotions may work the same way: across viewpoints (i.e., emotion-arousing situations) and exemplars (i.e., the person experiencing the emotion, whether it is you or someone else), you can use high level, abstract knowledge about mental states to identify the emotion in question. We believe that the dmPFC and associated regions (e.g. those that comprise a so-called mentalizing network; see Amodio & Frith, 2006; Zaki & Ochsner, 2012) more generally play key roles in the representation and use of this knowledge in everyday contexts where such information is useful, ranging from instances where you introspect about your own emotions to complex social interactions (Satpute et al., 2013, 2016; Zaki & Ochsner, 2012).

The fact that this knowledge takes the form of linguistically describable emotion categories—that we can think and talk about—turns out to have important and unexpected consequences. Imagine you are talking to a colleague about negative reviews of the manuscript you recently submitted to a top journal. As you recount the elements of the review, your emotions may swing from an initially neutral starting point to the depths of despair and back again. If your friend asks you to be specific about how you felt about a reviewer's request to conduct five new analyses, how would you respond? Might you note that you felt about a five on a seven-point scale, where one is neutral and seven is extremely negative? Or would you simply pick what seems like the most appropriate descriptor—in this case, angry? Everyday communication is heavily trafficked by terms like angry, happy, or sad used to describe our emotions. It is only in the world of the laboratory where we ask people to rate anything and everything on a seven-point scale. As such, when your negative emotion is quite strong, it might be easy to tell your friend you are angry. Conversely, when you are feeling calm, it might be easy to say you feel neutral. However, what about moments when you feel something in between—perhaps moderately but not extremely negative? Do you say you feel neutral or angry? And does it matter which one you pick?

We recently used a novel behavioral method combined with fMRI to ask how people make judgments about such liminal emotional states (Satpute et al., 2016). The method draws on the category boundary effect in perception research. As a hypothetical example, imagine sorting a set of balls of varying sizes into two bins; how do you do it? Very large balls could go into a large bin, whereas very small balls could go into a small bin. But what about the ball sized somewhere in between? It turns out that if you place them in the large bin, you come to perceive them as being larger than you had initially, whereas if you place them in the small bin, you come to perceive them as being smaller than you had initially. These types of effects are observed in various perceptual domains, ranging from vision to speech and audition (Anderson, Silverstein, Ritz, & Jones, 1977; Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Harnad, 1987).

Our task investigated category boundary effects in the perception of emotion using a variant of this procedure. Participants viewed images varying from neutral to moderately negative to highly negative. In the *continuous* condition, they rated their affective response by clicking anywhere that was appropriate along a graded scale ranging from neutral to bad. In the categorical condition, they had to choose which term—neutral or bad—best described their emotional response. Using psychophysical techniques, for each participant, we calculated a curve relating the probability they responded neutral or bad versus the normative degree of negativity in the image based on prior norming samples of participants (or put another way, we plotted stimulus attributes vs. the ability to perceive their presence). This allowed us to determine how normatively negative an image had to be for a given participant's experience to cross a subjective "tipping point" for judging their own response to be negative. The critical question was to what extent being forced to choose a single categorical descriptor shifted this threshold as compared to being able to click anywhere along a continuous scale.

To make this concrete, consider a case analogous to the earlier example of sorting balls into large versus small bins. Imagine you are presented with a moderately negative image and are asked to rate your emotional response along a continuous scale. You might click somewhere near the midpoint of the continuously graded neutral-to-bad scale, indicating a moderately bad reaction. Now imagine that in the categorical condition, you must rate your reaction to this image by selecting either of two words—neural *or* bad—that best describes that response. When presented with these two cases in our experiment, we observed that some participants would pick the word "bad" to describe their reaction to moderately aversive stimuli, suggesting that when using categorical language to describe their emotions, they had a liberal threshold for judging whether a stimulus made them feel bad. Conversely, other participants tended to pick the word "neutral" to describe their reaction to moderately aversive stimuli, suggesting that when using categorical language to describe their emotions, they had a conservative threshold for judging whether a stimulus made them feel bad. Put another way, depending on whether your threshold for judging the negativity of your emotions became more liberal versus more conservative, you would lump those reactions into either the "bad" or "neutral" response category.

These behavioral data suggested that participants were actually experiencing the liminal, moderately aversive, boundary-level stimuli differently when forced to describe their emotional responses using linguistic categorical terms of the sort we use in everyday communication. Brain data backed this up. Participants with more liberal or lower thresholds for reporting negative responses also showed greater amygdala and insula activity, whereas participants with more conservative or higher thresholds for reporting negative responses showed weaker amygdala and insula activity (see left and center panels of Fig. 3.6). Notably, the extent of the shift was predicted by greater connectivity between amygdala and insula, with dorsal medial prefrontal regions thought to support access to linguistic category descriptors of affective states (right panels, Fig. 3.6; note also that although the topography of these regions looks slightly different when statistically thresholded at conventional levels, they do not meaningfully differ when directly compared). Together, these data highlight that simply introspecting about and reporting on certain kinds of emotional states can actually change them, leading them to be neurally represented—and perhaps amplifying or diminishing their experience—in a way consistent with the terms you use to describe those states (cf. Kircanski, Lieberman, & Craske, 2012).

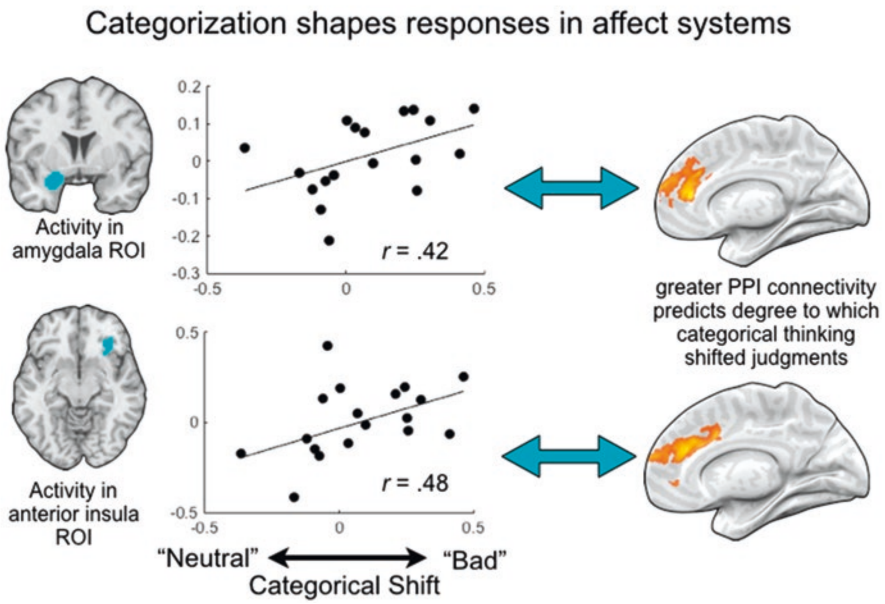

Fig. 3.6 Key results from study of identification stage of elaborated process model (Satpute et al., 2016). Individual participants vary in the extent to which categorical thinking shifts the threshold for reporting feeling neutral or bad when viewing moderately aversive images. The degree of this shift to report that more stimuli make you feel neutral versus bad correlates with lesser versus greater activity in key affective response systems (i.e., amygdala, insula) and was predicted by greater connectivity of these regions with dorsal medial prefrontal regions supporting access to linguistic category descriptors of affective states. See text for details

Evolving the Model of Self-Regulation to Account for the Social Regulation of Emotion

These elaborations to our initial model of the self-regulation of emotion broaden its scope and enable it to account for a much wider range of phenomena than the initial model could. Whereas the initial model was focused entirely on the implementation of strategies, the revised and expanded model describes three stages that come before implementation of a given strategy—identifying your emotion(s), evaluating the need to regulate your emotion(s), and if regulation is desired, selecting an appropriate strategy. As described above, new areas of research are growing up around these newly proposed stages. Over the next few years this work should help elucidate their psychological and neural bases—and perhaps more importantly, begin to elucidate how individual differences in our everyday emotions may arise from differences (between individuals or within an individual across time) in the way each of these stages operates. For example, an individual with anxiety might show low positive and elevated negative affect not just because they are unable to implement a particular kind of emotion regulation strategy, but rather (or also) because they have a lower threshold for perceiving negative emotions, do not always identify situations where they should regulate, and/or have trouble selecting appropriate strategies even when they do deem that regulation is necessary. Likewise, other clinical populations—from substance users to individuals with mood or personality disorders—may also differ from the normative population in these ways. And children or older adults may similarly differ from young adult populations in the ways they identify their emotions, evaluate the need to regulate, and tend to select specific strategies.

But there is still another important aspect of our emotional lives and capacity for regulation on which the model described thus far is silent: the social context of emotion regulation and, in particular, the way in which one individual may actively regulate the emotions of another. The social regulation of emotion may be at least as common, if not more common, than the self-regulation of emotion. Indeed, countless times a day, parents must actively help their children respond emotionally to various challenges. Friends help each other respond to life's setbacks. Relationship partners provide regulatory support in times of need. Therapists assist their clients with current or long-running emotional struggles. And sometimes, social forms of regulation are undertaken with the intent not to help, but to disrupt regulation, as when competitors in sports or business attempt to emotionally disequilibrate their opponents in a game or negotiation.

The expanded model of the self-regulation of emotion in Fig. 3.2 can also account for social forms of regulation. If self-regulation involves using one's frontal lobe to regulate one's affective response systems, then social regulation might involve the use of your frontal lobe to regulate another person's affective response systems (*illustrated in* Fig. 3.7). In terms of the elaborated process model (Fig. 3.2), we can accommodate social regulation with two simple twists illustrated in Fig. 3.8. First, we can use the top row of boxes, starting with emotion identification and ending with strategy implementation, to describe the series of processing steps that take place in the mind and brain of an individual—designated the *regulator*—who is attempting to alter or shape the emotions of another individual. Second, we can use the bottom row of boxes, starting with the perception of an emotion-eliciting stimulus and ending with an emotional response, to describe the series of emotion-generating processing steps taking place in the mind and brain of that second individual who we designate the *target* of the first person's regulatory attempts (again, see Fig. 3.7).

To make this concrete, consider the example offered in the introduction of this chapter. Imagine that your move to a new university is experiencing some expected, but nonetheless significant, emotional turbulence as you to attempt to build your new lab and navigate the politics and bureaucracy of the new institution. As you experience and express your anxiety about one particular setback, your relationship partner perceives your emotional state and identifies it correctly, judges that this might be a moment where regulatory action could be helpful, and decides to try and improve the situation by taking you on a relaxing evening out.

In this way, our multilevel model of emotion regulation can account for both the self-regulation and the social regulation of emotion. Whereas the top row always describes processing steps engaged by a regulator, the bottom row describes the

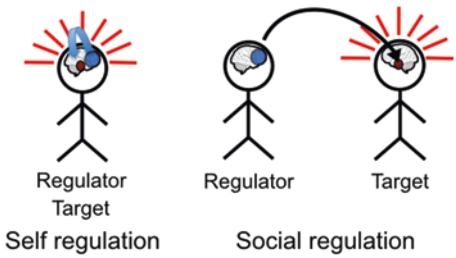

Fig. 3.7 Schematic of the relationship between the self-regulation and social-regulation of emotion: During self-regulation, you use your frontal lobe to regulate your affective response systems; during social regulation, you use your frontal lobe to regulate another person's affective response systems

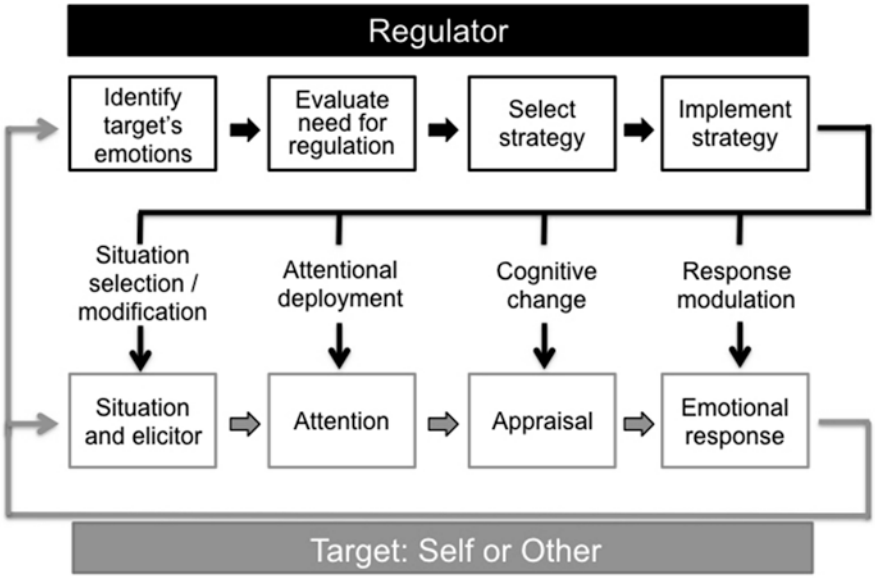

Fig. 3.8 A generalized model of emotion regulation that accounts for the self-regulation and the social regulation of emotion (cf. Dore et al., 2016; Reeck et al., 2016). See text for details and comparison to Fig. 3.2

processing steps generating the emotions of a regulatory target—whether that target is yourself (as in the case of self-regulation) or another person (as in the case of social regulation). In this way, what began as a model of the self-regulation of emotion—that we later adapted to the social regulation of emotion—can now be seen as a generalized emotion regulation model.

Conceptually, we have begun describing how this generalized model can organize our understanding of various kinds of behavioral and brain imaging data concerning the social regulation of emotion (Reeck et al., 2016). There have also been other approaches to studying the social regulation of emotion that emphasize different factors, including the ecological and relational context of social regulation (Beckes & Coan, 2011) or a target's motivation for seeking out the assistance of a regulator (Zaki & Williams, 2013). We see the social application of our generalized models as complementary to these approaches.

Empirically, we have begun using our social application of the generalized model to begin exploring the psychological and neural underpinnings of various types of social emotion regulatory phenomena. We now turn to a few illustrative examples of this work.

Attempting to Identify Another's Emotions Can Result in the Self-Regulation of Emotion

The first example is a bridge from our earlier self-regulation research to our current interest in social regulation. It comes from a study asking how identifying another person's emotions—by simulating or empathizing with them—might have unexpected self-regulatory effects. The need to simulate and empathize with other people arises in virtually all of our relationships. And over time we learn to internally represent the people we know and the way they experience the world. Consider, for example, a friend recounting a close call with a New York City taxi cab where they were almost struck while crossing the street. If that friend is neurotic and reactive—like the popular conception of well-known New York resident Woody Allen—you might expect them to have felt a great deal of fear and anxiety. By contrast, if they are stoic and strong—like a character played by the Western movie actor John Wayne—then you might expect them to have kept their relative cool. We wanted to know whether the act of empathizing with the friend's response to an emotionally charged situation—an instance where you may need to identify their emotions prior to deciding whether it is appropriate to offer regulatory support—may have unexpected regulatory consequences all by itself.

To study this, we asked participants to take part in a study that ostensibly was about empathic accuracy (Gilead et al., 2016). In an initial behavioral session, they responded to a number of self-report questions about their personal preferences, tastes, and attributes. They were also asked to read what they were told were the responses of two prior participants. In reality, each set of responses was from a fictitious participant—one set having been pretested to come across as highly emotionally reactive, like the Woody Allen example above, whereas the other set was pretested to come across as strong and resilient, like the John Wayne example. In a second session that took place in an MRI scanner, participants were asked to complete an empathic accuracy test. On each of a series of trials, they would see a potentially emotionally charged photographic image and would be cued to subsequently rate either their own emotional response or what they believed would have been the emotional response of the (unbeknownst to the participants, fictitious) Woody- or Wayne-like individuals.

Behaviorally, we found that adopting the Woody versus Wayne perspectives resulted in larger versus smaller ratings of estimated negative affect for those targets—that is, relative to the amount reported for the participant's own reactions on trials where the images are experienced from one's own perspective. Neurally, a similar pattern was found for amygdala responses. Notably, the amygdala effects were observed in a set of voxels that were more active when negative images were viewed from one's own personal perspective, which provided initial evidence that simulating another person's perspective on an event may have the unintended effect of changing the way *you* are appraising the meaning of that event. Intriguingly—like the study on the self-identification of emotion described earlier—we found that functional connectivity between amygdala and dmPFC was positive when participants adopted the emotion-amplifying Woody perspective and connectivity was negative when they adopted the emotion-dampening Wayne perspective. Consistent with the idea that this dorsal medial prefrontal region is important for the high-level differentiation of mental states associated with each perspective, a multi-voxel pattern analysis of activity in this region showed significantly different patterns as a function of the perspective adopted on a given trial. Figure 3.9 illustrates these two results.

One problem with interpreting these results, however, is that amygdala responses can reflect a variety of processes, not just threat appraisals or aversive emotions. Current accounts of amygdala function suggest that it may have a more general neuromodulatory function, surveilling the environment for stimuli relevant to both your aversive *and* appetitive goals (Cunningham & Brosch, 2012; Todd, Cunningham, Anderson, & Thompson, 2012). As such, amygdala activation when

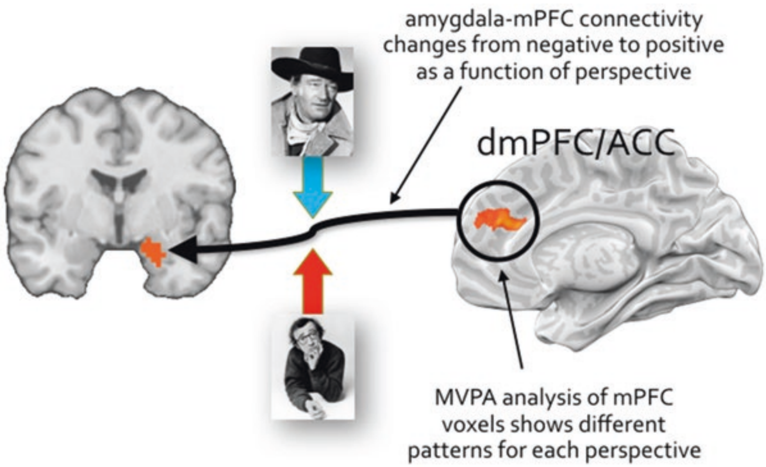

Fig. 3.9 In an initial study of how perspective taking serves as a form of social regulation (Gilead et al., 2016), we found that connectivity of amygdala with dmPFC was positive when participants adopted an emotion-amplifying perspective and connectivity was negative when adopting an emotion-dampening perspective. Multi-voxel pattern analysis of dmPFC activity showed significantly different patterns as a function of the perspective adopted

simulating another's perspectives could reflect changes in the way you are attending to and encoding goal-relevant information. While this may boil down to semantics in the sense that emotional appraisal maybe constituted of exactly these types of attentional and goal-directed processes, we nonetheless sought to provide a more stringent test of the idea that stimulating another's perspectives changes your own emotional experience. We then turned to an analytic technique developed by Luke Chang, Tor Wager, and colleagues at the University of Colorado Boulder (Chang, Gianaros, Manuck, Krishnan, & Wager, 2015). They identified a whole-brain pattern whose degree of expression predicts varying degrees of self-reported negative emotional experience. This pattern was derived from a large data set where participants view diverse images like the ones used in our study. We asked to what extent expression of this pattern varied as a function of the Woody versus Wayne perspective taken in our study. Critically, this pattern was expressed more strongly versus more weakly on trials where photos were viewed from the reactive Woody versus stoic Wayne perspectives. These data support the idea that simulating another person's emotional state—which we think may be the first step in a chain of events that could lead to the decision to help them regulate—may actually help regulate one's own emotional response.

Social Influence as an Example of the Social Regulatory Effects of Passively Identifying Another's Emotions

If actively simulating someone else's emotions may change the way you appraise and respond to an event, then an open question is whether and how passive exposure to another's emotions might also impact our emotions. Here, we started with the idea that any number of situations involve reacting to emotional events alongside other people. One common scenario is when we watch a movie in a crowded theater. If the moviegoers around us are laughing, we might be more likely to laugh as well. And if they are gasping in horror, our own fear might be heightened. Behavioral models of emotional contagion suggest that such effects should occur (Anderson, Monroy, & Keltner, 2017; Jordan, Rand, Arbesman, Fowler, & Christakis, 2013; Neumann & Strack, 2000), but little is known about the underlying neural mechanisms.

Observations such as these led us to ask how knowledge of other people's emotional responses to a shared event might have social regulatory effects. In this way, our model of the social regulation of emotion could help provide an account of the way in which social influences shape affective responding more generally. Neuroscience interest in social influence has increased over the past few years as evidenced by a handful of studies asking how knowledge of another's preferences for faces, music, and food is shaped by knowledge of group preferences for these stimuli. In general, these studies find that when you learn others have liked something either more or less than you do, subsequent tests demonstrate a corresponding shift in how much you like that stimulus—as well as in neural markers of subjective liking, such as activity in ventral portions of the medial PFC and striatum (Izuma & Adolphs, 2013; Klucharev, Hytonen, Rijpkema, Smidts, & Fernandez, 2009; Klucharev, Munneke, Smidts, & Fernandez, 2011; Nook & Zaki, 2015; Zaki, Schirmer, & Mitchell, 2011).

To study this phenomenon in an emotion context, we developed a variant of the methods used to study social influence over subjective preferences. In an initial phase, participants viewed neutral, positive, and aversive photographic images and rated how good or bad they felt in response on a scale that ranged from very negative to very positive. A few seconds after making their own rating, they were shown what they were told was the average emotional response to that image recorded in a prior group of peer participants. In reality, however, this information was manipulated so as to equally often match or to be more toward the negative or more toward the positive end of the scale than was the participant's own response. In a subsequent second phase, participants viewed all of these images a second time and were asked to rate their current emotional responses to them. Instructions explained that we were simply interested in the way in which emotional responses may or may not change across time. Consistent with the prior research on subjective preferences (Izuma & Adolphs, 2013; Klucharev et al., 2009; Nook & Zaki, 2015), learning that your peers had responded to a given image more positively or more negatively than you did led you to have subsequent reactions that had shifted to be more similar to the peer response.

Insight into the neural mechanisms producing these effects came from an analysis of fMRI data collected at the moment participants learned that peers had responded with dissimilar versus similar emotions to their own. Activity in posterior medial frontal regions (e.g., dACC) was associated with response conflict, as well as dorsal and ventral lateral prefrontal regions associated with cognitive control. Notably, many (if not all) of these regions had been shown in a meta-analysis (Buhle et al., 2014) to be recruited when one self-regulates emotions via reappraisal. This suggested that simply knowing that others have responded to an event with emotions different than your own motivates reconsideration of your initial appraisal of the meaning of that event. Consistent with this idea, amygdala response to aversive images (but not other image types) became stronger after learning that peers had responded to these images more negatively than you had initially (Fig. 3.10). Curiously, we did not find that amygdala responses weakened when peers responded less negatively to an image than you had initially, and responses in other regions associated with appetitive responding (e.g., the ventral striatum) did not change as a function of influence-related changes in positive responses. While the selective nature of these findings is intriguing and in need of replication and extension, we are tempted to speculate that this pattern is consistent with a broader theme in behavioral research on emotion often summarized with the phrase "bad is stronger than good" (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). The maxim is meant to convey that numerous studies demonstrate that negative emotions exert a stronger influence over behavior than do positive emotions. The present results fit this maxim insofar as a larger change in neural markers of appraisal (i.e., amygdala response) was found when participants learned that others believed an event was more emotionally upsetting as compared to less upsetting than you did and that parallel effects were not observed for more positive reactions to aversive stimuli.

Implementing Social Reappraisals

A final example comes from the realization that social emotion regulation is not isolated to single dyadic relationships between relationship partners, parents and children, clients and therapists, and so on. In a world where we each inhabit multiple social roles, embedded in different social networks, with communication aided by social media, social regulation may be taking place in multiple relationships in parallel. Motivated by this realization, we planned to develop a means for studying the social regulation of emotion by capitalizing on digital platforms that facilitate multiple lines of communication between individuals. These plans became a reality in a collaboration with Rosalind Picard and her graduate student Rob Morris in the Affective Computing group of MIT's Media Lab.

For his dissertation research, Rob Morris devised an online platform known as Panoply (Morris, Schueller, & Picard, 2015). This platform allowed individuals to anonymously login and do two things: share short descriptions of stressors for which they might seek the support of others, and/or read other people's descriptions and provide supportive written responses. Each participant was free to choose which one they wanted to do whenever they logged into the site. Critically,

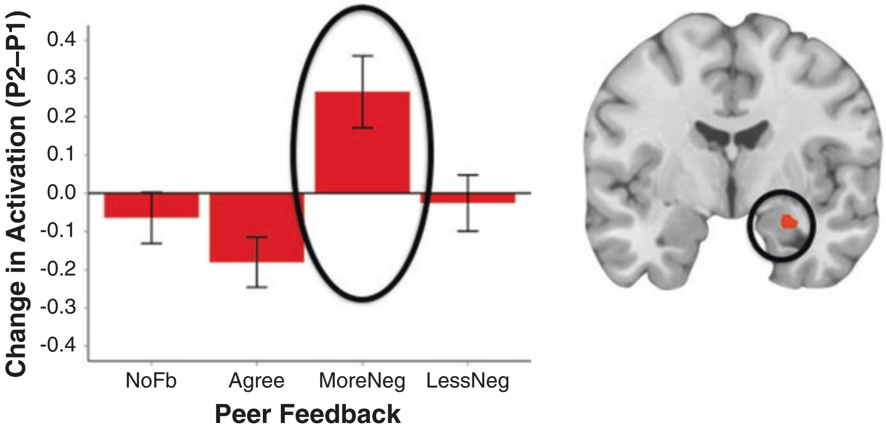

Fig. 3.10 Key result from study of social influence over affective responding (Martin, Weber, Koscik, Cunningham, & Ochsner, in press). Amygdala response to aversive images became stronger after learning that peers reported more negative responses to them. NoFb participants received no feedback about peer's emotion. *Agree* participants received feedback that peers had same emotional response to images. *MoreNeg, LessNeg* participants received feedback that peers had either more or less negative emotional response to images

however, in order to become a member of this platform, you had to first receive training in how to write brief summaries of stressful life events as well as how to provide effective written support to other people who posted descriptions of their own stressful life events. For writing responses to others, examples of three different kinds of regulatory strategies were provided: validating other people's feeling, debugging automatic negative thoughts (à la cognitive behavioral therapy), and reframing, which essentially was reappraisal in a social context. In an initial report on a group that participated in the Panoply environment for 3 weeks, Morris and colleagues reported an important finding: in general (i.e., without consideration of whether you wrote about a dilemma or provided supportive responses to others), participants felt happier and less depressed after having been in the environment (Morris et al., 2015).

These findings led us to ask *what aspect* of participating in the Panoply environment led to the mood benefits (Dore et al., 2017). In particular, we wondered whether or not the act of socially reappraising other people's unpleasant experiences might improve one's own reappraisal abilities. To address this question, we first asked what best predicted drops in depression: the number of stressful events a participant posted or the number of times a participant wrote supportive responses to other people's posts (note that because participants were free to either post, respond, or do both, analyses of the effects of each variable controlled for levels of the other variable)? Strikingly, providing support to others predicted one's own drop in depression.

Notably, the most common form of support offered in response to another's posts was reframing or reappraisal of the life events they described. This led us to ask a second question—did helping other people reframe their experiences change the way in which you reappraised your own life experiences? To test this hypothesis, we compared pre- vs. post-Panoply reports of the frequency with which participants reappraised in their daily lives collected using a common measure (the ERQ, see: Gross & John, 2003). This analysis showed that the frequency of reappraisal increased after having participated in the online environment, which motivated us to test a mediational model demonstrating that the extent to which writing supportive posts for others led you to feel less depressed depended on the extent to which it also increased the frequency of reappraisal in daily life. Or put another way, by helping others regulate their emotions, you may have more frequently reappraised your own emotional reactions, and that helped you feel less depressed. Again, these intriguing results may raise more questions than they answer, and future research is needed to explore the conditions under which personal benefits are derived from helping socially regulate other people's emotions. Numerous variables could ultimately prove important, ranging from the timing and frequency with which one helps others to the specific strategies used to the feedback a regulator receives from targets about the desirability and efficacy of their regulatory attempts (cf. Dore & Morris, 2018).

Looking Ahead: The Continued Evolution of Our Multilevel Model of Emotion Regulation

Studies of the brain systems supporting emotion regulation—when combined with careful behavioral analyses—can help us identify the psychological processes that connect behavior to brain. In so doing, they help us build a multilevel model of emotion regulation specifying the ways in which different classes of regulatory strategies rely on different sets of cognitive and affective processes that, in turn, arise from interactions among networks of brain systems.

This interdisciplinary, multilevel approach to studying emotion regulation has become so commonplace that it can be hard to remember it has been around for only a bit more than 10 years (Ochsner & Gross, 2005). As such, the day is still young and there is much research to come. In this final section of the chapter, we consider ways in which the model of regulation we propose will continue to evolve as well as its relationship to—and usefulness for—other related areas of research.

Evolution

While there are likely to be many ways in which the model will need to evolve—depending on the results of new studies conducted in the future—here we focus on two factors the model will need to increasingly consider.

From Groups to Individuals In many ways, the "holy grail" of all of psychological research is being able to provide an account of the behavior of a single individual. Indeed, we would all like to be able to specify how our theories make predictions for, and provide accounts of, the behavior of specific individuals. Unfortunately, of course, most so-called basic research is not designed to address this use. Instead, basic research is best suited for addressing questions and making predictions about the behavior of populations. As such, we make predictions for the group average, for processes that "in general" function in a certain way.

Ultimately, for models of emotion regulation to provide accounts that matter for our daily lives, the gulf between the population and the individual must be bridged. We suggested a means for building this bridge that involves conceptualizing every instance of emotion regulation as a person × situation × strategy interaction (Dore et al., 2016). Person level variables include one's genes, dispositional characteristics, knowledge, memories, and appraisal tendencies as shaped by the accumulated effects of his/her life history, from the prenatal environment to early life influences to current experiences. Situational variables include the specific emotion-evocative stimuli being encountered as well as the social, ecological, and temporal context of that encounter. Strategy variables include the specific means chosen to regulate a response.

The value of spelling out this three-way interaction is that it highlights the need to consider all of these variables when understanding whether the use of a specific emotion regulation strategy was or was not successful for a given person, in a given situation. On this view, strategies are neither universally useful nor universally pernicious. Whether they help or hurt depends on who is using them in a given situation. As mentioned above, work on the strategy *selection* stage of the model already suggests that these interactions are important and powerful because it has shown that reappraisal is not always useful for everyone in every circumstance. Likewise, children and older adults, or specific clinical populations, may not be as able as young adults to use certain classes of strategies, either because they lack knowledge of and experience with them or because they depend on brain systems that are immature and are undergoing age-related decline or whose function is impacted by some sort of clinical disorder (Helion et al., 2019; Silvers, Buhle, & Ochsner, 2014). Future work will need to manipulate all three variables—person, situation, and strategy—to examine their inter-relationships and inter-dependencies.

Learning Learning must play a key role in our regulatory lives, and yet relatively little is known about how this happens. In theory, learning plays a role in every stage of our generalized model: we learn how to identify our emotions or the emotions of others, how to evaluate a situation to decide if regulation is needed, the range of strategies we can select, and how to implement them.

And there are both lifespan and training-related aspects to each of these factors. For example, it is essential to know how the environment influences the development of different brain systems supporting a child's growing ability to learn how to identify, evaluate, select, and implement. And for older adults, we need to know how these abilities and their underlying systems change with age. We need to know this because children and older adults are vulnerable populations—if we can identify relative weak points in their regulatory abilities, we could design training regimes to strengthen them.

Although there is a steadily growing literature on emotion regulation in children and older adults (like most extant research), this work focuses primarily on the implementation stage (Helion et al., 2019). To date, this work has shown that both groups are less able to use certain forms of reappraisal to downregulate negative emotion, that regulation of some appetitive impulses may be effective, and that older adults may effectively use attentional and situation-focused strategies (Allard & Kensinger, 2014; Livingstone & Isaacowitz, 2015; Opitz, Rauch, Terry, & Urry, 2012; Silvers, Insel, et al., 2016; Silvers et al., 2012; Silvers, Shu, Hubbard, Weber, & Ochsner, 2015; Winecoff, Labar, Madden, Cabeza, & Huettel, 2010). But whether or not older adults differ from young adults for the other stages of the model remains to be seen. Work on clinical populations suggests that there may be deficits for some populations in the ability to implement specific forms of reappraisal to downregulation negative emotion, although results have been inconsistent (Denny et al., 2014; Dillon & Pizzagalli, 2013; Johnstone, van Reekum, Urry, Kalin, & Davidson, 2007; Kanske, Heissler, Schonfelder, & Wessa, 2012; Koenigsberg et al., 2009; Silvers, Hubbard, et al., 2016).

It is possible the identification, evaluation, and selection stages may reveal more consistent differences between clinical and typically developing populations.

Assuming we can identify deficits in the ability to engage specific regulatory processes, then knowing how to address these deficits with training becomes an essential question. A growing number of studies are asking how training can impact the ability to implement strategies for self-regulation. By and large these studies have taken one of two approaches. The first provides training in a specific strategy, typically attentional control or reappraisal (Denny, Inhoff, Zerubavel, Davachi, & Ochsner, 2015; Denny & Ochsner, 2014). The second trains cognitive control abilities like working memory or selective attention with the assumption that the processes underlying these abilities are domain general (Cohen, Henik, & Moyal, 2012; Cohen, Moyal, & Henik, 2015). As such, strengthening these processes via working memory training may provide some benefit to any other behavior that taps into the same domain general processes—like reappraisal. We recently reviewed both areas of research (Cohen & Ochsner, 2018) and concluded that there is much promise, but much more work to be done—including asking how training can improve the identification, evaluation, and selection stages of the regulatory cycle.

Connection to Other Areas of Research

It is a truism that the mappings from behavior to psychological process to underlying brain systems are not one-to-one (Poldrack & Farah, 2015). Put another way, single behaviors arise from the concerted actions of multiple underlying psychological processes, and each process may be supported by a network of interacting brain regions. This can be visualized by thinking about multiple pathways connecting the behavioral level of analysis embodied in Fig. 3.1, the psychological levels of analyses described in Figs. 3.2 and 3.8, and the kinds of brain systems described in Fig. 3.3. When thinking about emotion regulation, this means that the brain systems we discuss—lateral and medial PFC, amygdala, striatum, and so on—all participate in processes that contribute to multiple other behaviors. Given this, we do our best to characterize behavior-process-brain mappings in our model of emotion regulation in ways that make sense in the context of related research. In this way, our thinking about the model is informed and constrained by widespread findings.

This influence can be bidirectional—we can also think about how the model may inform the way we think about other phenomena. For example, the model, as currently constructed, provides a means for conceptualizing the way in which interactions between individuals shape their emotional states. If we make the (perhaps strong) assumption that emotions provide the core of meaning for individuals—after all, emotions tell us how and why things matter to us and provide guidance in how to respond appropriately (Osgood, Suci, & Tannenbaum, 1957)—then our model of emotion regulation could be seen as a starting point for formulating a more comprehensive model of socio-emotional behavior.

The model might be well-suited for this given that it specifies processing stages for self or other that reflect core topics in the study of emotion, self-regulation, and social behavior more generally. For example, the identification stage corresponds to the study of emotion perception and social cognition more generally. The evaluation and selection stages relate to the study of affective decision processes and social cognition to the extent that they involve assessments of the impact of regulation on a target's mental state. Evaluation, selection, and implementation also draw on selection and working memory processes studied under the aegis of executive/cognitive control. And the entire bottom sequence that specifies the steps that trigger the emotions in need of regulation corresponds to the study of emotion generation more generally.

The model could also be broadened to account for social and self-regulatory phenomena occurring beyond dyads. As noted earlier, we and others have studied the way in which regulation occurs in the context of online groups where multiple people interact in a pairwise fashion (Dore & Morris, 2018; Dore, Weber, & Ochsner, 2017; Morris et al., 2015). The model could be expanded, however, to accommodate multi-person interactions, where the emotional responses of multiple possible regulation targets are being simultaneously identified by multiple people, all of whom have to evaluate whether or not regulation is needed. This could take place in the context of interactions on Facebook or other social media platforms where individuals or groups broadcast their (often emotionally charged) experiences to multiple others who are free to decide whether and how to respond in a variety of ways. And it can happen in person-to-person contexts as well. Anyone who has been a parent at the birthday party of small children knows relevant situations quite well, as multiple children may become a bit too obstreperous, rowdy, or combative, and multiple adults are witnessing this and evaluating whether they need to step in and help regulate.

These examples also illustrate a final important aspect of the model as it is instantiated in social contexts. Social regulation is embedded in the context of relationships of all kinds (Clark, Armentano, Boothby, & Hirsch, 2017; Eisenberg et al., 2000; Impett et al., 2010; Kneeland, Dovidio, Joormann, & Clark, 2016). In the social media example, we may feel more free to offer regulatory support to people to whom we are close, such as friends or family. In the parent-child example, a parent may be more comfortable intervening with regulatory support for their own as compared to other people's children. And how an adult or child appraises the meaning of regulatory assistance from a friend or family member—as helpful and wanted, for example, as compared to disruptive and annoying—will determine its effectiveness. In general, differences in status, friendship, age, the motivation one has for regulating others—and the target's perception of that motivation—along with other variables will significantly determine the efficacy of social regulatory interactions (Reeck et al., 2016; Williams, Morelli, Ong, & Zaki, 2018; Zaki & Williams, 2013).

Conclusion

If the day is still young for the study of many aspects of emotion regulation, then it is good that there is evident excitement within the field for their study. As has been noted, the study of emotion regulation has grown exponentially over the past 15 years (Gross, 2015). I began this chapter by observing that the lion's share of this work has concerned the implementation of strategies for the self-regulation of emotion in contexts where experimenters tell participants when and how to regulate using a strategy in which they have received some degree of instruction. This chapter closes with the hope that the many other aspects of regulation discussed here (and others have discussed elsewhere, e.g., Gross, 2015; Zaki & Williams, 2013) increasingly become the field's new focus.

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