Searching for implicit emotion regulation

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How does one find what cannot be seen? Scientists often posit the presence of invisible entities from atoms and gravity to genes and climate change? Even if an entity or process cannot be directly observed (yet), scientists can posit a set of characteristic effects that ought to be present and observable if the hypothesized entity or process does in fact exist. If such a thing as implicit emotion regulation exists, this is probably the only way we will be to find and study it.

People try to regulate their emotions in various situations throughout their lives. Whether we are trying to avoid showing how nervous we are at the beginning of a presentation, taking our mind away from the current moment to reduce the distress of a broken arm, or trying to reframe things in a new light to recover from a broken heart – we often try to manage our emotions to feel differently or at least look like we are feeling differently. These common strategies of suppression, distraction, and reappraisal, respectively, all feature a strong conscious experiential component. Paraphrasing words of philosopher Thomas Nagel, there is something that it is like to be regulating one's emotions. When we regulate our emotions, we typically are doing it on purpose and have some awareness of the strategy we are using and whether it is changing how we feel.

For the past decade, I have studied a process that looks and feels very different from canonical emotion regulation processes. In various forms, my colleagues and I, ask people to put their feelings and affective evaluations into words without asking them to alter their feelings in any way. Sometimes they choose a single word to describe the emotional character of an emotional face or scene. Other times they choose a single word to describe their own emotional reaction to a scene. In still other cases, individuals might say sentences out loud to describe their fear of an upcoming situation.

Although putting one's feelings into words (i.e. *Affect Labeling*) can be used in the service of regulating one's emotions, either during reappraisal or psychotherapy, the act of affect labeling itself does not feel like emotion regulation. Indeed, in multiple studies participants have reported that they think affect labeling would lead to more intense negative emotional responses to unpleasant images than merely looking at the images passively (Lieberman et al. 2011). Despite this, I have hypothesized that affect labeling is a kind of emotion regulation process, albeit an implicit or incidental kind.

This is not an entirely new idea. The philosopher Spinoza (1675) long ago wrote that "An emotion, which is a passion, ceases to be a passion, as soon as we form a clear and distinct idea thereof." Psychologists William James (1890) and Edward Tichener (1908) said much the same near the turn of the 20th century. Writers have suggested the same with Shakespeare voicing the thought in Macbeth that we ought to "Give sorrow words. The grief that does not speak whispers the o'er-fraught heart and bids it break" and Henry Miller once suggesting "the best way to get over a woman is to turn her into literature."

Modern psychological research has also provided a number of findings consistent with this idea. Three decades of work on expressive writing demonstrates that writing about one's feelings can aid physical and mental health and even help one do better on an upcoming math test (Frattaroli, 2006; Ramirez & Beilock, 2011). Similarly, work with young children finds that those that are better able to put their feelings into words produce fewer classroom outbursts, do better in class, and are more popular with their peers (Izard et al., 2001). Nevertheless, all of these findings and musings are suggestive at best.

If people don't feel like they are regulating their emotions when they engage in affect labeling, how can we really know if affect labeling is actually is a kind of emotion regulation? Just as with other invisible entities like atoms and gravity, there are a series of characteristic effects associated with emotion regulation. If the characteristic effects of emotion regulation observed in neuroimaging, physiology, and self-report are also present during affect labeling, this would be strong evidence that affect labeling serves as a kind of emotion regulation. One could argue the neuroimaging evidence is the most central as it can show the actual emotion regulation process at work *in situ*, whereas the physiology and self-reports may reflect the consequences of emotion regulation having occurred. Below I will outline these characteristic effects of emotion regulation and then assess the extent to which affect labeling produces a similar set of effects.

Characteristic Effects of Reappraisal

I will use reappraisal as my example form of emotion regulation. This is in part because reappraisal has been studied more broadly than suppression or distraction. Additionally, if affect labeling resembles any kind of emotion regulation, reappraisal is the best bet as only reappraisal seems to involve linguistic or symbolic representation of one's feelings – though in the in case of reappraisal there is an explicit goal to then change those representations, a goal that is absent in affect labeling.

There are four characteristic indicators of reappraisal across different measurement modalities. The most straightforward is self-report. In reappraisal studies, people are asked to think about an emotionally evocative stimulus – a picture, a memory, an imagined scene – and then to change the way they are thinking about stimulus in order to change their emotional response. The great majority of studies have used negative stimulus materials and ask people to use reappraisal in order to diminish their negative affect. When asked whether they have been successful in this endeavor, participants typically report that they were able lessen their affective response through the reappraisal process (Gross, 2015). Thus, in the self-report modality, the characteristic indicator of reappraisal is self-reported reduction in distress (assuming instructions to lessen distress).

The second common domain of assessment is brain activity, typically using functional magnetic resonance imaging (fMRI). Researchers turned to neuroimaging, in part, to address a potential issue with self-report methodologies. While self-report is susceptible to demand characteristics, fMRI would hopefully shows the underlying dynamics regardless of demand. In other words, someone might say they felt less distress because the experimenter asked them to try to

experience less distress, but the brain data would reveal what was happening under the hood.

In 2014, three different meta-analyses were published (Buhle et al., 2014; Frank et al., 2014; Kohn et al., 2014) focusing either on reappraisal or emotion regulation more broadly defined. Despite slightly inclusion criteria and analytic approaches, the findings of the three meta-analyses are strikingly similar. Each found that during attempts at emotion regulation there was increased activity in a suite of frontal regions including bilateral ventrolateral prefrontal cortex, left dorsolateral prefrontal cortex, and supplemental motor area. In contrast, regulation attempts were consistently associated with decreases in amygdala activity. Thus, there are both characteristic increases and decreases in neural activity associated with emotion regulation in general and more specifically with reappraisal.

The last common domain of assessment is physiology. Physiological measurements such as skin conductance and electromyogram (EMG) have been used as indirect measures of reappraisal effects that are unlikely to be contaminated by demand characteristics. Although early tests were equivocal, over the last 15 years a series of studies have demonstrated that reappraisal produces diminished physiological responses compared to natural viewing of aversive images (Dillon & LaBar, 2005; Eippert et al., 2007; Jackson, Malmstadt, Larson, & Davidson, 2000; McRae, Ciesielski, & Gross, 2012; Ray, McRae, Ochsner, & Gross, 2010). Thus, decreased physiological responding is a fourth characteristic indicator of reappraisal.

Characteristic Effects of Affect Labeling

I have outlined four characteristic effects of reappraisal of negative affect: (a) diminished self-reports of negative affect; (b) diminished physiological responses during reappraisal relative to natural viewing; (c) increased activity in four frontal regions of the brain and; (d) decreased activity in the amygdala during reappraisal attempts. In this section, I will examine whether affect labeling produces each of these characteristic responses.

Unlike reappraisal, the first affect labeling studies involved neuroimaging so we will start there. The first affect labeling study (Hariri, Bookheimer, & Mazziotta, 2000) produced increased right ventrolateral prefrontal cortex activity and decreased amygdala activity relative to a control condition. In addition, negative functional connectivity was observed between these two regions, consistent with the idea that the prefrontal increases were dampening the amygdala responses. A series of affect labeling studies have extended and refined the initial findings, but have almost all shown right ventrolateral increases and amygdala decreases during affect labeling (Burklund et al., 2014; Burklund et al., 2015; Foland-Ross et al., 2012; Hariri et al., 2003; Lieberman et al., 2005; Lieberman et al., 2007; Payer, Lieberman, & London, 2011; Torre et al., under review). Most of these studies have also shown some form of inverse activity between the prefrontal and amgydala regions. One study used dynamic causal modeling to suggest that, indeed, right ventrolateral prefrontal activity is *leading to* the decreases in amgydala responses during affect labeling (Torrisi et al. 2013).

Although the focus of these studies has been on right ventrolateral prefrontal cortex, as observed in the original study, a number have also reported other prefrontal regions seen during reappraisal (Burklund et al., 2014; Foland et al., 2012; Hariri et al., 2003). Most recently, we have conducted a large study (N=120) in which participants performed both reappraisal and affect labeling trials (Torre et al., under review). In a conjuction analysis, we observed activity robust activation in all four prefrontal regions typically seen during reappraisal, as well as amygdala reductions. In another study (Payer et al., 2012), participants performed affect labeling or reappraisal during each of two scanning sessions. A strong correlation was observed between the amygdala reductions during affect labeling and reappraisal.

Together, these studies suggest that affect labeling produces a similar pattern of neural effects as observed in reappraisal. Both produce increased activity in bilateral ventrolateral prefrontal cortex, left dorsolateral prefrontal cortex, and supplementary motor area with a corresponding decrease in amygdala activity. More advanced techniques such as multivoxel pattern analysis will be needed to find out if this similarity holds up at a more fine-grained level.

Next we turn to physiological responses during affect labeling. Three studies have examined physiological responses *during* affect labeling, each suggesting that affect labeling can dampen physiological responses. The first of these three studies found that judging the affect present in a picture lowered skin conductance responses relative to judging one's own affect in response to the picture (McRae et al. 2010). However, the other two studies found that reporting on one's own affect decreased physiologically responding relative to stating a fact about the image (Matejka et al. 2013) or not reporting anything (Kassam & Mendes, 2013).

Three other studies used affect labeling as a clinical intervention and thus focused on longterm changes in physiology. The first study (Tabibnia, Lieberman, & Craske, 2008) examined skin conductance responses to spider images in individuals with spider fears a week after seeing spider images alone, paired with a negative word, or paired with a neutral word. The prior pairing of the negative word led to greater reductions in skin conductance than the other two conditions. A second study (Kircanski, Lieberman, & Craske, 2012) asked spider phobics to generate affect labeling sentences about their fear of a spider that was in the room. A week later after the intervention, skin conductance responses in the presence of the spider were reduced compared with exposure alone, reappraisal, and distraction interventions. Additionally, the more negative words used by participants, the greater the reduction in skin conductance at retest. Finally, individuals with public speaking phobia went through a series of public speaking trials, being asked to generate their own affect labeling sentences, or not (Niles, Craske, Lieberman, & Hur, 2015). Once again, at retest, physiological responses were diminished for those who had earlier labeled their anxiety prior to giving speeches. And again, these effects were enhanced for those who used more negative words during the generation of affect labeling sentences.

Whether physiological responses are examined in the moment of affect labeling or after a significant delay, affect labeling seems to lead to dampened

physiological responses. This is in line with the findings regarding reappraisal and physiology described earlier.

Last we come to self-report. Indeed, this was the last area where affect labeling research was initiated. Its difficult to measure the effects of affect labeling on self-reported distress, when self-reporting on this distress is hypothesized to change it.

We first examined self-reported affect in a series of four studies (Lieberman, Inagaki, Tabibnia, & Crockett, 2011). In three of the studies, participants viewed aversive images and either labeled a negative aspect of the image or just viewed it naturally. After each trial, participants were asked "How distressed did you feel while you were looking at the picture?" In each of these three studies, those who labeled an affective aspect of the image subsequently went on to report that they had felt less distressed than during the natural viewing trials. In one of these studies, participants also performed reappraisal trials. While reappraisal trials produced greater distress reductions than affect labeling, the reductions during labeling and reappraisal were significantly correlated. Both of these effects were replicated in a subsequence fMRI paper (Burklund et al., 2014).

An fMRI study (Burklund et al., 2014) measured self-reports of affect after each five trial block of affect labeling, reappraising, or natural viewing. Similar to the behavioral study, this study observed that both affect labeling and reappraisal produced distress reductions, that these reductions were greater for reappraisal than affect labeling, but that the reductions for affect labeling and reappraisal were correlated with each other.

A final study (Constantinou et al. 2014), focused on how negative images can increase symptom reports of pain and other physical symptoms. They found that affect labeling reduced self-reported affect to the images as well as symptom reports after the picture task. However, they also observed that a non-affective form of labeling produced the same set of effects.

Across the five studies focused on self-reports of negative affect, each has shown reductions in self-reported distress with affect labeling. These effects appear to be smaller than those observed with reappraisal, yet also correlated with reappraisal-specific reductions.

Conclusions

Intuitively, affect labeling does not look or feel like a kind of emotion regulation. People do not label with the primary goal of regulating their feelings and have predicted that affect labeling will actually enhance their negative feelings (Lieberman et al., 2011). Yet affect labeling appears to have many of the characteristic effects associated with reappraisal, a well-established form of emotion regulation.

Neurally, both affect labeling and reappraisal produce a similar set of prefrontal increases and reductions within the amygdala. Both processes have been associated with reduced physiological responses to negative stimuli. Finally, both lead to reductions in self-reported distress or negative affect. Indeed, for the neural and self-report domains, these effects have been shown to be correlated across the two processes suggestion some mechanistic commonality.

Together these findings should give us a reasonable amount of confidence that affect labeling constitutes a form of emotion regulation. Given that it is not a process that we consciously and introspectively recognize as emotion regulation, we have found it most appropriate to characterize it as a form of implicit emotion regulation. Unearthing invisible entities require special tools and methods and implicit emotion regulation is no different. By definition, people cannot report when implicit emotion regulation is occurring. However, by using tools such as fMRI, we have a way to identify the presence and processes supporting implicit emotion regulation.

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