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Applying the Quadruple Process model to evaluate change in implicit attitudinal responses during therapy for panic disorder

Elise M. Clerkin [a,*], Christopher R. Fisher [a], Jeffrey W. Sherman [b], Bethany A. Teachman [c]

[a] Department of Psychology, Miami University, Oxford, OH, USA
[b] Department of Psychology, University of California, Davis, CA, USA
[c] Department of Psychology, University of Virginia, Charlottesville, VA, USA

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ABSTRACT

Objective: This study explored the automatic and controlled processes that may influence performance on an implicit measure across cognitive-behavioral group therapy for panic disorder.
Method: The Quadruple Process model was applied to error scores from an Implicit Association Test evaluating associations between the concepts Me (vs. Not Me) + Calm (vs. Panicked) to evaluate four distinct processes: Association Activation, Detection, Guessing, and Overcoming Bias. Parameter estimates were calculated in the panic group ($n = 28$) across each treatment session where the IAT was administered, and at matched times when the IAT was completed in the healthy control group ($n = 31$).
Results: Association Activation for Me + Calm became stronger over treatment for participants in the panic group, demonstrating that it is possible to change automatically activated associations in memory (vs. simply overriding those associations) in a clinical sample via therapy. As well, the Guessing bias toward the calm category increased over treatment for participants in the panic group.
Conclusions: This research evaluates key tenets about the role of automatic processing in cognitive models of anxiety, and emphasizes the viability of changing the actual activation of automatic associations in the context of treatment, versus only changing a person's ability to use reflective processing to overcome biased automatic processing.

One of the biggest challenges when treating panic and other anxiety disorders is the seeming disconnect between what people report "knowing" at a more controlled, strategic level, versus what they report "experiencing" at a more automatic, uncontrollable level. This fundamental discrepancy has led researchers to posit that relatively automatic processing (e.g., processing that is outside one's conscious control or awareness) is critical in understanding the fear and anxiety response (e.g., Mathews & MacLeod, 1994; McNally, 1995; Williams, Watts, MacLeod, & Mathews, 1997). For instance, Beck and Clark (1997) theorize that anxiety problems result in part from the activation of a relatively automatic, reflexive "primal threat mode," which is followed by a more strategic and elaborative form of cognitive processing. Indeed, Beck and Clark (1997) suggest that deactivating biased automatic processing, while activating more adaptive forms of thinking, is *the* critical goal when treating anxiety problems.

Several reviews have demonstrated that automatic processing biases are common and predict important outcomes among people with anxiety problems (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Teachman, Joormann, Steinman, & Gotlib, 2012). However, one major limitation with our current understanding of the role of automatic processing in anxiety pathology is that the measurement of automatic processes is not process pure (Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005; Sherman, 2009; Sherman et al., 2008). Instead, as implicit social cognition researchers have convincingly articulated, these measures capture the combined contributions of several, qualitatively different processes, including ones that are relatively controlled in nature (Conrey et al., 2005; Sherman et al., 2008; Sherman, Klauer, & Allen, 2010). In other words, simply using an indirect measure, like the Implicit Association Test (IAT, Greenwald, McGhee, & Schwartz, 1998), does not permit strong conclusions about the relative influences of automatic versus relatively more controlled components of processing.

Along these lines, Teachman, Marker, and Smith-Janik (2008) recently investigated implicit panic associations, or interconnected associations in memory that are difficult to consciously

* Corresponding author. Miami University, Psychology Department, 100 Psychology Building, Oxford, OH 45056, USA.
E-mail address: clerkiem@miamioh.edu (E.M. Clerkin).

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control, measured with the IAT. To evaluate whether change in panic-relevant IAT scores [i.e., associations between Me (vs. Not Me) + Calm (vs. Panicked)] led to subsequent change in panic symptoms across a 12-week course of cognitive-behavioral group therapy for panic disorder, researchers used dynamic bivariate latent difference score modeling. This test allows one to model both the change processes across the two variables, as well as the relationship between those change processes (see McArdle & Nesselroade, 2002). Given the sample size, the researchers constrained the change process to be the same over time to test whether one change process was a leading indicator of another change process, but this test did not address the question of exactly when in treatment the change was most predictive. Results indicated that changes in panic-relevant IAT scores predicted the degree of subsequent symptom change. This work was exciting because it suggests that change in cognition, including cognition that is activated at a relatively automatic level, occurs in advance of and predicts the extent of symptom reduction among patients with panic disorder. However, given that the IAT captures both relatively automatic and controlled components of anxious processing, it is not clear what components of the IAT change were driving the results in this study. For example, it could be that automatic, panic-relevant associations were being altered, or it could be that patients were becoming better at regulating these automatically activated associations. Given the mounting research demonstrating that implicit associations assessed with the IAT can be modified in a clinical context (e.g., Clerkin & Teachman, 2010; Teachman et al., 2008; Teachman & Woody, 2003; see review in Roefs et al., 2011), it is critical to understand the underlying processes driving these changes.

The current study seeks to better understand what aspects of automatic and controlled processing change over the course of treatment by applying the Quadruple Process or Quad model to a subset and extension of Teachman et al.'s (2008) data. Specifically, this study seeks to test the components of implicit attitudinal responses that change in response to a full dose of treatment, in addition to comparing differences in Quad model parameter estimates between a group diagnosed with panic disorder and a healthy control group. Ultimately, applying the Quad model is important because it enables a refined test of the underlying processes driving overall IAT effects.

The Quad model

The Quad model is a multinomial processing tree model that has been validated across a variety of tasks, including the IAT (Conrey et al., 2005; Sherman et al., 2008; see Methodological detail on the IAT, below). Similar to other mathematical modeling approaches (e.g., Control Default model: Jacoby, 1991; Diffusion model: Klauer, Voss, Schmitz, & Teige-Mocigemba, 2007; Process Dissociation model: Payne, 2008), applications of the Quad model are part of a growing recognition that crude classifications of implicit versus explicit dimensions likely miss critical distinctions within measures of cognitive processing. Specifically, the Quad model decomposes implicit task performance into four interdependent, but distinct processes: 1) Activation of Associations (AC) refers to the degree to which biased associations are activated when responding to a stimulus. All else being equal, the stronger the associations, the more likely they are to be activated and to influence behavior. In the current context, AC is measured with two parameters. Specifically, $AC_{me\ +\ calm}$ measures the degree to which an association between Me (i.e., the self) and Calm is activated, whereas $AC_{not\ me\ +\ panicked}$ measures the degree to which an association between Not Me (i.e., others) and Panicked is activated. 2) Detection (D) corresponds to a more controlled process that enables detection of correct and incorrect responses (note that "Detection" is conceptually the same as the earlier "Discriminability" parameter outlined by Conrey et al., 2005). 3) Guessing (G) reflects a general response bias when no associations are activated and the correct response cannot be determined. 4) Finally, at times there is a conflict between automatically activated associations and the response detected as correct. In this case, the Quad model proposes that a self-regulatory process may override the influence of automatically activated associations. This self-regulatory process is referred to as the Overcoming Bias (OB) parameter.

In the present study, we explored the relative influence of each of the four Quad model parameters on implicit panic responses during therapy for panic disorder. Given our goal of decomposing the basic IAT effect into relatively automatic and controlled forms of processing, in this initial application of the Quad model to implicit panic data, it was important to consider all the parameters that reflect these different types of processes. For instance, it is possible that an overall IAT effect is driven by changes in the ability to detect the correct response, differences in the ability to overcome automatic or habitual associations, or differences in response bias toward a certain category.

With this in mind, we first, we evaluated whether $AC_{me\ +\ calm}$ and $AC_{not\ me\ +\ panicked}$ would increase over the course of treatment, reflecting greater activation of an automatic association between the self and calm. This test provides a critical opportunity to determine whether it is actually the automatically activated associations that are shifting over treatment, as suggested by cognitive models of anxiety treatment (e.g., Beck & Clark, 1997), distinct from the more controlled processing that the IAT also captures. Our modeling approach also allowed examination of changes in Detection and Guessing across treatment, and as a function of group status (panic vs. healthy control). There were no specific hypotheses for changes in Detection, other than possible improvement over time with practice. With respect to the Guessing parameter, it seemed plausible that the response bias would be relatively more oriented toward panicked (vs. calm) among the panic group compared to the healthy control group prior to treatment. Whether this Guessing parameter would shift following treatment was more exploratory.

Finally, recall that the OB parameter reflects an override of an automatic or habitual response. Given the structure of these data, the OB parameter in this study represents the ability to overcome the tendency to associate oneself with calm.[1] Thus, for OB to reduce one's implicit panic associations in this context, participants would have needed to *lose* their self-regulatory abilities across treatment, which does not seem highly plausible given the intention in treatment to *gain* self-regulatory skills (Barlow & Craske, 1994).

Therefore, this study was well designed to evaluate whether relatively pure measures of activation, detection, and guessing change over treatment, but was not as well-suited to test whether override responses change. Critically, the advantage of applying the Quad Model to basic IAT data is that it is possible to learn how different automatic and strategic facets of implicit associations change in response to treatment, rather than evaluating only a single general effect.

[1] As discussed in Teachman et al. (2007), individuals with panic disorder have *relatively* stronger panicked (versus calm) associations with the self (versus others) compared to a healthy control group, as measured with the IAT. However, both groups still have a stronger absolute association between the self and calm, in the sense that they are generally quicker to respond to words when "Me + Calm" are paired, as compared to "Me + Panicked." Given this, "Me + Calm" is the compatible pairing in this data (as opposed to "Me + Panicked," which is the incompatible pairing). Hence, the OB parameter reflects overcoming the tendency to associate oneself with calm.