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Anxiety sensitivity and CO_2 challenge anxiety during recovery: Differential correspondence of arousal and perceived control

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ABSTRACT

The relations between changes in arousal and perceived control with changes in anxiety-related distress during a 10-min recovery period after exposure to 10% CO_2-enriched air was examined among community participants ($N = 47$) high ($n = 23$) and low ($n = 24$) in anxiety sensitivity (AS). Rate of decline in arousal was significantly positively associated with rate of decline in anxiety among high and low AS participants when controlling for valence. Rate of increase in perceived control was significantly negatively related to rate of decline in anxiety in the high AS group but not in the low AS group when controlling for valence. These findings suggest that associations between arousal, perceived control, and anxiety-related recovery from a panic-relevant episode of abrupt increases in bodily arousal differ as a function of pre-existing fears of anxiety-related symptoms (i.e., AS). Implications of these findings for disorders associated with elevated AS are discussed.

Anxiety sensitivity (AS) is defined as the fear of anxiety-related bodily sensations based on beliefs that these symptoms have harmful physical, psychological, or social consequences (Reiss & McNally, 1985). AS is proposed to arise from the combination of genetic predispositions (Stein, Jang, & Livesley, 1999) and learning experiences that result in the acquisition of beliefs about potentially harmful effects of autonomic arousal (e.g., Stewart et al., 2001). An extensive literature suggests that relatively elevated AS may amplify fearful reactions to various events (e.g., abrupt increases in bodily arousal), thereby placing individuals at risk for the development of anxiety-related conditions, especially panic disorder (e.g., Reiss, 1991; Taylor, 1999). Accordingly, studies have consistently demonstrated a strong, positive relation between AS and panic symptoms (e.g., Apfledorf, Shear, Leon, & Portera, 1994; McNally & Lorenz, 1987). In addition, AS has been shown to predict fearful responding to panic-related events, such as abrupt increases in bodily arousal (Rapee, Brown, Antony, & Barlow, 1992), and AS prospectively predicts the development of panic attacks (Schmidt, Lerew, & Jackson, 1997).

Despite ongoing research on AS, there remains a paucity of research identifying individual difference variables and processes that may influence the association between AS and the development of anxiety. The available literature suggests that periods of high arousal are particularly distressing for individuals high in AS. High AS individuals are theorized to perceive physical sensations marked with autonomic arousal as danger signals and, as a result, to experience elevated levels of anxiety during periods of arousal (Schmidt & Zvolensky, 2007). Biological challenge laboratory studies that evaluate fear responding to a wide range of procedures that elicit bodily arousal offer direct evidence for the association between AS and anxious reactivity to arousal (see Zvolensky & Eifert, 2000 for review). For example, laboratory studies indicate that AS is a significant predictor of fear responses to inhalation of carbon dioxide-enriched air (CO_2; Zvolensky et al., 2002) independent of trait anxiety among adults (Zinbarg, Brown, Barlow, & Rapee, 2001; Zvolensky, Feldner, Eifert, & Stewart, 2001) and youth (Leen-Feldner, Feldner, Bernstein, McCormick, & Zvolensky, 2005).

In addition to the likely interaction between arousal and AS, perceived control also likely interacts with AS to influence anxious responsivity. A large collection of laboratory-based experiments with animals and humans, has found uncontrollable aversive events to have a substantial impact on anxiety (Chorpita & Barlow, 1998; Mineka & Zinbarg, 2006). Accordingly, perceived control may influence association between AS and symptoms of anxiety. In a longitudinal study on military participants undergoing basic training, Schmidt and Lerew (2002) found that high perceived control regarding basic training was protective against the development of panic disorder at 5 months for high AS individuals. A more recent study also found that lower perceived control was associated with a stronger relation between AS and agoraphobia (White,

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Brown, Somers, & Barlow, 2006). Biological challenge studies have also yielded similar findings. For example, Telch, Silverman, and Schmidt (1996) found that high AS participants in a no-perceived control condition experienced significantly more distress during a caffeine administration challenge than high AS participants in a perceived control condition, whereas no differences in distress were observed between conditions for low AS participants.

Laboratory studies employing inhalation of CO_2-enriched air have also examined the role of perceived control in anxious responding. For example, patients with panic disorder given the "illusion" they could stop presentation of CO_2-enriched air have been shown to report less anxiety compared to persons without the perception of control (Sanderson, Rapee, & Barlow, 1989). Zvolensky and colleagues also have examined the impact of control over the repeated presentation of CO_2-enriched air on anxious responding among high AS individuals (Zvolensky, Lejuez, & Eifert, 1998; Zvolensky, Eifert, Lejuez, & McNeil, 1999). This line of research has shown that participants without control report significantly more anxiety and more intense panic experiences compared to those with control. The anxiety-related effect of a lack of control also appears to persist in future situations where a control option is available.

Taken together, the available literature suggests that autonomic arousal exerts a significant effect on anxiety-related distress for individuals high in AS. Moreover, for those high in AS, low perceived control results in greater anxiety-related distress compared to higher perceived control. Unfortunately, the question of how the impact of arousal and control on anxiety may differentially relate to AS has been largely investigated in the context of *reactivity* to various laboratory provocations with very little research examining the effects of these processes on *recovery* from laboratory provocations.[1] The importance of examining less commonly studied facets of emotional responding such as recovery has been previously emphasized (Davidson, 2000; Davidson, Jackson, & Kalin, 2000). However, there is a noticeable absence of systematic research along these lines, which has direct implications for better understanding the role of AS in anxiety-related phenomena (cf., Feldner, Zvolensky, Stickle, Bonn-Miller, & Leen-Feldner, 2006; Zvolensky et al., 2004).

Broadening assessment to recovery periods after a biological challenge may advance our knowledge of how the impact of arousal and perceived control on anxiety-related distress differentially relate to AS across time. As a result of panic-related sensations (e.g., racing heart, lightheadedness, sweating), individuals low in perceived control may begin to experience anxiety about having future panic attacks. Indeed, laboratory studies have shown that perceived control buffers panic-relevant reactivity to biological challenges (Sanderson et al., 1989; Zvolensky, Eifert, & Lejuez, 2001). Comparably, theoretical models also posit that reductions of autonomic arousal may lead to reduced estimates of danger and promote general changes in anxiety (Foa & Kozak, 1986). Together, this work suggests that reductions in anxiety symptoms following a panic-like episode (recovery) may be dependent upon increases in perceived control and decreases in arousal, particularly among high AS individuals. This postulation is in line with existing evidence suggesting that high AS individuals show less habituation to CO_2 presentations relative to low AS individuals (Beck, Shipherd, & Zebb, 1996), panic symptoms elicited by biological challenges differ as a function of pre-experimental AS levels (Forsyth, Palav, & Duff, 1999), and reductions in arousal correspond to reductions in AS (Schmidt, Trakowski, & Staab, 1997).

A better understanding of how arousal and perceived control relate to anxiety-related recovery as a function of AS may prove to be especially informative in the development of panic prevention programs, as such efforts necessitate an understanding of malleable processes that impact individual differences in recovery from acute panic-relevant experiences (Feldner, Zvolensky, & Schmidt, 2004; Feldner, Zvolensky, Babson, Leen-Feldner, & Schmidt, 2008; Schmidt et al., 2007; Zvolensky, Schmidt, Bernstein, & Keough, 2006). Despite considerable research documenting the deleterious effects of high arousal and low perceived control on emotional responding among high AS individuals, surprisingly few published studies have been devoted to improving the understanding of the relationship between these processes during recovery from a theoretically relevant stressor.

It was predicted in the present investigation that significant reductions would be observed in anxiety, arousal (self-reported and physiological), uncontrollability, and negative valence during recovery after a CO_2 challenge among high and low AS individuals. It was also predicted that reductions in anxiety during recovery would be accelerated by corresponding decreases in arousal and increases in perceived control among high, but not low, AS individuals. Perceived valence (negative–positive) has been proposed to explain significant variance in the emotional meaning of a negative event (Osgood, Suci, & Tannenbaum, 1957). Furthermore, research has shown that negative perceived valence of a CO_2 challenge is predicted by anxiety-related variables (Zvolensky, Eifert et al., 2001; Zvolensky, Feldner et al., 2001). Given that reductions in anxiety-related distress during habituation may then be confounded by changes in the perceived valence of the feared context (Foa & Kozak, 1986), the influence of arousal and control on anxiety as a function of AS was examined after controlling for valence ratings. Controlling for the potential confounding effects of changes in valence allows for a relatively stringent test of the specific contributions of changes in arousal and control on anxiety-related distress during habituation.

1. Method

1.1. Participants

One hundred and two (44 females) adults (M_{age} = 23.19 years, SD = 8.2) were recruited via fliers and announcements within a relatively large southern community (i.e., northwestern Arkansas; population of approximately 350,000). Of this sample, 4.9% completed high school, 86.3% partial 4-year college programs, 2.0% a 2-year college program, 2.0% a 4-year college program, 3.9% partial graduate school, and 1.0% completed graduate school. In terms of ethnicity, 95% were Caucasian, 2.5% African-American, and 2.5% Asian.

In order to be eligible for this study, participants must have been at least 18 years of age. Participants were excluded based on evidence of: (1) a lifetime history of Axis I psychopathology, including panic attacks or psychotropic medication use; (2) history of significant medical illness, such as cardiovascular, endocrine, pulmonary (including asthma), and gastrointestinal illness; (3) limited mental competency and the inability to give informed, voluntary, written consent to participate; (4) pregnancy; and (5) suicidality. Participants reporting current Axis I psychopathology or suicidality were given referral information when appropriate. The Structured Clinical Interview-Non-Patient Version for the *Diagnostic and Statistical Manual* (*DSM*)-*Fourth Edition* (SCID-IV; First, Spitzer, Gibbon, & Williams, 1995) was used to assess for histories of Axis I psychopathology, suicidality, and medication

[1] It should be noted that operational definitions of recovery may vary. For the purpose of the present study, recovery refers to simple habituation of response to an aversive event. Further theoretical and empirical development is needed to determine if strategic processing and evaluation of an aversive event is a necessary condition for recovery.