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Generalization of Respiratory Symptom Triggers

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Behavioral management of asthma and other chronic conditions depends upon the accurate identification of environmental factors that trigger symptom onset. In this study, we developed a lab-based conditioning method to study category-based acquisition and generalization of respiratory symptom triggers. During trigger acquisition, unique exemplars of two different categories were shown to a sample of healthy participants (n = 48). CS+ exemplars were paired with CO_2 inhalation on 50% of trials, while CS- exemplars were always paired with room air. Trigger categories differed in their conceptual similarity. In a generalization task, participants rated symptom expectancy for a set of triggers that included previously seen exemplars, novel exemplars, and exemplars from novel categories. Results show that participants acquired differential symptom expectancies based on category information, which generalized to novel CS+ exemplars and novel categories that shared similarity with the CS+ category. Greater similarity between CS+ and CS- categories increased differential effects for both old and novel exemplars of CS+ and CS- categories, and increased the proportion of novel CS+ exemplars that were remembered as being seen during acquisition. These findings suggest that a more narrowly defined contrast between triggers and nontriggers promotes category-based inference and could help to reduce uncertainty about potential triggers.

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ASTHMA IS A CHRONIC RESPIRATORY DISORDER that is characterized by airway inflammation, intermittent airway constriction, and physical symptoms such as shortness of breath and cough (Global Initiative for Asthma [GINA], 2012). Worldwide, asthma affects about 300 million individuals (GINA, 2012). In the United States, the overall prevalence of asthma is 7.8%, but prevalence is markedly higher among members of ethnic minorities and individuals living in poverty (Moorman, Zahran, Truman, & Molla, 2011).

As a chronic condition, asthma cannot be cured. However, the symptoms of asthma can be controlled by taking appropriate medication and by identifying and avoiding environmental exposures that may trigger asthma symptoms (GINA, 2012). Asthma guidelines state that asthma is best managed collaboratively by the patient and health care provider, and put an emphasis on training asthma self-management skills as part of this collaboration (GINA, 2012).

Asthma symptoms can occur in response to a variety of environmental triggers and the number and type of triggers may differ greatly among individuals. This makes asthma trigger identification and avoidance important aspects of asthma management (Janssens & Ritz, 2013). However, in day-to-day care, systematic identification of asthma triggers is often lacking and trigger management options are only briefly (if at all) discussed by health care practitioners (Rank, Wollan, Li, & Yawn, 2010). Therefore, it is not surprising that individuals with asthma

indicate a lack of knowledge about their asthma triggers and associated uncertainty and anxiety (Caress, Luker, Woodcock, & Beaver, 2002; Tumiel-Berhalter & Zayas, 2006). Furthermore, there is an emerging literature showing that the identification of asthma triggers is prone to errors. For example, in individuals with asthma, symptom beliefs often do not match the results of allergy skin test (Li, Andrist, Bamlet, & Wolter, 2000; Ritz, Steptoe, Bobb, Harris, & Edwards, 2006).

Challenges in identifying symptom triggers are not unique to asthma, but also occur in other chronic conditions such as chronic migraine, food allergy/hypersensitivity, and Multiple Chemical Sensitivity (MCS) (Devriese et al., 2004; Kelman, 2007; Pereira et al., 2005). When objective symptom markers are available (e.g., double blind food challenges in food allergy/hypersensitivity), individuals that report these conditions have shown a marked inaccuracy in identifying symptom triggers (Martin & MacLeod, 2009; Niestijl Jansen et al., 1994). The identification of symptom triggers can be conceptualized as a contingency learning task that occurs in a motivational context (identification of danger and safety). This is highly similar to the identification of cue-outcome contingencies during fear learning. Furthermore, a lack of accurate detection of danger and safety cues has been proposed as a key feature of anxiety disorders such as panic disorder and generalized anxiety disorder (Britton, Lissek, Grillon, Norcross, & Pine, 2011; Grupe & Nitschke, 2013; Lissek et al., 2009), for which individuals with asthma show an increased prevalence compared to healthy controls (Katon, Richardson, Lozano, & McCauley, 2004; Lavoie, Boudreau, Plourde, Campbell, & Bacon, 2011). Due to this high degree of similarity between fear learning and trigger identification, adapting constructs and procedures from fear learning research may be helpful in increasing our understanding of why inaccuracies in the perception of trigger-outcome contingencies occur.

A process that may help to understand inaccuracies in the identification of trigger-symptom contingencies is generalization of learned cue-outcome contingencies to similar cues. Generalization is the tendency to exhibit a conditioned response to a stimulus that resembles a conditioned stimulus (CS+), in this case a symptom trigger along a perceptual dimension such as size, shape, or color (Lissek et al., 2008; Riccio, Ackil, & Burch-Vernon, 1992). The strength of the response tends to decline as the resemblance between the stimulus and the CS+ decreases (Riccio et al., 1992). Furthermore, generalization also occurs along more abstract dimensions, such as emotional valence (Devriese et al., 2000), and recent research has highlighted the role of higher-order cognitions such as conceptual knowledge or category membership as a basis for fear generalization (Dunsmoor & Murphy, 2015). In order to explore the role of category information in fear learning, Dunsmoor and colleagues have developed a conditioning procedure that uses unique category exemplars during acquisition (Dunsmoor, Martin, & LaBar, 2012). In this procedure, exemplars from one category (e.g., animals) are paired with unpleasant electrical stimulation for half of the exemplar presentations, whereas exemplars from another category (e.g., tools) are never paired with the electrical stimulation. Crucially, during the experiment, exemplars are never repeated, so in order to learn about the predictive value of CS+ exemplars, participants have to rely on the shared category relationship of CS+ exemplars. Using this procedure, Dunsmoor and colleagues have shown that category information is used to generate shock expectancy and conditioned fear responses for novel category exemplars and that recognition rates improved for CS+ exemplars compared to CS- exemplars (Dunsmoor et al., 2012).

In asthma trigger identification, generalization effects could explain why patients that have experienced respiratory symptoms in response to a specific asthma trigger may expect the same symptoms to occur when confronted with asthma triggers that resemble the original trigger. For example, an allergic response to the neighbor's cat might lead an asthma patient to expect symptoms when confronted with other pets or animals. The ability to learn which stimulus forms a threat and to generalize this information to stimuli that are very much alike is a useful survival mechanism. However, widespread generalization may cause patients to unnecessarily avoid a wide variety of triggers.

In anxiety disorders, category-based generalization has been described as a characteristic of phobias. Individuals with arachnophobia, for example, not only fear spiders but also different situations (seeing a web, going into a basement) that have the same consequences (presence of a spider) and thus belong to the same category (Shepard, 1987). Indeed, recent research has shown that category membership promotes generalization of threat avoidance in phobic individuals (Dymond, Schlund, Roche, & Whelan, 2013). Similarly, individuals with obsessive-compulsive disorder tend to avoid a wide range of cues that share a common association with danger or harmfulness (Hermans, Baeyens, & Vervliet, 2013).

In this study, we explored the role of generalization of asthma triggers as a mechanism for the development of inaccurate asthma trigger beliefs.