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## The Effects of Maternal Information Transmission on Daughters' Responding to a Voluntary Hyperventilation Challenge

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The Effects of Maternal Information Transmission on Daughters' Responding to a Voluntary Hyperventilation Challenge

The Effects of Maternal Information Transmission on Daughters' Responding to a Voluntary  
Hyperventilation Challenge

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
Master of Arts in Psychology

by

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John Brown University  
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This thesis is approved for recommendation to the Graduate Council.

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## Abstract

Contemporary models of panic etiology would benefit from additional tests of how fear of internal cues is acquired. Drawing from literature suggesting parent-to-child verbal information transmission is one pathway by which fear of *external* stimuli is learned, the current study is designed to address the effects of this pathway on fearful responding to internal cues (i.e., somatic perturbation produced by a voluntary hyperventilation challenge). Specifically, 53 mothers of adolescent females between the ages of 10 and 14 years were randomly assigned to either share negative or positive information regarding their experience with a voluntary hyperventilation challenge prior to their daughters undergoing an identical challenge procedure. It was hypothesized that daughters in the negative information condition would evidence greater fear-relevant responding to the challenge than those in the positive information condition. Unexpectedly, no significant differences between groups emerged regarding daughters' response to the hyperventilation challenge. Results are discussed in terms of their implications for developmentally sensitive perspectives on panic vulnerability.

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## **The Effects of Maternal Information Transmission on Daughters' Responding to a Voluntary Hyperventilation Challenge**

Previous research suggests panic attacks, particularly those occurring prior to the age of 20 years, represent a risk factor for multiple clinically-relevant problems (Baillie & Rapee, 2005). Panic attacks are conceptualized to emerge from fear conditioning of somatic cues through a process called interoceptive learning (Bouton, Mineka, & Barlow, 2001). Prior work also indicates parents can influence offspring fearful reactivity to external stimuli (e.g., an animal) via the transfer of negative verbal information from parent to child (Muris, van Zwol, Huijding, & Mayer, 2010). It therefore stands to reason that parents could play a role in fear conditioning of interoceptive cues among adolescent offspring. Missing in the current literature is experimental research designed to understand the specific role that parents play in shaping adolescent interoceptive learning. The current study begins to address this gap in the literature by evaluating whether parental verbal information affects adolescent anxious response to somatic perturbation.

### **Panic Psychopathology: Nature and Prevalence**

Panic attacks (PA), the characteristic symptom of panic disorder (PD), are acute periods of intense anxiety that occur in the absence of any real danger; these episodes are typified by specific emotional, cognitive, and bodily symptoms such as sweating, racing heart, and thoughts of dying (American Psychiatric Association, 2013). Panic attacks occur in a substantial minority of individuals. For example, community (Goodwin & Gotlib, 2004), clinical (Ollendick, Mattis, & King, 1994), and epidemiological (Essau, Conradt, & Petermann, 1999) work suggests between 3.3% and 18% of adolescents have experienced a panic attack in their lifetime. In terms of 12-month prevalence rates, data from a community-based German sample of 3,021

adolescents and young adults ages 14 to 24 years suggest approximately 2.7% of adolescents and young adults in this range experienced a panic attack in the preceding 12 months (Reed & Wittchen, 1998). It is important to evaluate risk factor processes related to the etiology of panic attacks and related problems for at least two reasons. First, panic attacks are necessary for the pathogenesis of PD (APA, 2013), a common, severe, and chronic condition associated with substance use disorders, poor physical health outcomes, and high rates of healthcare utilization (Greenberg et al., 1999). Specifically, individuals with panic disorder, along with posttraumatic stress disorder, are the top utilizers of psychiatric services (e.g., counseling, medical visits) within the anxiety disorder subtypes. Greenberg and colleagues estimated the economic costs of anxiety disorders at \$42.3 billion dollars annually. Moreover, panic attacks are conceptualized as a risk factor for a variety of other mental health problems (Baillie & Rapee, 2005); research with adult samples consistently links panic attacks to the development of other disorders, including bipolar disorder, depressive and anxiety disorders, and substance use problems (Craig, Hwang, & Bromet, 2002; Goodwin & Hamilton, 2002a; 2002b). Similar findings are available for youth; panic attacks predict the onset of depression and co-morbid anxiety disorders and are associated with an increased likelihood of affective disorders (Andrade, Eaton, & Chilcoat, 1996; Goodwin & Gotlib, 2004; Hayward et al., 1997; Reed & Wittchen, 1998). Indeed, data from multiple sources suggest the presence of panic attacks in adolescence represents a possible prodrome of a wide array of psychological problems (Goodwin & Hamilton, 2002a). Despite the theoretical and pragmatic importance of understanding what factors increase the likelihood of an initial panic attack, data are lacking in regard to specific, developmentally-relevant risk factors that map onto panic vulnerability among youth (Vasey & Dadds, 2001).

### **Conceptual Models of Panic Etiology: Adolescence as a Key Developmental Period**

In seeking to better understand risk factor processes pertinent to panic, a brief review of contemporary etiological models is warranted. Bouton and colleagues (Bouton et al., 2001) articulated the most widely accepted model of panic etiology. This theory emphasizes the role of interoceptive conditioning in producing panic attacks and PD. The authors suggest an initial panic attack, which may happen spontaneously due to heritable or environmental factors (e.g., “false alarm;” Barlow, 2002) or as a result of repeated pairings of bodily arousal (e.g., breathlessness) and fear, sets the stage for somatic cues to elicit panic-relevant responding. In other words, the repeated pairings of somatic cues and personal threat/anxiety results in bodily arousal becoming a phobic stimulus. Panic-relevant risk factors theorized to enhance such conditioning include genetic heritability (e.g., Kendler et al., 1995), sensitized neurobiological “fear networks” (Gorman, Kent, Sullivan, & Coplan, 2000), negative affectivity (Hayward, Killen, Kraemer, & Taylor, 2000), gender (Craske, 2003), avoidance-oriented coping strategies (Feldner, Zvolensky, & Leen-Feldner, 2004), traumatic event exposure (Nixon, Resick, & Griffin, 2004), cigarette smoking (Zvolensky & Bernstein, 2005), contextual factors (e.g., relative “unexpectedness” of somatic experiences; Craske, 1999) that serve to increase the threat value associated with bodily cues (Craske, 2003; Ollendick, 1998) as well as cognitive vulnerability variables such as catastrophic misinterpretation of bodily sensations (Clark, 1986) and beliefs about the harmful consequences of anxiety sensations (anxiety sensitivity [AS]; Reiss, 1991).

Although there is a large descriptive literature on panic correlates among adults, there has been comparably less attention to the construction of developmentally sensitive models of PA/PD etiology and research with adolescents has lagged behind that of adults. Theorists have recently begun to expand existing panic models to include “developmental” factors such as the

role of parenting in enhancing panic vulnerability (Craske, 2003; Ollendick, 1998). This is an important advance, given the relative malleability of parenting compared to other risk factors (e.g., gender). As such, it can be targeted in interventions focused on reducing panic incidence (Mrazek & Haggerty, 1994). In addition, consideration of parenting behavior in panic development among adolescents is theoretically indicated for several reasons. First, available evidence suggests panic symptomology commonly emerges during adolescence (Kessler, Chiu, Demler, & Walters, 2005). For instance, in a study investigating the link between panic attacks and psychopathology among 1,285 youth ranging from ages 9 to 17 years using standardized assessments, Goodwin and Gotlib (2004) reported that the mean age of youth who had experienced panic attacks was 13.4 years. Indeed, the existence of PA in pre-pubertal children is rare and adolescence appears to be a particularly sensitive period for the onset and increasing severity as well as frequency of PA (Ollendick et al., 1994). These data are consistent with developmental psychopathology models suggesting adolescence represents a “core risk” phase during which vulnerability is transformed into clinically-relevant psychopathology (Cicchetti & Rogosch, 2002).

Second, adolescence is a unique developmental phase during which there is considerable biopsychosocial change, driven in part by the complex bodily changes related to puberty (Hayward & Sanborn, 2002). Indeed, the morphologic changes that occur in this pervasive process provide a fecund context for learning about somatic cues. Puberty is typified by profound somatic events and bodily changes; in a relatively short time-span, youth reach skeletal maturity (growth spurt) and develop primary and secondary sexual characteristics (Dubas, Graber, & Peterson, 1991; Rogol, Roemmich, & Clark, 2002; Sheehy, Gasser, Molinari, & Largo, 1999). Importantly, these physical changes typically co-occur with unexpected and/or

undesirable bodily events (e.g., onset of menses, irregularity of initial menstrual cycles and associated “accidents”; Costos, Ackerman, & Paradis, 2002). It is well documented that, compared to external stimuli, interoceptive cues are more likely to be experienced as “unexpected,” even if there is a specific source associated with them (Barlow, 2002; Craske, 1991, 1999; Zvolensky, Lejuez, & Eifert, 2000). Consistent with this conceptualization, empirical work suggests advancing pubertal development marks enhancement of panic risk (see Reardon, Leen-Feldner, & Hayward, 2009, for a review). One challenge of successfully navigating adolescence is learning to manage and appropriately respond to bodily and psychosocial changes that characterize this period (Dahl, 2004). A large body of work indicates that while parents are increasingly “deidealized” across the course of adolescence, they continue to play a critical role in guiding the teenagers’ progression through adolescence (Berk, 2008, p. 616; De Goede, Branje, Delsing, & Meeus, 2009). For instance, parental monitoring and support correlate negatively with adolescent drinking behavior, illicit drug use, deviant acts, and school misbehavior (Barnes & Farrell, 1992). Relevant to the current study, available work suggests that parents, particularly mothers and daughters, communicate about the experience of puberty (Costos et al., 2002). For example, data from this study of 138 adult women interviewed about their experiences with menarche found that 50% of participants had learned about menstruation from their mothers. Also, the authors found 59% of the women only told their mother about their first period and 22% told their mother as well as others. Interestingly, however, the majority of the sample reported the message from their mother about menarche was predominantly negative (e.g., “grin-and-bear-it;” Costos et al., 2002, p. 53), resulting in dissatisfaction about the process among daughters.

Extrapolating from the available work, it stands to reason that parents may be in a key position of influence in terms of helping adolescents to understand how changes in their body relate to physiological health. More specifically, these exchanges may enhance panic vulnerability via fear-relevant “interoceptive learning” (associating fear with bodily sensations). This is important because a central question pertinent to panic etiology is the *process* by which fear of somatic perturbation is acquired. Research on fear acquisition, reviewed next, provides a larger theoretical context for the current study.

### **Learning Pathways**

Rachman (1977) proposed three pathways by which fear can be acquired: direct experience, vicarious learning, and verbal information pathway. Thus, an individual comes to fear a particular stimulus (e.g., spider) by either having a direct interaction with the stimulus (e.g., getting bit by a spider), witnessing another individual fearfully interact with the stimulus (e.g., watching mother react fearfully to a spider), or threat information about the stimulus being verbally passed from another individual (e.g., mother saying the spider could bite you and really cause you harm). There is a wealth of human (Field, Lawson, & Banerjee, 2008; Gerull & Rapee, 2002; Muris et al., 2010) and non-human animal (e.g., Cook & Mineka, 1989; Mineka, Davidson, Cook, & Keir, 1984) work supporting direct and vicarious conditioning as mechanisms through which fear of external stimuli is acquired. For instance, Gerull and Rapee (2002) investigated toddlers’ reactions to their mothers modeling positive, negative, or neutral expressions to external stimuli (i.e., rubber snake or rubber spider). Children who witnessed their mother react negatively (e.g., fearful or disgusted) in response to the external stimulus evidenced significantly more fear in response to their mothers’ reactions and greater avoidance behavior when exposed to the external stimulus compared to toddlers who witnessed their mothers react

positively. These data accord with non-human primate work in which Rhesus monkeys naïve to the study stimuli acquired fearful reactivity to a variety of fear-relevant objects (e.g., toy snakes and crocodiles), but not to fear-irrelevant objects (e.g., flowers and toy rabbits) after observing videos of monkey models react fearfully to these objects (Cook & Mineka, 1989).

There is also evidence that the provision of negative verbal information plays a role in fear acquisition (Field, 2006; Field & Lawson, 2003; Muris & Field, 2010). For example, Field, Argyris, and Knowles (2001) conducted two experiments examining the effect of information type and source of information on children's fear beliefs about external stimuli (i.e., novel monster dolls). In the first study, fear beliefs of children aged 7-9 years who heard a negatively valenced story from their teacher about the external stimulus significantly increased whereas fear beliefs of children who heard a positively valenced story did not change. In the second experiment, the increase in children's fear beliefs was stronger when an adult experimenter or teacher told the negatively valenced story about the external stimulus compared to a same-age peer relating the negatively valenced story. In a related study, Field and colleagues (2008) investigated the long-term impact of information type on fear beliefs among 6-8 year olds and 12-13 year olds. These authors found an increase in children's fear beliefs and avoidance behavior in both age groups after hearing a female experimenter relate verbal threat information about an external stimulus (i.e., Australian marsupial), and they also found these fear beliefs persisted across a prospective six month assessment interval. Similarly, Field and Schorah (2007) assessed physiological responding (i.e., heart rate) among children aged 6-9 years during an avoidance task after hearing negative, positive, or no information related to external stimuli (i.e., Australian marsupials). Children who heard negative information from the experimenter about the animal had significantly higher average heart rate when approaching the box housing the

Australian marsupial compared to children who heard no information. Lastly, Muris and colleagues (2010) found children's fear beliefs related to a novel, external stimulus (i.e., Australian marsupial) significantly increased after hearing a negatively valenced script about the animal from one of their parents. Collectively, these data suggest the verbal information transmission is a likely pathway by which children acquire fear of external stimuli.

In contrast, very little research has investigated how fear of internal stimuli is acquired (i.e., interoceptive fear conditioning), and all available work is based upon classical conditioning models. Here, akin to Rachman's (1977) direct experience pathway, the overarching conceptual model is that unconditioned stimuli (US; antecedents of a panic attack, such as heart palpitations) become conditioned stimuli (CS), producing increasingly intense arousal and fear (conditioned response) via repeated pairings (Bouton et al., 2001; Razran, 1961). Razran proposed that panic-relevant conditioning results most commonly when the CS and the US are both internal to the organism. In his seminal work, Razran exposed dogs to bursts of 10% CO<sub>2</sub>-enriched air, which produces excess CO<sub>2</sub> in the blood, or hypercapnia. Carbon-dioxide-enriched air typically produces panic-relevant sensations in humans, such as breathlessness and fear (Zvolensky & Eifert, 2001). Razran showed that, following repeated pairings of experimenter induced intestinal distention and 10% CO<sub>2</sub>-enriched air, experimenter induced distension came to elicit hypercapnia in the dogs (in the absence of the CO<sub>2</sub> administration). This landmark study was the first to show that internal stimuli could be classically conditioned, although it would be decades before researchers began to investigate the phenomenon in humans. In one of the few studies on interoceptive fear conditioning in humans, Acheson, Forsyth, and Moses (2012) administered bursts of 20% CO<sub>2</sub>-enriched air in differing time intervals to a healthy sample of college students (i.e., a 5-s burst served as the CS and a 15-s burst served as the US). All participants were

exposed to the same number of CS trials. Compared to a CS-only condition (in which only 5s intervals of CO<sub>2</sub>-enriched were presented), self-reported fear and distress was higher among participants exposed to contingent US-CS presentations, suggesting fear of internal stimuli can be acquired via interoceptive conditioning. These data are consistent with other interoceptive conditioning studies in humans (Acheson, Forsyth, Prenoveau, & Bouton, 2007; De Cort, Griez, Buchler, & Schruers, 2012) and despite the relatively small size of the literature, suggest there is emerging evidence for interoceptive conditioning in humans.

Although classical conditioning likely contributes to panic vulnerability as conceptualized by Bouton and colleagues (2001), modern learning theory acknowledges the role of multiple types of conditioning experiences in producing clinically relevant phenomena (Bouton, 2007). Indeed, research reviewed above suggests information transmission is an important pathway by which children acquire fear of external stimuli. Absent from the empirical literature is evaluation of how fear of internal stimuli is acquired, and no work has evaluated whether the pathway of verbal information transmission enhances fear of internal stimuli. In addition to the theoretical relevance of such a test to models of panic etiology, given the importance of key socializing agents, including parents, in helping adolescents manage the complex somatic changes that characterize this developmental phase, this is a critical gap in the extant literature.

### **The Current Study**

The objective of the current study was to evaluate the effects of maternal negative information provision on fear-relevant responding to somatic arousal in a sample of adolescent females. Mothers and daughters were selected in light of the fact that discourse about somatic events (in the context of puberty) is most likely within this dyad (cf., mother-son; Downs &

Fuller, 1991; Stein & Reiser, 1994). In addition, females are more likely than males to evidence panic-relevant problems (Kessler et al., 2012).

**Primary hypotheses.** Daughters whose mothers transmit negative information regarding somatic arousal produced by a voluntary hyperventilation challenge (negative information condition), relative to those whose mothers transmit positive information (positive information condition), were expected to evidence greater fear-relevant responding to a voluntary hyperventilation challenge. Specifically, adolescents in the negative information condition were hypothesized to report:

- 1) higher self-reported post-challenge anxiety
- 2) greater intensity of post-challenge panic symptoms
- 3) decreased behavioral willingness to participate in a second hyperventilation

## **Method**

### **Participants**

Fifty-three mothers ( $M_{age} = 37.70$  years,  $SD = 6.95$ ) and their 10 to 14 year old daughters ( $M_{age} = 12.47$  years,  $SD = 1.30$ ) were recruited from the general community. The adolescents and mothers in the sample primarily identified as Caucasian, and most mothers in the sample endorsed partial completion of college with the average income of \$52,958 dollars. However, most participants elected not to complete the income question; so, this data point is based on a subset of the sample ( $N = 17$ ). Please see Table 1 for complete demographic information of the mothers and daughters by condition. The mother-daughter dyads were recruited using a variety of strategies including a) flyers placed throughout the local community, b) internet resources (e.g., Craigslist, Star Shopper), c) information booths set up at community functions (e.g., farmer's market, Cinco de Mayo festival) and d) advertisements distributed through local

community organizations, including the Jones Center as well as the Boys and Girls Club. Participants contacting the laboratory were fully informed about study procedures and administered an initial screening to assess basic study eligibility requirements (i.e., offspring age, previous participation in research studies conducted by the current team, asthma). One hundred and eight interested adolescents or parents contacted the laboratory; the current sample is comprised of those who could be contacted (e.g., via return telephone call), were eligible based on the pre-screening telephone assessment, and available to take part in a two-hour laboratory session. Comprehensive screening for inclusion and exclusion criteria took place in person at the beginning of the laboratory session (see *Procedure* for details).

## **Measures**

**Adolescents.** Adolescents completed a *demographic questionnaire* assessing basic demographic characteristics including age, gender, ethnicity, race, grade in school, and body mass index. In addition to female gender (Craske, 2003), the most well established correlates of panic-type problems among youth are anxiety sensitivity (Taylor, 1999), cigarette smoking (Johnson et al., 2000), pubertal status (Reardon et al., 2009), and negative affectivity (Craske, 2003). These variables were assessed to ensure the efficacy of random assignment in equating groups on these factors.

All adolescent participants were administered the panic section of the *Anxiety Disorders Interview Schedule-IV: Child Version* (ADIS-C; Silverman & Albano, 1996) in order to screen for current or past panic disorder, which was an exclusionary criteria for the current study (see *Procedure* for details). The PI administered the ADIS-C following comprehensive training. The ADIS-C has been validated with adolescents and covers all Axis I mood/anxiety diagnoses by the DSM-IC (APA, 1994). The interview typically takes about 10 minutes and has good

psychometric properties including excellent interrater agreement for the PD module ( $\kappa = .93$ ) and evidence of convergent validity (Wood, Piacentini, Bergman, McCracken, & Barrios, 2002). Specifically, children diagnosed with panic disorder by the ADIS-C endorsed significantly higher scores on the on the total Multidimensional Anxiety Scale for Children (MASC) and also on the parent report of the MASC Physical Symptom subscales compared to children diagnosed with other anxiety disorders.

The *Child Anxiety Sensitivity Index* (CASI; Silverman, Fleisig, Rabian, & Peterson, 1991; Wright et al., 2010) was used to index anxiety sensitivity. The total score of the CASI reflects fear of the consequences of anxiety generally, including social, mental, and physical concerns. While the entire CASI was administered, only the physical concerns facet was utilized to evaluate random assignment, as this factor evidences the most robust conceptual and empirical relations with panic-relevant responding among youth (e.g., Wright et al., 2010). For this facet, participants rated the degree to which they experienced fear in response to their arousal-related bodily sensations by endorsing 1 (“none”), 2 (“some”), or 3 (“a lot”) for 18 items. An example item is “It scares me when I feel like I am going to throw-up.” This scale was adapted for and validated with children and adolescents and has good psychometric properties (e.g.,  $\alpha = .80$  for the Physical Concerns subscale in the current sample; Silverman, Goehart, Barrett, & Turner, 2003). For example, the two-week, test-retest reliability for a nonclinical sample was  $r = .76$  (Silverman et al., 1991). Additionally, in terms of construct validity, Silverman and colleagues (1991) presented evidence that the CASI is not simply a measure of anxiety symptom frequency; correlations between the CASI and prevalence of anxiety symptoms (indexed by the Child Anxiety Frequency Checklist, CAFC) ranged from .12 to .51 in clinical and nonclinical samples.

Cigarette smoking was measured with the tobacco use-related items from the well-established *Youth Risk Behavior Survey* [YRBS; Centers for the Disease and Control and Prevention (CDC), 2006]. The YRBS was developed as part of the CDC-sponsored Youth Risk Behavior Surveillance System aimed at monitoring health-risk behaviors among youth in the United States. This questionnaire measured smoking status (i.e., “have you ever smoked a cigarette), age of initial use, current use, and use within the past month. Rates of current use (smoking within the past month; Eaton et al., 2012) were compared across conditions.

The *Tanner Staging System* (Morris & Udry, 1980) was employed to measure adolescent pubertal status. Each participant was shown sex-appropriate drawings depicting specific secondary sexual characteristics across the course of puberty (i.e., breasts and pubic hair). Participants were asked to “choose the drawing that most looks like you” from each set of five drawings. Self-ratings were averaged to generate a single score ranging from Tanner stage I (immature) to Tanner stage V (mature) for each participant. This instrument is commonly used in pubertal research (e.g., Hayward et al., 1992; Wilson et al., 1991) and data support the validity of this assessment strategy. For instance, Duke, Litt, and Gross (1980) reported good convergent validity between this measure and physician ratings of pubertal stage, with kappa coefficients ranging from .81 to .88. In terms of construct validity, self-reported Tanner stage correlated positively with physiological processes known to occur during puberty, such as increases in sex steroid concentrations (reflected by increased levels of Insulin-Like Growth Factor I; Wilson et al., 1991).

The negative affect subscale of the *Positive and Negative Affect Schedule for Children* (PANAS-CN; Laurent et al., 1999) was administered to index generalized negative affectivity. Participants specified the degree to which they had “felt this way during the past few weeks” by

endorsing 1 (“very slightly or not at all”), 2 (“a little”), 3 (“moderately”), 4 (“quite a bit”), or 5 (“extremely”) in response to 30 adjectives listed (e.g., interested, nervous, fearless, gloomy, etc.). The PANAS-CN has demonstrated good psychometric properties ( $\alpha = .85$  in the current sample); for instance, Wilson, Gullone, and Moss (1998) reported Cronbach’s alpha of .81 for negative affect among Australian children. Divergent validity was evidenced by the absence of a significant correlation between the negative and positive affect subscales. By contrast, in support of the convergent validity of the PANAS-CN, this subscale related positively to neuroticism and was unrelated to extraversion (Wilson et al., 1998).

**Mothers.** Mothers completed a *demographic questionnaire* assessing for basic demographic characteristics including gender, age, education level, household income, occupation, marital status, number of children in the household, and body mass index. As with the adolescent offspring, maternal anxiety sensitivity, cigarette smoking, and negative affectivity were evaluated to check the efficacy of random assignment. In addition, maternal history of panic attacks, a strong correlate of panic-type problems among adults (Goodwin, Hamilton, Milne, & Pine, 2002), was indexed.

The *Anxiety Sensitivity Index* (ASI-3; Taylor et al., 2007) was used to index anxiety sensitivity among mothers. Only the physical concerns subscale was used to address the efficacy of random assignment, as this facet demonstrates the most robust associations with panic-type outcomes among adults (e.g., Taylor, 1999). For this subscale, participants rated the degree to which they experienced fear in response to their body arousal by endorsing 0 (“very little”), 1 (“a little”), 2 (“some”), 3 (“much”), or 4 (“very much”) to 18 items such as, “When my stomach is upset, I worry that I might be seriously ill.” The ASI-3 has evidence of good psychometric properties ( $\alpha = .81$  for the Physical Concerns subscale in the current sample). For example,

Taylor and colleagues (2007) reported Cronbach's coefficient alphas ranging from .76 to .86 for the physical concerns facet across multiple national and international samples. There has also been good evidence of construct validity. In terms of divergent validity, for instance, Taylor and colleagues reported a small correlation between education level and the ASI-3 ranging from -.06 to .15. For convergent validity, Taylor and colleagues reported the ASI-3 subscales correlated positively with similar ASI subscales in comparison to dissimilar subscales (e.g., physical concerns subscale compared to social concerns subscale).

The Panic Attack Questionnaire (PAQ-IV; Norton, Zvolensky, Bonn-Miller, Cox, & Norton, 2008) was used to assess for lifetime history of panic attacks among the mothers in the study. Many different facets of panic were assessed via the PAQ-IV, such as endorsement of personal history of panic attacks over the past year, month, and week. After a description of a panic attack was provided along with a list of associated bodily symptoms (e.g., pounding or racing heart, dizziness, etc.), the participants were asked about their lifetime history of panic attacks ("Have YOU ever had one or more panic attacks in your life?"). The PAQ-IV has been employed to assess for history of panic attacks among adults (e.g., Mathew, Norton, Zvolensky, Buckner, & Smits, 2011), and has been validated for use with adults (Norton et al., 2008). For example, Norton and colleagues reported that scale scores of panic attack symptom severity and likelihood and avoidance of panic in particular situations on the PAQ-IV accounts for 81% of the variance in the scores on the Panic Disorder Severity Scale (PDSS) among a college-aged sample.

The *Smoking History Questionnaire* (SHQ; National Cancer Institute) was administered to evaluate the total amount of cigarettes smoked in the past week. While the entire questionnaire was administered (questions such as, "Do you currently use: a. Cigars/ b. Smokeless tobacco/ c.

Pipe tobacco”), only the question pertaining to the average number of cigarettes smoked per day in the past week was of interest when assessing the efficacy of random assignment.

The negative affect subscale of the *Positive and Negative Affect Schedule* (PANAS-N; Watson, Clark, & Tellegen, 1988) was employed to assess generalized negative affectivity. Participants were given the full version of the PANAS with a mix of ten positively valenced words (e.g., inspired, determined) and ten negatively valenced words (e.g., guilty, nervous) and asked to rate the degree to which they “generally feel this way” from 1 (“very slightly or not at all”) to 5 (“extremely”). The PANAS-N has demonstrated good psychometric properties ( $\alpha = .85$  in the current sample). For example, Crawford and Henry (2004) reported Cronbach’s coefficient alpha of .85 for the negative affect subscale within a sample from the United Kingdom. Evidence of construct validity was also obtained in this study; the PANAS-N was significantly associated with the depression ( $r = .60$ ) and anxiety ( $r = .60$ ) subscales of the Depression and Anxiety Stress Scale.

**Challenge measures.** Both parent and adolescent participants were administered the *Medical Screening Interview* to assess for the possibility of pregnancy and current/past cardiac or respiratory problems (e.g., “Has the doctor ever told you have any respiratory (breathing) problems, such as asthma or bronchitis?”). Endorsement of cardiac or respiratory problems and/or pregnancy served as the basis for exclusion from the current study to ensure participants were healthy enough to take part in the hyperventilation task. Mother and daughter participants verbally endorsed “yes” or “no” and had the opportunity to provide additional comments. Responses that indicated uncertainty (e.g., “I don’t know,” “I can’t remember,” or “Yes, but it was benign”) were treated as a positive endorsement, and those subjects were not allowed to participate in the proposed study. These screening criteria have been used successfully in the past

with similar provocation procedures (Leen-Feldner, Feldner, Bernstein, McCormick, & Zvolensky, 2005). This interview took approximately 5-10 minutes.

The procedure and assessments were identical for mothers and adolescents in terms of the voluntary hyperventilation procedure. As a measure of self-reported anxiety, both parent and adolescent participants provided ratings of their *Subjective Units of Distress* (SUDS; Wolpe, 1958) in terms of current anxiety (i.e., “what is your level of anxiety right now?”), sadness, and happiness on a Likert scale from 0 (“no anxiety”) to 100 (“extreme anxiety”) following the pre-hyperventilation 5-min baseline period, directly following the procedure, and once every minute during a 5-min recovery period.

Directly following the challenge, participants completed the *Acute Panic Inventory* (API; Dillon, Gorman, Liebowitz, Fyer, & Klein, 1987; Leen-Feldner, Reardon, & Zvolensky, 2007; Pine et al., 1998), a 23-item assessment of panic-relevant responding. Each item on the API represented a panic attack symptom (e.g., “do you feel like passing out?”) to which respondents endorsed 0 (“no”), 1 (“a little”), 2 (“somewhat”), or 3 (“a lot”), yielding a total score ranging from 0-69. The API has sound psychometric properties ( $\alpha = .92$  in the current adolescent sample) and has been successfully employed in previous research administering tasks eliciting somatic arousal among children and adolescents (Pine et al., 2000; Pine et al., 2005). For instance, children and adolescents who experienced a panic attack after administration of 5% CO<sub>2</sub>-enriched air reported a higher total API mean ( $M = 12.1$ ,  $SD = 6.5$ ) than the children and adolescents who did not experience a panic attack ( $M = 2.3$ ,  $SD = 3.0$ ) during the CO<sub>2</sub> administration (Pine et al., 2005). Further, the API scores for anxious children (i.e., children clinically diagnosed with an anxiety disorder) were significantly higher during the CO<sub>2</sub> inhalation task than nonanxious children and adolescents.

Finally, participants completed the *Avoidance Measure* (adapted from Levitt, Brown, Orsillo, & Barlow, 2004), a face valid one-item index that provides a gross index of behavioral avoidance with regard to the challenge procedure. Specifically, participants were asked to rate the degree of willingness to participate in a second challenge using a 5-item scale (0 “not at all” to 4 “a lot”). A second challenge was not actually administered.

## **Procedure**

**Consent, screening, and questionnaires.** Upon arrival, parents provided written informed consent for personal and adolescent participation, and adolescents provided written informed assent. The PI then reviewed the key features of the consent/assent forms (i.e., Procedures, Risk/Benefits, Voluntary Withdrawal, and Limits of Confidentiality) and addressed any questions. Next, study inclusion and exclusion criteria were evaluated. Included in the study were primarily biological mothers ( $n = 2$  step-mothers) and their 10-14 year old daughters. Subjects were excluded based on self or parent report of: (a) current or past cardiopulmonary or respiratory (chronic) illness (e.g., chronic obstructive pulmonary disease; asthma); (b) current acute respiratory illness (e.g., bronchitis); (c) possibility of being pregnant (by self-report); (d) limited mental competency and the inability to give informed, written consent, or (e) having participated in a previous study completed by the current research team. Adolescent offspring were also excluded if they met diagnostic criteria for panic disorder. Collectively, these exclusion criteria ensured participant safety in the context of a breathing challenge and ensured participants were naïve to the challenge itself (i.e., had not participated in prior work conducted by the research team). These criteria were evaluated using the telephone screener, Medical Screening Interview, and ADIS-C described above. If mothers or adolescents had reported medical or psychological conditions that rendered them ineligible for the study, they would have

been compensated \$5 and fully debriefed. However, no participants were excluded from study participation based on in-laboratory screenings. Parents and adolescents were next escorted to private rooms to obtain participant height/weight and asked to complete a battery of questionnaires. The battery was randomized to limit order effects. A trained research assistant was available at all times to address questions. Please see Figure 1 for a visual depiction of study procedures.

**Parent administration of instructional set and hyperventilation.** Prior to the creation of the instructional script, mothers were assigned to one of four conditions using randomized block design to ensure similar number of participants in each condition (Kazdin, 2003). This technique also helped guarantee random assignment to either the negative or positive information conditions as well as the counterbalancing of script presentation (i.e., presenting the mother with the positive or negative script first). As adapted from Muris and colleagues' (Muris et al., 2010) study with parents of 8-13 year old children, mothers were given a negative script containing three negative phrases (i.e., *discomfort from the feelings in my body; distressing increase in heart rate; fear*) and a positive script containing three positive phrases (i.e., *excitement from the feelings in my body; thrilling increase in heart rate; fun*) regarding the bodily sensations elicited by the hyperventilation task. The phrases were matched for length and word number but differed in valence. The descriptive words used in the phrases (e.g., excitement, distressing, etc.) were chosen from Bradley and Lang's Affective Norms for English Words (ANEW; Bradley & Lang, 1999). Mothers were instructed to read the sentences silently and imagine what it might have felt like to experience these feelings while engaging in the hyperventilation task. Then, mothers were asked to write one sentence for each phrase in their own words as if they were describing their experiences with the hyperventilation task to another person, such as their daughter. Mothers

practiced reading their scripts to the PI prior to recording the scripts on the iMac's application, GarageBand. Before the adolescent engaged in the hyperventilation task, the recording of the mother delivering either the negative script or positive script was presented. Importantly, the daughter did not know this was a recording, but was told her mother wanted to tell her about her own experiences with the breathing task. This approach was designed to limit potential confounds introduced by non-verbal cues during script delivery (e.g., facial expressions). Two research assistants, blind to condition, coded adherence to the instructions (Muris et al., 2010). Specifically, the research assistants used a 8-point scale ranging from "Not at all" to "Very, very much" to rate the negative valence of the three statements (i.e., pertaining to bodily feelings, heart rate, and overall experience) for each recording presented to the daughter (either negative or positive) about the hyperventilation procedure. Inter-rater reliability was high (i.e.,  $r_s$  ranged from .84 to .95). Next, both rater's scores of all three statements were averaged, and an ANOVA was conducted to compare the negative valence of the averaged score between the two conditions; results from this analysis revealed mothers' statements in the negative information condition ( $M = 5.48, SD = .91$ ) were significantly more negative in valence than mothers' statements in the positive information condition [ $M = .35, SD = .37; F(1, 51) = 709.02, p < .001$ ].

The PI carefully considered whether to expose the mothers to the hyperventilation task following the script construction, given it is not necessary to address the primary study hypotheses and it increases the time the mother and daughter spend in the laboratory. However, the PI reasoned that including a maternal challenge would be beneficial. Specifically, the data obtained from this task may be valuable in further understanding how anxiety is passed from

parent to child (i.e., set the stage for a number of secondary analyses regarding intergenerational transmission of panic-relevant reactivity), offsetting concerns regarding participant burden.

**Maternal hyperventilation.** Following the script construction, mothers took part in a well-established three-minute voluntary hyperventilation procedure (e.g., Bunaciu, Feldner, Babson, Zvolensky, & Eifert, 2012). Hyperventilation served as the challenge procedure because it can be safely employed, its parametric properties are well studied, and it can reliably produce bodily arousal that mimics anxiety and panic attack symptoms (Hornsveld, Garssen, Dop, & van Spiegel, 1990). Moreover, voluntary hyperventilation has been shown to be reliable and safe when used with adults, children, and adolescents (e.g., Bunaciu et al., 2012; Leen-Feldner et al., 2005; Unnewehr, Schneider, Margraf, Jenkins, & Florin, 1996). The challenge interval is 3 minutes, with a breathing rate of 30 respiratory cycles/min. This rate of hyperventilation has been shown to produce a decrease in  $p\text{CO}_2$ , an elevation in blood pH, and increases in plasma epinephrine and lactate levels (Fried & Grimaldi, 1993; Gorman et al., 1988). As a measure of anticipatory anxiety, mothers provided ratings of their current anxiety level (SUDS) following a five-minute baseline period. The experimenter then read the following directional script:

This tape will now guide you through a deep breathing exercise. In this exercise, you will be asked to breathe in and breathe out very deeply. The instructions will tell you when you should breathe in and when you should breathe out. Simply inhale when asked to “breathe in,” [experimenter demonstrated] and exhale when asked to “breathe out” [experimenter demonstrated] – making each breath in as deep as possible and each breath out as forceful as possible. It is important that you follow these instructions as best as you can, and continue the exercise until you are asked to stop and rest. The breathing exercise can cause feelings of sweating or faster heart rate. These feelings will go away as soon as

you stop the exercise and breathe normally again. Please do your best to keep up with the instructions.

The experimenter ensured mothers understood the procedure, and then left the room. A pre-recorded audiotape guided the participant through the breathing challenge. Directly following the hyperventilation challenge, participants completed the post-challenge SUDS anxiety ratings, API, and avoidance measure. Finally, they were asked to provide SUDS anxiety ratings every minute during a 5-min recovery period.

**Adolescent hyperventilation.** Prior to maternal script delivery, adolescents took part in a five-minute baseline after which they were provided pre-challenge SUDS anxiety ratings. Thereafter, the mothers' scripted recording was delivered as described above. Immediately following the recording, adolescents took part in a three-minute hyperventilation procedure. The procedure was identical to that described above, including post-challenge administration of the SUDS anxiety, API, and avoidance measure as well as SUDS anxiety ratings every minute during a 5-minute recover period.

**Manipulation check: Script recall.** Immediately following the 5-minute recovery period, adolescents were asked to rate the pleasantness of their mothers' description regarding the hyperventilation task on a 10-point scale with 0 being *not at all pleasant*, and 10 being *very pleasant*. They also provided a fear rating of how scared they were after hearing the description using the same approach. Synonyms were given for "pleasant" (e.g., good, enjoyable) if the adolescent appeared confused or asked for clarification.

**Adolescent positive induction task.** It is standard in child and adolescent experimental psychopathology research to employ a validated "happiness induction" to ensure participants leave the laboratory in a positively valenced affective state (e.g., Gotlib, Traill, Montoya,

Joormann, & Chang, 2005). Available evidence supports the utility of “laugh boxes” among adults (Provine, 1992) and adolescents (Jones, Leen-Feldner, Olatunji, Reardon, & Hawks, 2009) in effectively inducing positive affectivity. Similarly, positively valenced images drawn from the International Affective Picture System (i.e., ratings of at least 7.5 on a 9 point scale; Lang, Bradley, & Cuthbert, 1999), particularly when paired with positive valenced music (“Brandenburg Concertos 2 and 3” by Bach; Conklin & Perkins, 2005; Goodwin & Sher, 1993), increase positive affect. Adolescent participants were, therefore, asked to either activate “Tickle-Me-Elmo” doll or watch a short slide show accompanied by Bach’s Brandenburg Concertos 2 and 3 and provide SUDS ratings for anxiety, sadness, and happiness immediately following the induction. No adolescent left the laboratory in a distressed state; their affective state upon completion of the debriefing (as indexed by SUDS ratings or verbal report) was at or above their baseline (prior to participating in the voluntary hyperventilation).

**Debriefing and compensation.** Finally, mothers and adolescents were comprehensively debriefed as to the ethical, educational, methodological, and participant satisfaction functions of participant debriefing consistent with published recommendations (Sieber, 1983; Tesch, 1977). Specifically, the mothers and daughters were informed about the purpose and aims of the current study and provided with a thorough description of the condition to which they were assigned. In addition, the experimenter discussed expected findings as they relate to intervention development in this area. After addressing all participant questions regarding the study, mothers and adolescents were given \$20 each and thanked for their time.

### **General Analytic Strategy**

**Power analyses.** Limited research has been conducted on verbal information transmission between parent and child, and no studies have examined this process in the context

of interoceptive stimuli. Drawing on work conducted with children (6-10 years) on the effect of verbal information passed from experimenter to child about external stimuli on attentional biases (Field, 2006) and heart rate reactivity (Field & Schorah, 2007), there is evidence for a medium to large effect ( $r_s = .34$  and  $.42$ , respectively). The role of the person (i.e., teacher, adult stranger, peer, or control) relating the verbal information to the child has also been investigated in regard to children's acquired fear beliefs of external stimuli ranging from ages 7-9 years (Field et al., 2001) with only adults having a significant impact on children's fear beliefs, (effect size  $d = .72$ ). Similarly, Muris and colleagues (2010) reported a moderate to large effect size (partial  $\eta^2 = .45$ ) in their study of parental verbal information transmission from parent to child. Collectively, the available evidence suggests we can expect a moderate to large effect size. Given power of .80, 50 participants will thus be sufficient to detect an effect if present.

**Preliminary analyses.** Measures completed by mothers and adolescents are distinguished by the addition of "M" or "A," respectively, at the end of each acronym (e.g., SUDS-A). First, to assess the efficacy of random assignment, groups were compared on a number of conceptually relevant characteristics. Specifically, t-tests were conducted to compare groups in terms of the continuous variables of adolescent age, CASI-PC, ASI-PC, PANAS-CN, PANAS-N, Tanner Stage, and number of cigarettes smoked in the past month or week as determined by the YRBS and SHQ. A chi-square test was utilized to compare groups in terms of the dichotomous variable of the PAQ. Finally, zero-order correlations were conducted between continuous variables, and the conceptually relevant characteristics that differed between conditions or were significantly related to the dependent variables were included as covariates in relevant analyses.

As a manipulation check, analyses of variance (ANOVA) were utilized to assess for differences in daughters' recall and subjective response regarding maternal script delivery between groups. Specifically, valence (i.e., pleasantness) of the maternal script or adolescents' subjective fear in response to the maternal script were entered as the dependent variable and condition (positive information; negative information) was entered as the fixed factor.

**Primary analyses.** ANOVAs were used to test the primary hypotheses. Specifically, condition (positive information; negative information) was entered as the fixed factor and API-A, SUDS-A, and behavioral avoidance were entered as the dependent variables. Scores on the API-A and behavioral avoidance evidenced a positive skew, and were square root transformed prior to analysis.

## Results

### Preliminary analyses

**Covariates.** The chi-square test evaluating group differences on the PAQ [ $\chi^2(1) = .93, p = .34$ ] indicated no differences between the positive ( $M = 1.28, SD = .46$ ) and negative ( $M = 1.41, SD = .50$ ) information conditions in terms of maternal panic attack history. Similarly, the t-tests assessing group differences in terms of adolescent age, CASI-PC, ASI-PC, PANAS-CN, PANAS-N, Tanner Stage, and number of cigarettes smoked in the past week as determined by the SHQ also suggested no differences between groups (please see Table 2 for descriptive data). The descriptive statistics for the major variables were generally comparable to previous published work (e.g., CASI-total among girls:  $M = 28.88, SD = 6.04$ ; Silverman et al., 1991;<sup>1</sup> ASI-PC among women:  $M = 4.3, SD = 4.2$ ; Taylor, 2007; PANAS-CN:  $M = 26.97, SD = 10.58$ ; Laurent et al., 1999; PANAS-N:  $M = 18.10, SD = 5.90$ ; Watson et al., 1988). Interestingly, however, adolescents in both conditions of the current sample endorsed somewhat higher API-A

and, in particular, SUDS-A scores (please see Table 1) than reported in similar work with a non-clinical adolescent sample (e.g., API-A:  $M = 9.88$ ,  $SD = 8.17$ ; SUDS-A:  $M = 23.74$ ,  $SD = 21.50$ ; Leen-Feldner et al., 2005). Only one adolescent reported smoking on one day or more; thus, the YRBS was not included in analyses determining inclusion of covariates.

While groups did not differ on any of the identified covariates, ASI-PC was positively related to API-A ( $r = .28$ ,  $p < .05$ ) and CASI-PC was positively associated with SUDS-A ( $r = .36$ ,  $p < .05$ ). Accordingly, ASI-PC and CASI-PC were utilized as covariates when conducting the primary analyses with API-A and SUDS-A as the dependent variables. Of note, the pattern of findings remained unchanged when covariates were excluded from analyses. Please see Table 3 for all zero-order relations among the continuous potential covariates and outcome variables.

**Manipulation check.** Adolescents in the negative information condition endorsed significantly higher levels of fear ( $M = 4.56$ ,  $SD = 2.78$ ) in response to the maternal script than adolescents in the positive information condition [ $M = 1.38$ ,  $SD = 2.16$ ;  $F(1, 51) = 21.44$ ,  $p < .001$ ]. Further, adolescents in the negative information condition also reported maternal script as significantly less pleasant ( $M = 4.85$ ,  $SD = 2.80$ ) than adolescents in the positive information condition [ $M = 7.31$ ,  $SD = 2.00$ ;  $F(1, 50) = 13.35$ ,  $p = .001$ ].

### Primary analyses

In terms of the first hypothesis regarding post-challenge reports, adolescents in the negative information condition ( $M = 38.21$ ,  $SD = 35.53$ ) did not evidence significantly higher SUDS-A ratings as compared to adolescents in the positive information condition [ $M = 38.36$ ,  $SD = 33.89$ ;  $F(1, 43) = .002$ ,  $p = .97$ ] after accounting for CASI-PC. Contrary to the second hypothesis, adolescents in the negative information condition ( $M = 15.04$ ,  $SD = 12.64$ ) did not report significantly greater API-A compared to adolescents in the positive information condition

[ $M = 17.40$ ,  $SD = 12.86$ ;  $F(1, 48) = .08$ ,  $p = .77$ ] after accounting for ASI-PC. Finally, there were no significant differences in terms of behavioral avoidance among adolescents in the positive information condition ( $M = 1.15$ ,  $SD = 1.01$ ) as compared to the negative information condition [ $M = 1.78$ ,  $SD = 1.45$ ;  $F(1, 51) = 1.22$   $p = .28$ ].

### **Discussion**

Extant literature supports verbal information transmission as a potential pathway for the acquisition of fear regarding external stimuli (e.g., Field et al., 2008; Field et al., 2001; Muris et al., 2010). However, the effect of the verbal information pathway has not yet been investigated in the context of bodily arousal among parent-adolescents dyads in a laboratory setting. The purpose of the current study was, therefore, to experimentally evaluate the effect of maternal transmission of negative versus positive information on adolescent offspring response to a voluntary hyperventilation task.

In contrast to prediction, there were no differences in fear-relevant responding (i.e., post-challenge anxiety, panic symptoms, avoidance) between daughters whose mothers transmitted negative information and those whose mothers transmitted positive information concerning somatic arousal elicited by a voluntary hyperventilation challenge. Importantly, the daughters whose mothers transmitted negative information reported higher subjective fear levels in response to their mothers' information and rated their mothers' information as less pleasant than adolescents whose mothers transmitted positive information. These results suggest the manipulation (instructional set) had the intended impact in terms of increased transmission of negatively valenced or scary information to those in the negative, relative to the positive, information condition. Contrary to expectations, however, this manipulation did not

differentially influence daughters' fear-relevant responding to the voluntary hyperventilation task.

The effects of maternal information transmission regarding offspring interoceptive stimuli (i.e., somatic arousal) have not been directly evaluated in the extant literature; however, the current findings are inconsistent with prior work supporting offspring fear acquisition in the context of external stimuli through parental verbal information transmission (e.g., Muris et al., 2010). This discrepancy may be due to a number of methodological differences between published work and the current study. First, research to date has focused on fear acquisition in the context of an *external* stimulus (e.g., Australian marsupial). One possibility is that fear of internal stimuli may be acquired through different mechanisms. For instance, modeling (e.g., Ehlers, 1993) or direct conditioning (Acheson et al., 2007; 2012; De Cort et al., 2012) may be more powerful pathways by which fear of somatic arousal is acquired. Relatedly, the stimulus in prior work was novel to participants in the study, whereas most adolescents have prior experience with bodily sensations, such as a racing heart or dizziness. It is also possible that latent inhibition (i.e., stimulus pre-exposure retards subsequent conditioning; Bouton, 2007) influenced results; the instructional set employed in the current study may not have been powerful enough to impact responding to somatic perturbation given youth likely have significant prior experience with such sensations. Further, adolescents in the current study directly encountered the stimulus of somatic perturbation prior to providing ratings of anxiety and panic symptoms. By contrast, children in the marsupial study never actually engaged with the novel stimulus, and thus did not have an opportunity to make their own appraisals. Finally, the sample in Muris and colleagues' study was younger ( $M_{age} = 10.82$ ), and accordingly the discrepancy in findings could be due to age-specific variables that vary between the

developmental periods of childhood and adolescence (e.g., impact of maternal transmission, study engagement, sensitivity to fear acquisition, etc.). Each of these methodological issues (e.g., internal vs. external stimuli, degree of experience with stimuli, developmental considerations) merits investigation to inform our understanding of the role these variables may play in fear acquisition.

The absence of group differences with regard to behavioral avoidance was also contrary to prediction. Here again, it is possible that transmission of fear-relevant information in the context of internal stimuli is not a pathway by which avoidance of somatic perturbation is acquired; although, there are a number of methodological considerations that may explain the observed null effects. First, despite evidence suggesting the manipulation was effective, daughters' valence ratings for the negative information transferred (not response to the task) for the manipulation check were not exceptionally unpleasant, nor were fear levels extremely elevated. These data suggest the information conveyed in the negative information condition may not have been particularly robust in terms of eliciting fear. Similar results were observed in a study investigating the effect of maternal information transmission on children's fear regarding a novel external stimulus (i.e., real Gerbils; Remmerswaal, Muris, & Huijding, 2013). Differences between groups were not detected on mothers' or children's self-reported fear, but children in the negative information condition evidenced significantly greater approach latency to interacting with the gerbil. Remmerswaal and colleagues (2013) suggest, in line with the discussion above, that more intensive (ethically appropriate) fear induction procedures may be necessary to influence self-reported fear ratings. For instance, enhancing maternal expression of negative affect (e.g., strained voice) or repeating the instructional sets may increase their impact. Interestingly, however, the current study did not replicate the avoidance findings observed in

Remmerswaal and colleagues' study. This may be due to differences in the assessment of avoidance. Specifically, Remmerswaal and colleagues employed a behavioral avoidance task, in which the children's latency to place their hand inside a box housing the gerbil was evaluated. In the current study, participants were asked to self-report on whether they would be willing to complete a second challenge. While some participants may have indicated that they were less willing to do so due to concerns about encountering somatic arousal, it is also possible that participants were fatigued, bored, or otherwise unmotivated to complete a second challenge. Utilization of more direct measures of avoidance would help address this issue. For example, future studies could employ an avoidance task measuring delay time (Bunaciu et al., in press) by asking the adolescent to complete the breathing task for a second time and then indexing the amount of time it takes the adolescent to begin the task.

Several other methodological issues merit additional consideration. First, in terms of ecological validity, it may be unusual, in a naturalistic setting, for mothers to describe their somatic experiences in such detail, using the adjectives provided by the experimenter. Further, the script was delivered via computer. These issues may have reduced the credibility of the positive and negative scripts, thus attenuating their impact. It will be important for future work in this area to assess credibility of instructional sets administered to youth. Second, the positive information shared by mothers could have created a contrast effect, wherein the expectancies engendered in adolescents in this group were markedly different from the experience of hyperventilation, thus enhancing fearful responding to the hyperventilation task (Biernat, 2005). To evaluate this possibility, future work will benefit from the inclusion of negative, positive, and neutral information regarding somatic sensations evoked by the hyperventilation task. Third, debriefing revealed that a substantial minority of adolescents may not have understood the

meaning of “anxiety” in the context of SUDs ratings. Training on labeling of affective states, prior to challenge procedures, would attenuate concerns regarding participant comprehension. Fourth, the current study did not employ an empirically supported manipulation check of adherence to the hyperventilation task (e.g., expired carbon dioxide [ $p\text{CO}_2$ ]; Rapee, Brown, Antony, & Barlow, 1992). Accordingly, daughters in the negative information condition may not have fully engaged in the task due to fear evoked by maternal information. Fifth, while power analyses indicated the current sample size was adequate to detect effects, these analyses were based on work involving external stimuli. It is possible that verbal information transmission produces a relatively smaller effect for fear acquisition of internal (cf., external) stimuli and the current study was underpowered to detect such an effect. Finally, the current sample was all female, primarily identified as Caucasian, and were paid to take part in a laboratory-based investigation. Future research using larger samples as well as more diverse recruitment and compensation strategies would enhance the generalizability of findings.

Extant work on fear acquisition suggests verbal information transmission could be a potential pathway through which fear is acquired of somatic arousal. However, the current investigation did not find support for adolescent fear acquisition of bodily arousal via maternal information transmission. Given the public health relevance of understanding pathways by which youth acquire fear of internal sensations, it will be important to systematically address this question across more diverse samples, settings, and outcomes to determine whether the verbal information transmission pathway pertains to the learning of internal sensations. Future work in this area could have important implications for panic etiology.

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## Footnote

<sup>1</sup>While the current literature has some discrepancy regarding the factor structure (i.e., two, three, or four-factor models) of the Childhood Anxiety Sensitivity Index (CASI), the most recent confirmatory factor analysis conducted by Wright and colleagues' (2010) supports the three-factor model (Walsh, Stewart, McLaughlin, & Comeau, 2004) consisting of a single, higher order factor and three subfactors (physical concerns, social concerns, and psychological concerns). To date, however, no work has published descriptive statistics of the physical concerns subfactor using Walsh's three-factor model among youth. Due to the lack of data in the extant literature, the current study compared the CASI total score, as opposed to the CASI physical concerns subscale, to previous published work. Importantly, the CASI total score in the current sample ( $M = 28.28$ ,  $SD = 4.92$ ) was comparable to previous studies (e.g.,  $M = 28.88$ ,  $SD = 6.04$ ; Silverman et al., 1991) conducted with female youth in a nonclinical sample.

Table 1.

*Sample Characteristics and Dependent Variables as a Function of Condition (raw data)*

	Condition	
	<i>Negative Information</i>	<i>Positive Information</i>
	<i>M or n (SD or %)</i>	<i>M or n (SD or %)</i>
<i>Adolescent Daughter</i>		
Age	12.49 (1.21)	12.45 (1.40)
Racial Composition		
White/Caucasian	17 (63.0%)	19 (73.1%)
Asian	0 (0%)	1 (3.8%)
Biracial	2 (7.4%)	2 (7.7%)
African American	6 (22.2%)	0 (0.0%)
Other	1 (3.7%)	4 (15.4%)
Missing	1 (3.7%)	0 (0.0%)
Ethnic Composition		
Hispanic/Latino	2 (7.4%)	2 (7.7%)
Non-Hispanic	25 (92.6%)	24 (92.3%)
Education		
Fourth grade	1 (3.7%)	0 (0.0%)
Fifth grade	3 (11.1%)	6 (23.1%)
Sixth grade	6 (22.2%)	6 (23.1%)
Seventh grade	9 (33.3%)	6 (23.1%)
Eighth grade	6 (22.2%)	5 (19.2%)
Ninth grade	2 (7.4%)	3 (11.5%)
Fear-Relevant Dependent Variables		
API-A	14.48 (12.73)	17.00 (12.77)
SUDS-A	38.70 (34.95)	40.08 (34.98)
AM-A	1.78 (1.45)	1.15 (1.01)
<i>Mother</i>		
Age	36.30 (6.81)	39.15 (6.92)
Family Income <sup>a</sup>	\$50,589	\$55,625
Racial Background		
White/Caucasian	22 (81.5%)	23 (88.5%)
Asian	0 (0%)	1 (3.8%)
Biracial	2 (7.4%)	2 (7.7%)
African American	2 (7.4%)	0 (0.0%)
American Indian/Alaska Native	1 (3.7%)	0 (0.0%)
Ethnicity		
Hispanic	2 (7.4%)	1 (3.8%)
Non-Hispanic	25 (92.6%)	24 (92.2%)
Missing	0 (0.0%)	1 (3.8%)

Table 1 (cont.)

	Condition	
	<i>Negative Information</i>	<i>Positive Information</i>
	<i>M or n</i> ( <i>SD</i> or %)	<i>M or n</i> ( <i>SD</i> or %)
Education		
Attended high school	0 (0.0%)	2 (7.7%)
Graduated high school	5 (18.5%)	5 (19.2%)
Attended college	10 (37.0%)	3 (11.5%)
Graduated 2-year College	1 (3.7%)	5 (19.2%)
Graduated 4-year College	6 (22.2%)	6 (23.1%)
Attended graduate school	0 (0.0%)	1 (3.8%)
Completed graduate school	5 (18.5%)	4 (15.4%)
Marital Status		
Never married	4 (14.8%)	2 (7.7%)
Divorced/Annulled	4 (14.8%)	3 (11.5%)
Separated	0 (0.0%)	1 (3.8%)
Widowed	0 (0.0%)	0 (0%)
Married/Living with someone	19 (70.4%)	20 (76.9%)

Note:  $N = 53$ ;  $n = 27$  (Negative Information);  $n = 26$  (Positive Information). API-A = Acute Panic Inventory- Adolescent; SUDS-A = Subjective Units of Distress- Adolescent Anxiety; AM-A = Avoidance Measure- Adolescent.

<sup>a</sup> $N = 17$ ;  $n = 9$  (Negative Information);  $n = 8$  (Positive Information).

Table 2.

*Evaluation of the Efficacy of Random Assignment among Conceptually-Relevant Characteristics (raw data)*

	Condition		<i>t</i>
	<i>Negative Information</i>	<i>Positive Information</i>	
	<i>M (SD)</i>	<i>M (SD)</i>	
<i>Conceptually-Relevant Characteristics</i>			
Adolescent Daughter Age	12.49 (1.21)	12.45 (1.40)	-.13
CASI-PC <sup>a</sup>	18.21 (4.27)	18.14 (3.62)	-.06
Tanner Stage <sup>b</sup>	3.07 (1.19)	2.73 (1.23)	-.92
PANAS-CN <sup>c</sup>	25.68 (7.73)	28.77 (10.37)	1.20
ASI-PC <sup>d</sup>	3.12 (5.35)	4.00 (5.17)	.60
SHQ <sup>e</sup>	1.15 (4.16)	.31 (1.01)	-.78
PANAS-N <sup>f</sup>	17.81 (5.39)	18.29 (4.42)	.35

Note: *N* = 53. No statistically significant differences were observed. CASI-PC = Child Anxiety Sensitivity Index- Physical Concerns subscale; PANAS-CN = Positive and Negative Affect Schedule for Children, Negative Affect subscale; ASI-PC = Anxiety Sensitivity Index- Physical Concerns subscale; SHQ = Smoking History Questionnaire- Cigarettes per day; PANAS-N = Positive and Negative Affect Schedule, Negative Affect subscale.

<sup>a</sup>*N* = 46. <sup>b</sup>*N* = 41. <sup>c</sup>*N* = 51. <sup>d</sup>*N* = 51. <sup>e</sup>*N* = 29. <sup>f</sup>*N* = 50.

Table 3.

*Zero-order Relations among Conceptually-Relevant Characteristics, Manipulation Check Variables, and Outcome Variables (raw data)*

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age-A	--												
2. Tanner <sup>a</sup>	.67**	--											
3. PANAS-CN <sup>b</sup>	.18	.22	--										
4. PANAS-N <sup>c</sup>	-.26	-.14	-.04	--									
5. CASI-PC <sup>d</sup>	.16	.08	.30*	-.21	--								
6. ASI-PC <sup>e</sup>	.09	-.02	-.06	.30*	.07	--							
7. SHQ <sup>f</sup>	-.01	.12	.05	.20	-.25	.52**	--						
8. MC-P <sup>g</sup>	-.21	-.20	.08	.13	-.13	-.24	-.44*	--					
9. MC-F	-.20	-.19	-.12	-.17	.02	-.12	.07	-.11	--				
10. AM-A	.21	.15	.07	-.23	.08	-.20	-.24	-.26	.13	--			
11. SUDS-A	-.11	-.03	.09	.001	.36*	.10	.28	-.10	.10	-.28*	--		
12. API-A	-.04	-.003	.15	-.04	.15	.28*	.27	-.18	.21	-.16	.60**	--	

Note:  $N = 53$ . Age-A = Adolescent Age; Tanner = Tanner Staging System; PANAS-CN = Positive and Negative Affect Schedule for Children, Negative Affect subscale; PANAS-N = Positive and Negative Affect Schedule, Negative Affect subscale; CASI-PC = Child Anxiety Sensitivity Index- Physical Concerns subscale; ASI-PC = Anxiety Sensitivity Index- Physical Concerns subscale; SHQ = Smoking History Questionnaire- Cigarettes per day; MC-P = Manipulation Check- Pleasantness of maternal script; MC-F = Manipulation Check- Fear of maternal script; AM-A = Avoidance Measure- Adolescent; SUDS-A = Subjective Units of Distress- Adolescent Anxiety; API-A = Acute Panic Inventory- Adolescent.

<sup>a</sup> $N = 41$ . <sup>b</sup> $N = 51$ . <sup>c</sup> $N = 50$ . <sup>d</sup> $N = 46$ . <sup>e</sup> $N = 51$ . <sup>f</sup> $N = 29$ . <sup>g</sup> $N = 52$ .

\* $p < .05$ . \*\* $p < .01$ .

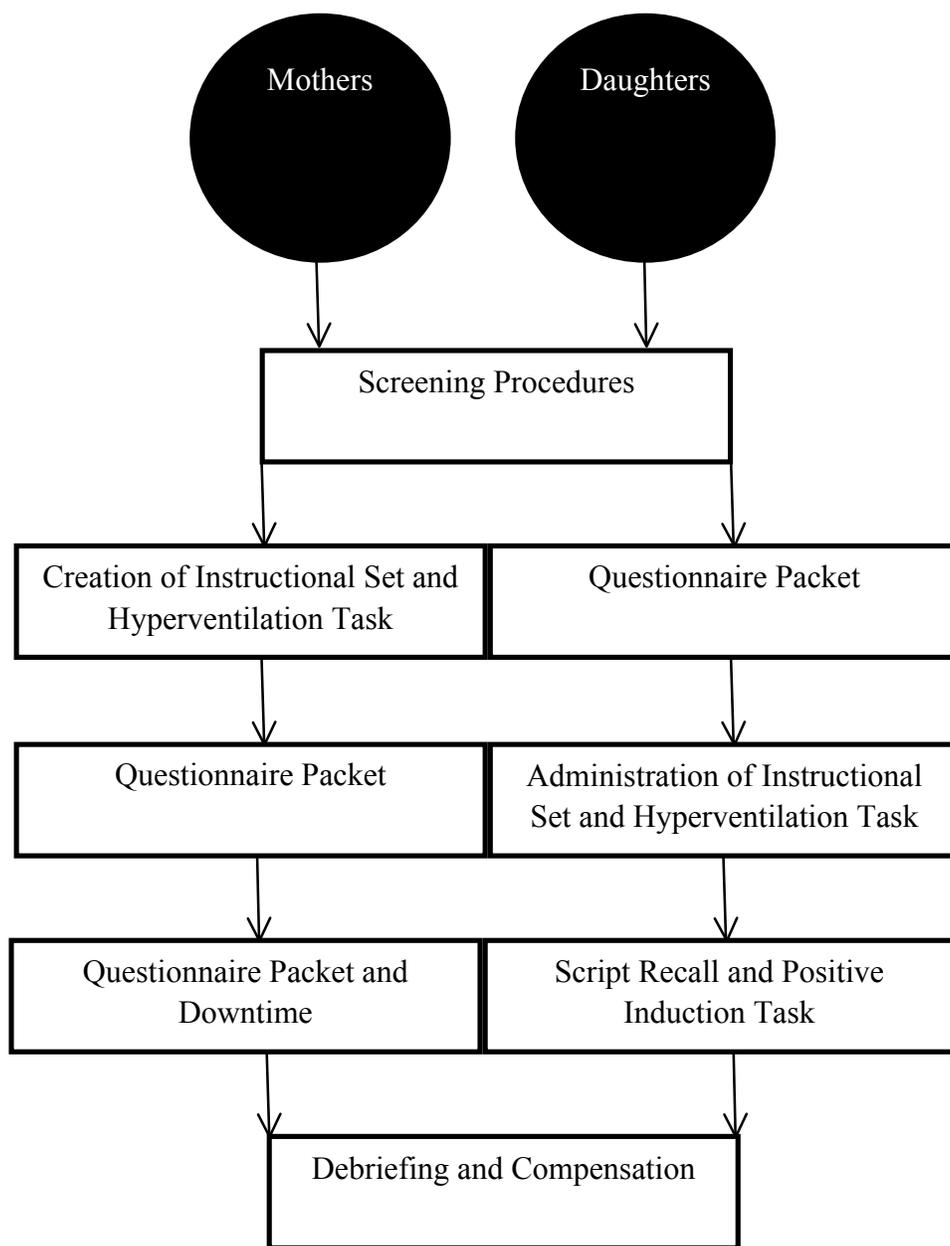


Figure 1. Visual depiction of study procedures for eligible mothers and daughters in the study.

## Appendix A



Office of Research Compliance  
Institutional Review Board

September 19, 2011

## MEMORANDUM

TO: Ashley Knapp  
Ellen Leen-Feldner

FROM: Ro Windwalker  
IRB Coordinator

RE: New Protocol Approval

IRB Protocol #: 11-09-094

Protocol Title: *Parent-Adolescent Information Transmission*

Review Type:  EXEMPT  EXPEDITED  FULL IRB

Approved Project Period: Start Date: 09/16/2011 Expiration Date: 09/15/2012

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (<http://vpred.uark.edu/210.php>). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

**This protocol has been approved for 120 participants.** If you wish to make any modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or [irb@uark.edu](mailto:irb@uark.edu).