5-2012

Worry Induction Among Adolescents: A Laboratory Evaluation

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WORRY INDUCTION AMONG ADOLESCENTS: A LABORATORY EVALUATION

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in Psychology

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May 2012
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Abstract

Available research indicates that worry is an important process involved in the development and maintenance of both psychological (e.g., Generalized Anxiety Disorder) and physical (e.g., coronary heart disease) problems. However, this process is still in need of further investigation, particularly among adolescents. While a sizable body of literature has examined the nature, prevalence, and correlates of worry in both adults and youth, laboratory investigations of this variable using a real-time worry induction paradigm have previously only been done with adults. The current study aimed to extend the literature by using the controlled laboratory methods well established in the adult literature to experimentally examine worry and the validity of a worry induction in a sample of adolescents. Specifically, 50 adolescents between the ages of 12 and 17 years were randomly assigned to either a worry or a neutral thought condition. Results provided initial support for the validity of using an ideographic worry induction procedure with adolescents. Specifically, consistent with hypotheses, participants in the worry group reported elevated levels of worry, depression, negative affectivity, and muscle tension relative to the control group. Similarly, repeated measures analyses indicated the manipulation produced increases in negatively valenced mood and future-oriented thought among those in the worry condition. Unexpectedly, predictions regarding the effects of the induction on happiness and degree of verbal-linguistic thoughts were not supported and there was not evidence that the induction served as a semantic prime. Finally, individual differences in metacognitive worry were not predictive of challenge response. Results are discussed in terms of their convergence and divergence with the adult literature, relevant developmental factors to consider, and future directions using experimental psychopathology methodologies in order to better understand the phenomenology and consequences of worry among youth.

This dissertation is approved for recommendation
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Acknowledgements

I would like to thank Dr. Ellen Leen-Feldner for her invaluable guidance and insight throughout this process and an amazing five years of mentorship. I would also like to thank my committee members, Dr. Lindsay Ham, Dr. Patricia Petretic, and Dr. David Schroeder for their support and feedback in the design and analysis of this project. A special thanks goes to Kevin Autry for his guidance on the development and implementation of the lexical decision task and Trey Andrews for his patient consulting on statistical methods.

I would also like to thank all of the families that participated in the study and helped make this research possible.

Finally, I own a deep and special thank you to my husband, Chris, for his encouragement, patience, and love throughout the graduate school process. Without his unwavering support none of this could have been possible. Additionally, I must thank my daughter Alia for helping me have perspective on this project.

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Worry Induction among Adolescents: A Laboratory Evaluation

Available research focused on the role of worry in the development of both psychological (e.g., Generalized Anxiety Disorder [GAD]; Hoyer, Becker, & Roth, 2001) and physical (e.g., coronary heart disease; Kubzansky, Kawachi, Weiss, & Sparrow, 1998) problems indicates that worry is an important process in need of further investigation, particularly among adolescents (Laugesen, Dugas, & Bukowski, 2003). While a sizable literature has examined the nature, prevalence, and correlates of worry in both adults and youth, laboratory investigations of this variable using a real-time worry induction paradigm have only been done with adults. This is a notable gap in the literature given the importance of experimental psychopathology laboratory methods for better understanding and systematically examining psychological processes (Zvolesnky, Lejuez, Stewart, & Curtin, 2001). In order to fully address the processes and mechanisms of worry in youth it will be important to model this factor in a controlled laboratory setting. The objective of the current study was therefore to experimentally examine the validity of a worry induction in a sample of adolescents.

Worry: Nature and Prevalence

Worry is defined as a future-oriented cognitive process that is verbal-linguistic in nature (cf., imagery based) and involves repetitive thoughts related to negative future events, outcomes, and consequences (Barlow, 1988; Vasey, Crnic, & Carter, 1994). The verbal-linguistic quality of worry is a defining feature of this construct and may contribute to the unique psychophysiological effects that characterize the state of worry. Specifically, theoretical accounts of the verbal-linguistic nature of worry (Freeston, Dugas, & Ladouceur, 1996; Lyonfields, Borkovec, & Thayer, 1995) are supported by self-report of verbal-linguistic mentations among individuals while worrying (Borkovec & Inz, 1990; Freeston et al., 1996) and by increased frontal

cortical activation (Borkovec, Ray, & Stöber, 1998), which suppresses affect-related subcortical regions (Hoehn-Saric, Lee, McLeod, & Wong, 2005). In other words, brain areas activated during the state of worry are tied more closely to verbal-linguistic processing than to imagery-based processing. These neuroimaging patterns are discernable among non-anxious participants (Hoehn-Saric et al., 2005) as well as high trait worriers (Schienle, Schäfer, Pignanelli, & Vaiti, 2009) and change with psychopharmacologic intervention for individuals with GAD (Hoehn-Saric, Schlund, & Wong, 2004). For example, fMRI data collected by Hoehn-Saric et al., (2005) from non-anxious individuals indicated that worry activated the left inferior frontal gyrus which is an area associated with language, and the orbitofrontal gyrus which is linked with decision making and integrating information about the reinforcement value of stimuli. Furthermore, these authors reported a negative correlation between the activation of the orbitofrontal gyrus and the activation of the amygdala (the structure in the limbic system associated with emotion) suggesting that worry inhibits the limbic system. The verbal-linguistic nature of worry is important because while the precise etiological and maintenance factors involved in pathological worry are still unclear, contemporary theoretical models suggest the verbal-linguistic quality of worry allows for the rehearsal of feared outcomes and is associated high stable heart rate and low heart rate variability (i.e., low vagal tone), which may allow the worried individual to remain at a consistent level of anxiety (Llera & Newman, 2010, Newman & Llera, 2011). The avoidance of large mood fluctuations in response to stressors, termed a “contrast effect” thereby negatively reinforces the worry process. Indeed, there is a wealth of data indicating that worry, similar to other types of anxious arousal results in both increased sympathetic arousal (e.g., heart rate; galvanic skin responding; Hofmann et al., 2005; Lyonfields et al., 1995; Stapinski et al., 2010; Thayer, Friedman, & Borkovec, 1996; York, Borkovec, Vasey, & Stern, 1987) and decreased vagal tone

(Brosschot, 2010; Brosschot & Thayer, 2003; Hoehn-Saric, McLeod, Funderburk, & Kowalski, 2004; Lyonfields et al., 1995; Thayer et al., 1996).

Worry is conceptualized to exist on a dimension between normative and pathological (Olatunji, Broman-Fulks, Bergman, Green, & Ziomke, 2010; Ruscio, Borkovec, & Ruscio, 2001); compared to normative worry, pathological worry is more characteristically maladaptive, intrusive, excessive, unrealistic and, most importantly, uncontrollable (Borkovec, Shadick, & Hopkins, 1991). Normative and pathological worry can be distinguished in at least three important ways. First, pathological worry is associated with increased meta-cognitions about worry (i.e., worry about worry; Wells, 2005, Wells & Carter 1999, 2001). Meta-worry is linked to greater concerns about the nature and consequences of worrying, believing for example, that worry is dangerous and uncontrollable (Wells, 2005). Individuals high in meta-worry appear to be more sensitive to worry and more likely to engage in pathological worry. Second, pathological worry often co-occurs with characteristic psychophysiological symptoms, including restlessness, fatigue, irritability, muscle tension, sleep, and concentration difficulties (American Psychiatric Association, 2000). Third, while normative worry is prevalent (i.e., more than two-thirds of children report worrying occasionally about at least one topic; Orton, 1982; Silverman, La Greca, & Wasserstein, 1995), pathological worry is relatively less common. Nonetheless, a substantial minority of adolescents experience excessive and uncontrollable worry (e.g., 21%; Laugesen et al., 2003).

Pathological worry is the hallmark symptom of GAD, a psychological condition characterized by excessive and uncontrollable worry (Olatunji, Wolitzky-Taylor, Sawchuk, & Ciesielski, 2011; Tracey, Chorpita, Douban, & Barlow, 1997; Wells, 2005). Prospective data indicates full-blown GAD, is rare among adolescents (1%; Canino et al., 2004), however, it increases in prevalence in adulthood (5.7%; Kessler et al., 2005). Beyond GAD, pathological worry is considered a basic

risk factor that cuts across a number of other psychological disorders (Albano & Hack, 2004; APA, 2000), including panic disorder (Craske et al., 2010), obsessive-compulsive disorder (Wells & Papageorigiou, 1998), hypochondriasis (Martin & Jacobi, 2006), depression (Olatunji, Broman-Fulks, Bergman, Green, & Ziomke, 2010), eating disorders (Sassaroli, et al., 2005), and various internalizing-type symptoms (Olatunji et al., 2010). For example, in a study of 1,220 undergraduate participants, Olatunji and colleagues evaluated worry from a taxometric perspective. These authors found that worry is not taxonic but rather continuous in nature, suggesting the full spectrum of worry is worthy of consideration in scientific investigation. Furthermore, worry across the continuum was equally associated with anxiety, depression, and stress. Collectively, these findings suggest that individuals likely vary along a continuum from normative to pathological worry and that worry is a non-specific predictor of several clinically relevant outcomes. Worry-related outcomes are discussed next as a means of situating the current study within the broader literature and highlighting the necessity of identifying a valid means of inducing worry among youth. When possible, work with children and adolescents is discussed, although in some cases the youth literature lags considerably behind adult work.

Correlates and Consequences of Worry

In addition to specific psychological conditions, excessive and uncontrollable worry is linked to a wide range of negative sequelae among youth, including lowered academic functioning, impaired social relationships, higher frequency of school absenteeism (Albano & Hack, 2004), as well as maladaptive problem-solving (Gosselin et al., 2007; Laugesen et al., 2003). For example, in a study of 528 adolescents aged 14-18 years, Laugesen et al., (2003) found that worry related positively to a negative problem-solving orientation, which reflects a lack self-efficacy in problem solving and belief that problems are unsolvable. Laugesen and colleagues suggest that a

negative problem-solving orientation may be particularly problematic during adolescence, a time in which youth are confronted with increasingly frequent problems to which they need to devise constructive solutions. Additionally, Gosselin et al. (2007) found, in a study of 777 adolescents aged 12-19 years, that adolescents with high levels of worry had more avoidance strategies and endorsed more erroneous beliefs about the usefulness of worry (e.g., worry helps prevent negative events). Collectively, these data suggest worriers may be underprepared to effectively resolve the developmental challenges inherent in adolescence.

Worry is also associated with health concerns (Brosschot, Gerin, & Thayer, 2006; Brosschot & Van Der Doef, 2006) such as an increased risk of heart disease, including hypertension and an elevated likelihood of experiencing a fatal coronary event (Kubzansky et al., 1998). For instance, Brosschot and Van Der Doef (2006) reported a positive correlation between high trait worry and health complaints. Interestingly, these authors also found that such complaints reduced after a brief worry intervention. Cardiac vagal tone, an indirect measure of the parasympathetic nervous system, indexed with heart rate variability, is an established outcome related to chronic worry (Borkovec & Hu, 1990; Hammel et al., 2011; Pieper, Brosschot, van der Leeden & Thayer, 2007; Verkuil, Brosschot, Borkovec, & Thayer, 2009) and is a potential risk factor for sudden cardiac arrest even among people without coronary heart disease (Ghuran et al., 2002). In addition, chronic worry is linked with decreased immune functioning; the dampening effects of worry on the autonomic nervous system are thought to be linked to lower immune responses through a reduction of lymphocyte functioning (La Via, Workman, & Lydiard, 1992; La Via et al., 1996; Segerstrom, Glover, Craske, & Fahey, 1999). For instance, Verkuil and colleagues (2009) assessed physiological outcomes (e.g., heart rate and heart rate variability) in sample of 53 adults during period of worry, relaxation, or problem-

solving in the laboratory. Their results indicated that negative cardiovascular effects were enhanced during both the worry and problem-solving periods suggesting that the chronic high cognitive load often associated with persistent worry may increase cardiovascular risk. The research linking health relevant outcomes with worry in youth has been limited in part due to the lack of a laboratory method for modeling the worry process in youth. Addressing this gap will allow future researchers to replicate and extend the health literature in adults to youth samples. As will be discussed next, late childhood and adolescence mark an important period in terms of psychological vulnerability (Dahl, 2004; Paus, Keshavan, & Giedd, 2008), thus making the systematic study of worry and its consequences imperative during these developmental stages.

Worry Across Development

The existing youth worry literature has relied almost exclusively on self-report questionnaires (Gosselin et al., 2007; Laugesen et al., 2003; Muris, Roelofs, Meesters, & Boomsma, 2004; Muris, Meesters, Merckelbach, & Hülsenbeck, 2000; Silverman et al., 1995; Szabó, 2009). Published studies utilizing relatively more sophisticated approaches to the study of worry among youth use methods such as presenting vignettes of anxious situations (Suarez & Bell-Dolan, 2001; Vasey et al., 1994) and interviews (Turner & Wilson, 2010; Vasey et al., 1994; Weems, Silverman, & La Greca, 2000) but few have utilized experimental procedures (e.g., random assignment; Turner & Wilson, 2010) and none have employed a laboratory induction of worry commonplace in the adult literature (see *Methodological Shortcomings of the Extant Literature,* below for a detailed discussion of worry induction among adults). Nonetheless, available data speak to the phenomenology of worry among youth, which is an important backdrop to the proposed study. Specifically, two lines of evidence are relevant; one focuses on the nature of worry among children and adolescents, and the other relates to potential changes in worry across

this developmental transition.

First, previous research using child samples (e.g., ages 6 – 16) has investigated content domains (Szabó & Lovibond, 2004), number, frequency, and intensity (Weems et al., 2000) of worry. In general, children worry more about physical threat or situations while the content of adult worry is often more focused on social threats (Campbell & Rapee 1994; Henker, Whalen, & O'Neil, 1995; Muris et al. 2000; Silverman et al.1995; Szabó, 2009.) For example, in a study of 119 clinically anxious youth aged 6-16 years Weems et al., (2000) found that Health, School, Disasters, and Personal Harm were the most frequent domains of worry; these were similar to topics reported in previous studies of non-clinical youth (Silverman et al., 1995), suggesting that worry *content* does not distinguish pathological from normative worry. Instead, Weems et al. (2000) found that that intensity and number of worries was most important in distinguishing between pathological worry (i.e., worry in individuals with GAD) from non-pathological worry (i.e., worry in individuals with specific phobia). Weems et al. (2000) found that these dimensions of worry (e.g., intensity and number) predicted children's level of fear above and beyond trait anxiety providing initial evidence that pathological worry in children is conceptually distinct from anxiety.

Second, extant theory, and to a lesser extent, data also indicate that the nature of worry changes across time; current conceptual models highlight the transition from childhood to adolescence as a particularly important epoch with regard to the nature of worry. While the content of worry changes as adolescents emerge from childhood, a process likely driven by the context and stressors specific to each developmental stage (e.g., specific fears vs. social fears; Vasey & Daleiden, 1994), research suggests that this content shift may not be as important as an increasing capacity for abstraction (Vasey, Crnic, & Carter, 1994). In a cross-sectional study examining worry

differences between younger children (i.e., 5-6 years old), mid-range children (i.e., 8-9 years old), and older children (i.e., 11-12 years old) Vasey et al., (1994) found that age significantly predicted degree of worry elaboration (i.e., longer and more varied worry sequences). More specifically, cognitive development that characterizes this period is hypothesized to be an important factor in worry (Szabó, 2009). Adolescents are moving into the period of formal operations (Case, 1987; Piaget, 1970), thereby developing more elaborate and abstract reasoning skills as well as the ability to mentally represent future events (Case, 1987; Fisher, 1985; Siegler, 1983, 1994). Given the definition of worry as future-oriented (Barlow, 1988; Vasey et al., 1994), particular cognitive competencies are necessary to successfully engage in the process of worry; one must be able to think beyond what is observable, consider future scenarios, and elaborate on catastrophic possibilities. Therefore, elaborative worry (i.e., the ability to imagine catastrophic consequences and outcomes about future events) is likely intensified during this period of cognitive development (Vasey et al., 1994). Consistent with this theoretical perspective, empirical work indicates that worry correlates positively with age during adolescence (Barahmand, 2008) and prospective data suggests pathological worry in particular increases during adolescence, especially among girls (Hale, Raaijmakers, Muris, van Hoof, & Meeus, 2008). Similarly, Szabó (2009) found, among 42 adults, 62 younger children (aged 6-9 years), and 85 older children (aged 10-13 years), that older youth evidenced worry patterns more similar to that of adults (evidenced by an increased importance probability cost judgments in predicting worry).

Taken together, the worry literature examining developmental factors influencing worry indicates that while the worry process in younger children may be distinct from that of adults, “adult-like” worry comes on-line during the transition from childhood to adolescence, making this a critical developmental period for the study of worry and associated outcomes. While promising,

the extant literature is characterized by a number of significant shortcomings; these will be discussed next.

Methodological Shortcomings of the Extant Literature

Despite the growing literature regarding the phenomenology of worry in youth and the substantial literature about worry in adults, there are at least three limitations that characterize the extant literature. First, data regarding the content, number, frequency, and intensity of youth worry is limited by its exclusive reliance on retrospective self-report. Therefore, observed findings may be due to inaccurate reports (memory bias) or affective biases. For example, research on mood congruence suggests that individuals are more likely to remember events that have an affective valance similar to the one they are currently experiencing (Egidi & Gerrig, 2009). Depressed mood, for instance, is associated with both the recall of more negatively valenced information (Matt, Vazquez, & Campbell, 1992) and more inaccurate information (Joormann, Teachman, & Gotlib, 2009). Thus, our understanding of the nature and developmental trajectory of worry will be more sophisticated if we can reduce the employment of methods that are particularly susceptible to such biases (e.g., retrospective self-report).

Second, there is over two decades of research in the adult literature utilizing worry induction as a sophisticated experimental approach to studying this risk factor (York, Borkovec, Vasey, & Stern, 1987; Llera & Newman, 2010). In adult samples worry is typically induced by gathering information about participants' primary domains of worry and then providing idiographic instructions to worry about the identified topics (Behar, Zuellig, & Borkovec, 2005; McLaughlin, Borkovec, & Sibrava, 2007; Thayer et al., 1996). This methodological approach has yielded a wealth of information including physiological (Andrews & Borkovec, 1988; Oathes, Bruce, & Nitschke, 2008; Thayer et al., 1996), psychological (McLaughlin et al., 2007)

information processing (Oathes, Squillante, Ray & Nitschke, 2010), brain imaging (Hoehn-Saric et al., 2005; Oathes et al., 2008), and health-related (Verkuil et al., 2009) outcome data which has greatly enhanced our understanding of the nature and consequences of adult worry. However, the study of psychopathology risk factors indicates that findings from the adult literature should not be *assumed* to extend to youth (e.g., Cicchetti & Rogosch, 2002; Muris, 2006). Rather, consistent with empirical principles that characterize the process of scientific investigation, better understanding of the nature and consequences of worry among youth requires the study of youth. Furthermore, childhood and adolescence is a "core risk phase" for anxiety related problems because risk factors begin compounding and symptoms patterns begin to shift from mild symptoms to meeting full clinical criteria. Indeed, evidence suggests that age of onset for most anxiety disorders is childhood through late adolescence (Beesdo, Knappe, & Pine, 2009) suggesting that etiology research must be conducted during this time of enhanced risk. Additionally, within the existing youth worry literature there is comparatively little work with adolescent samples. It is important to extend the growing adolescent worry literature because adolescence is a developmental period during which mental-health risk factors, if not addressed, can persist and worsen in adulthood (Copeland, Shanahan, Costello, & Angold, 2009; Ferdinand & Verhulst, 1995; Hofstra, Van Der Ende, & Verhulst, 2001). Continued research on the nature of worry among youth will set the stage for targeting worry-related risk and maintenance factors during this sensitive period.

Finally, it is notable that the absence of comparable child and adolescent worry induction data make it difficult to draw firm conclusions regarding the developmental trajectory of worry. This gap is both surprising and problematic given theoretical accounts regarding differences in the phenomenology of worry across development (Muris, Merckelbach, & Luijten, 2002). By utilizing a well-established worry induction procedure that is routinely employed in adult studies,

researchers will be poised to directly compare worry-related outcomes across developmental stages (e.g., linkage between meta-worry indices and sensitivity to worry inductions among adolescents as compared to adults). Furthermore, a laboratory based method for inducing worry among youth would allow researchers to assess psychosomatic outcomes linked to worry in adults (e.g., immune response; Sergerstrom et al., 1999) which would permit the development of timely prevention programs.

Experimental Psychopathology: Using Worry Induction to Better Understand Adolescent Worry

Absent from the literature is a real-time laboratory assessment of worry among youth. The validation of such an analogue procedure is consistent with experimental psychopathology methods, which are defined as "identifying experimental psychopathology approaches of and manipulating variables so as to induce essential features of psychopathology in a person… without known psychopathology" (pp. 48, Olatunji, Leen-Feldner, Feldner, & Forsyth, 2007). Experimental psychopathology approaches to worry have been widely used in adult populations (Behar et al., 2005; Borkovec et al., 1998; McLaughlin, Borkovec, & Sibrava, 2007; Thayer et al., 1996) but have not yet been validated with youth. An experimental psychopathology approach aims to examine key features of a disorder such as etiology by "modeling" the maladaptive behavior in a controlled laboratory setting. This paradigm allows for real-time assessment of outcomes, which can reduce confounds such as retrospective recall bias (Zvolensky et al., 2001). For example, using a sample of 60 adult participants, McLaughlin et al., (2007) examined the effects of worry and rumination. Participants were randomly assigned and then instructed to either worry or ruminate using a standardized script. A repeated measures design was used to assess the content of the participants' mentation and mood throughout the

induction, and depression, anxiety, relaxation, and negative affect ratings were collected immediately following the negative mood induction (i.e., worry or rumination). This laboratory based approach moves beyond existing data showing a correlation between worry and negative outcomes (e.g., anxiety) by examining the real-time effects of worry.

The availability of a valid worry induction procedure for use with youth has at least two other critical advantages. First, it will allow investigators to obtain a multimodal index of the phenomenology and consequences of worry among youth. Thus, researchers could, for example, address whether the parasympathetic activation observed in adults in a worry state is similar for children and adolescents. Finally, the worry induction procedure lends itself to causally-oriented hypothesis testing. For example in the adult literature, worry inductions have been used to demonstrate that a high level of acute worry can interact with trait levels of worry, causing interference in threat processing (Verkuil et al., 2009). This type of laboratory-based research has resulted in an attentional retraining treatment shown to reduce trait worry (Hazen, Vasey, & Schmidt, 2009).

Proposed Study: Conceptual Model and Hypotheses

Collectively, the available data highlight the negative consequences of worry and the importance of having a sophisticated understanding of this construct among adolescents. However, the majority of the worry research in youth focuses on identifying the content (e.g., Muris, Merckelbach, Luijten, 2002; Vasey et al., 1994), frequency, intensity (Weems, Silverman, & La Greca, 2000), and cognitive correlates (Gosselin et al., 2007; Laugesen et al., 2003) of worry. While promising, this work is limited almost exclusively to retrospective self-report, and no work has examined worry among adolescents using the worry induction procedures that are widespread in adult work. The proposed study aimed to fill this gap in the literature by experimentally

evaluating the validity of a worry induction paradigm in producing worry among adolescents. Specifically, adolescents between the ages of 12 and 17 years were randomly assigned to either a worry or a neutral thought condition, and the utility of the worry induction in terms of producing the characteristic affective and cognitive correlates of worry was evaluated. Four specific hypotheses guided the investigation.

First, following previous work, a main effect of condition was expected, such that participants in the worry induction condition, relative to the neutral comparison condition, would evidence elevated affective and physical reactivity to the laboratory task as evidenced by greater increases in self-reported worried and depressed (Behar et al., 2005; Borkovec et al., 1998; McLaughlin et al., 2007) affect, as well as generalized negative affectivity (McLaughlin et al., 2007). Further, compared to those in the neutral condition, participants in the worry condition were predicted to evidence increased self-reported muscle tension (Pluess, Conrad, & Wilhelm, 2009). As a test of divergent validity, it was expected that condition would not predict ratings of happiness.

Second, consistent with previous adult research (Borkovec & Hu, 1990) as well as the research and theory documenting the defining features of worry (Vasey et al., 1994), participants in the worry condition compared to those in the neutral condition were expected to evidence increased negatively valenced mood as well as verbal-linguistic and future-oriented mentations across the induction period.

Third, consistent with the verbal-linguistic nature of worry, it was expected that the worry condition would serve as a semantic prime. Therefore, in line with the adult information processing literature (Kiefer & Martens, 2010; Mogg & Bradley, 2005; Oathes, Squillante, Ray, & Nitschke, 2010) and theories about child information processing (Vasey & Daleiden, 1994),

youth who had been semantically primed (i.e., worry condition) compared those assigned to the neutral comparison group were predicted to evidence faster reactions times in a lexical decision task for worry related verbal information (i.e., worry words) as compared to non worry related information (i.e., neutral words). As observed in prior work (White, Ratcliff, Vasey, & McKoon, 2010), no differences for word accuracy were expected between word type or condition due to the ceiling effects.

Finally, consistent with the metacognitive model of worry, which suggests that concerns about the negative effects of worry predicts increased pathological worry (Wells, 2005; Wells & Carter, 1999; 2001), it was predicted that metacognitive worry would relate positively to elevated reactivity (i.e., ratings of worry and generalized negative affectivity) to the worry induction.

Method

Participants

Fifty adolescents aged 12-17 years (26 girls; M_{age} = 14.98 years; *SD* = 1.73) were recruited via flyers and advertising placed in the community. Descriptive data for the sample are presented in Tables 1 (continuous variables) and 2 (categorical data). Reflecting the geographic locale, the racial/ethnic status of youth in the sample was 86.0% Caucasian, 14% African American, and 4% Hispanic. All but one participant was enrolled in high school; the average grade level was 9th grade. In terms of diagnostic status, 8.2% of participants met criteria for GAD and 14% met criteria for MDD; while the number of GAD diagnoses was higher than expected, the frequency of MDD diagnoses was similar to rates observed in prior work (e.g. 3.6% GAD; 13.6% MDD; Kessler et al., in press).

Thirty-eight consenting parents/guardians were the biological mother, five the biological

father, four the biological grandmother, two the adoptive mother, and one was a stepfather. As can be seen in Table 2, there was variability in parent/guardian education, although most had completed high school/obtained a GED or part of college. The age of the consenting parent/adult ranged from 32-59 years with the average age being 42 years. The mean household of income of participants in the study was $55,025 (range: $10,000- $200,000). Participants were screened for current medication use that affects the central nervous system, cardiac system, or muscular-skeletal system as well as evidence of limited mental competency and the inability to give informed, voluntary, written assent to participate. No participants were screened out based on these criteria.

Measures

Pre-induction Psychological Assessment.

Anxiety Disorders Interview Schedule –Child version (ADIS-C; Silverman & Albano, 1996). Diagnoses of GAD and MDD were indexed via the widely used ADIS-C. The ADIS-C is a semi-structured clinical interview developed for use with children and adolescents ages 8-17 years. The ADIS-C is commonly used in research and clinical settings to evaluate the major anxiety, mood, and externalizing disorders as described by the DSM-IV (APA, 1994). The ADIS-C is well-validated and evidences good test-retest reliability (Silverman, Saavedra, & Pina, 2001; Wood, Piacentini, Bergman, McCracken, & Barrios, 2002).

Penn State Worry Questionnaire for Children (PSWQ-C; Chorpita, Tracey, Brown, Colica, & Barlow, 1997). The PSWQ-C is a 16-item measure that is used to assess trait worry among children and adolescents. Participants use 5-point Likert type scale (0 = *not true* to 4 = *always true*) to respond to questions such as “my worries really bother me.” The PSWQ-C evidences a strong correlation with other measures of anxiety [e.g., Revised Children’s Manifest Scale- Worry Subscale (RCMAS-worry; Reynolds & Richmond, 1978)] as well as acceptable

internal consistency (∝ = .81-.90; Chorpita et al., 1997; (∝ =.91 in the present sample).

Meta-cognitions Questionnaire for Adolescents (MCQ-A; Cartwright-Hatton, Roberts, Chitsabesan, Forthergill, & Harrington, 2004). The MCQ-A is a 30-item scale designed to measure metacognitive beliefs among adolescents using five subscales relating to intrusive thinking and worry (i.e., positive beliefs, uncontrollability and danger, cognitive confidence, superstition, punishment and responsibility, and cognitive self-consciousness). Participants rate statements such as "My worrying is bad for me" on a 4-point Likert-type scale (1 = *do not agree* to 4 = *agree very much*). The MCQ-A evidences adequate convergent validity [e.g., significant positive correlation with the Revised Children's Manifest Scale (RCMAS; Reynolds & Richmond, 1978)], the Children's Depression Inventory-Short Form (Kovacs, 1992) and the Leyton Obsessional Inventory-Child Version (Berg, Whitaker, Davies, Flament, & Rapoport, 1988)] as well as acceptable internal consistency (∝ = .66-.88; Cartwright-Hatton et al., 2004; ∝ = .87 in the present sample).

Piagetian Cognitive Development Task. Previous research highlights the importance of cognitive development in the ability to imagine and elaborate future possibilities as a necessary component of worry (Vasey et al., 1994), and theorizes that concrete operational capacities are necessary to engage in worry (Vasey et al., 1994; Muris et al., 2002). Cognitive development was indexed directly in the current study rather than allowing age to serve as a proxy for cognitive development. In other words, cognitive assessment was utilized to evaluate group equivalence and to ensure that all participants had achieved at least some aspects of formal operations (e.g., conservation of substance) to avoid any confounds that may be introduced by including youth who, by virtue of their cognitive developmental stage, were unable to effectively worry. Consistent with the anxiety and worry literature (Muris, et al., 2002; Muris, Mayer,

Vermeulen, & Hiemstra, 2007) two Piagetian conservation tasks were administered to measure participant's concrete operational skills: (1) Conservation of liquid: the experimenter presented two glasses of colored water (filled to the same level) and the participant was asked to confirm that each glass has the same amount of water. Then the water from one glass was poured into a tall skinny glass and the participant was asked if the glasses both contain the same amount of liquid or if the contain different amounts of liquid; (2) Conservation of Area: the experimenter presented two identical green surfaces and blocks were placed on each surface in identical positions. The participant was asked to confirm that each surface has the same amount of space remaining. Then the blocks were scattered and the participant was asked if each surface had the same amount of space remaining or if they are different. Each task was scored as either *0 (failed)* if the participant reported that the property (water, green surface) was different or *1 (passed)* if the participant said the queried attributes remained the same. Participants were considered passing concrete operations if they passed both conservations tasks. Tasks were counterbalanced to reduce order effects.

Logical Reasoning Test (LRT; Allen, 1984). Select questions from Burney's Logical Reasoning Test were administered to provide an index of the degree to which participants had achieved formal operations. This test was developed to determine a participant's level of Piaget's cognitive development. Three syllogisms and three verbal analogies were selected from the measure for use in the current study on the basis that the verbal reasoning would be more closely tied to the verbal-linguistic nature of worry. Because previous research suggests that not all participants in this age range would be classified as being in formal operations using this measure (Allen, 1984), total scores were examined as a continuous variable to assess the degree to which formal operations had been achieved. Each item was scored as either 1 (*correct)* or 0

(incorrect) and then item scores were summed to create a total LRT score. See Appendix A for a copy of the questions used in the current study.

Dependent Measures.

Positive and Negative Affect Schedule for Children (PANAS-C; Joiner, Catanzaro, & Laurent, 1996). The PANAS-C is a 20-item scale; participants rate each descriptor (e.g., sad, frightened) on a 5-point Likert-type scale (1 = *very slightly* to 5 = *extremely*) to indicate the degree to which the descriptor represents how they currently feel. The PANAS-C was originally developed for use with youth ages 8-16 years (Joiner et al., 1996) but has been successfully used with youth through age 18 years (Jacques & Mash, 2004; Laurent, Catanzaro, & Joiner, 2004). The PANAS-C evidences adequate convergent validity [e.g., significant negative associations with the Revised Children's Manifest Scale (RCMAS; Reynolds & Richmond, 1978)] as well as acceptable internal consistency ($\propto$ = .78-.81; Wilson, Gullone, & Moss, 1998; $\propto$ = .80 in the present sample). Only the 10 questions comprising the negative affect scale (PANAS-CN) were used in the current study.

Future-Oriented/Verbal-Linguistic Visual Analog Scale for Children (FOVLAS-C). The FOVLAS-C was created from the measure described by McLaughlin et al. (2007) to assess the content of mental activity during worry. Participants were provided a definition of verbal and image based mental activity and then asked to evaluate the degree to which their current mental activity was both verbal-linguistic and future-oriented using a 0-100 visual analog scale. See Appendix B for a copy of this measure.

Self-Assessment-Manikin Scales (SAM; Lang, 1980). The SAM was used to evaluate the valence of affective responding. Participants selected their current level of valence by marking on or between one of five mood illustrations, yielding a 9-point rating for each scale.

The SAM has adequate psychometric properties and is commonly used in research with youth populations (Beidel, 1991; Greenbaum, Turner, Cook, & Melamed, 1990; Leen-Feldner, Blumenthal, Babson, Bunaciu, & Feldner, 2008). Please see Appendix C for a copy of this measure.

Subjective Units of Distress Scale (SUDS; Wolpe, 1958). Several SUD scales were used to evaluate self-reported worry, depression, happiness, and muscle tension in response to the laboratory procedures using a 0 (e.g., *no worry*) to 100 (e.g., *very very much worry*) scale. This is a well-established measure of self-reported affective state and has been used successfully with youth samples (Leen-Feldner, Zvolensky, Feldner, 2004; Leen-Feldner, Feldner, Tull, Roemer, & Zvolensky, 2006). See Appendix D for a copy of this measure.

Lexical Decision Task. Participants were asked to decide whether a letter string (e.g., concern/ cruation) was a word or a non-word. Linguistic and developmental experts judged all words as being at or below the 5th grade level (see Appendix E for a complete list of items). Furthermore, a post-challenge assessment was given to a sub-group of participants to assess word comprehension. For this task five of the most difficult words were chosen (i.e., reveal, resemble, wisdom, dread, disturbed, and suspense) and participants were asked to indicate whether they knew what that word meant. Only eight participants indicated that they did not know what at least one word meant and overall participants did not know only 5.3% of words. Following empirical precedent in the anxiety literature (Silvert, Delplanque, Bouwalerh, Verpoort, & Sequeira, 2004; Stip, Lecours, Chertkow, Elie, & O'Connor, 1994), participants completed 100 counterbalanced trials in which they saw 25 anxiety relevant word trials, 25 neutral word trials and 50 non-word trials. Because word length can affect lexical decision latencies (Hasson & Glucksberg, 2006) this variable was controlled across stimuli. Worry words

were selected by using synonyms of the word “worry” and also included threat relevant words used by MacLeod and McLaughlin (1995). Neutral words were selected to match word length and frequency of worry words from the list of non-threat words and were drawn from those used by MacLeod and McLaughlin (1995) whenever possible. Non-words were also matched for length. Subjects were instructed to press either the “j” key for ‘yes’ or the “f” key for ‘no’ to indicate whether or not a letter string corresponded to a real word (these keys were also labeled directly on the keyboard and above the screen to remind participants of instructions). They were asked to respond as quickly and accurately as possible. A practice task with feedback was administered prior to the mood induction to orient all participants to this procedure.

Procedure and Laboratory Tasks

Please refer to Appendix F for a graphical overview of the procedure and laboratory tasks. Participants contacting the laboratory in response to study advertisements were informed that the purpose of the study was to understand adolescent worry and the protocol was fully described. A laboratory visit was scheduled for interested and eligible participants and their parents or legal guardians. Upon arrival, adolescents provided written, informed assent and their parents or guardians provided informed consent for child participation. Participants were informed of the study procedures, risks and benefits, limits of confidentiality and that they could withdraw at any time without penalty or prejudice. All participants were also provided with local mental health referrals. No participants withdrew from the study.

Each participant completed one session lasting approximately one hour. Participants began by completing a battery of self-report questionnaires in a quiet private space. The questionnaire battery was randomized to control for order effects and a trained researcher was on hand to address any questions. All participants were given a standard definition of worry drawn

from the Anxiety Disorders Interview Schedule for Children (ADIS-C) (i.e., "*Worry is when you keep thinking about things over and over and it's hard to stop thinking about it. The things you are thinking about are usually things that you feel nervous or afraid about.*"; Silverman & Albano, 1996, p.41). At this time, and consistent with empirical precedent (McLaughlin et al., 2007), participants were asked to provide three topics about which they frequently worry (e.g., school, family) and three neutral topics (e.g., watching TV) for use during the mood induction procedure. Participants then completed the cognitive development tasks.

After completing the developmental tasks, participants were randomly assigned to either a worry induction condition or a neutral mood condition. The random assignment was not completed until this point in the experimental protocol to ensure that the principal investigator was blind to participant condition for as long as possible. Next, participants were seated in the experimental room and given instructions specific to their condition, which included a 5-minute baseline period, the 5-minute experimental mood induction (i.e., worry or neutral), and a 10-minute post-induction recovery period. The experimenter left the room while the participant sat quietly for the 5-minute baseline period, which has been successfully employed in laboratory-based anxiety research (e.g., Forsyth, Eifert, & Thompson, 1996; Leen-Feldner, Feldner, Bernstein, McCormick & Zvolensky, 2005) to establish baseline levels of affect and cognitive activity prior to induction (McLaughlin et al., 2007). At the end of this baseline period participants provided baseline FOVLAS-C, SUDS, SAM, and PANAS-CN ratings. Then, the experimenter guided the participant through one of two instructional sets (i.e., worry or neutral), depending on the condition to which the participant had been randomly assigned.

Participants assigned to the worry induction condition were again reminded of the definition of worry adapted from the ADIS-C and then a standardized, scripted instructional set adapted

from McLaughlin (2007) which incorporated the idiographic worry topics identified by the participant was read:

During this period, we would like you to create a worried state of emotion. Let's review the list of topics that you said you worry most about. You said you worry about _____ (most worrisome topic) the most. When I ask you to begin, please close your eyes and worry about _____(most worrisome topic) in the way you usually worry about it, but as very much as you can, until I ask you to stop and to open your eyes. If you normally worry about only one topic at a time, please try to do the same during this period. However, if your thoughts change to another topic that you usually worry about during this period feel free to allow these thoughts to continue. It is all right to change topics during this period if the changes usually happen when you worry. (p. 27)

Participants assigned to the control condition used the three neutral topics they provided previously and a standardized, scripted instructional set designed to match the worry condition was administered:

During this period, we would like you to create a neutral state of emotion (not good or bad, just in the middle). Let's review the list of topics that you said are ordinary and do not result in strong feelings. You said one of these things is _____ (previously listed neutral topic). When I ask you to begin, please close your eyes and think about _____ (previously listed neutral topic) in the way you usually think about it, but as very much as you can, until I ask you to stop and to open your eyes. If you normally think about only one ordinary everyday topic at a time, please try to do the same during this period. However, if your thoughts change to another neutral topic that you usually think about during this period feel free to allow these thoughts to continue. It is all right to change topics during this period if the changes usually happen when you think about

ordinary things.

During the challenge procedures and consistent with the previous literature (McLaughlin et al., 2007), participants were interrupted every 60 seconds and asked complete the FOVLAS-C and SAM-valence scales. After each interruption, participants were instructed to close their eyes and resume thinking about worrisome or neutral topics (e.g., *please close your eyes continue to worrying about _____ as you were prior to the interruption*).

Directly following the challenge procedures, participants provided post-challenge SUDS worry, depression, muscle tension, and happiness ratings, completed the PANAS-CN, and took part the lexical decision task. Finally, after the post-induction tasks a positive mood induction was administered to all participants to ensure that participants did not leave the laboratory in an acute worried state. Specifically, participants watched a short segment from a Mr. Bean slapstick comedy film clip. This induction has been previously validated with youth and used as a reliable way to decrease ratings of anxiety (Hughes & Kendall, 2008). At the conclusion of the protocol, participants were comprehensively debriefed regarding the conceptual and methodological objectives of the study; any parent or adolescent questions regarding study participation were also addressed at this time. Finally, adolescent participants were compensated $20 and parents were compensated $5.

General Analytic Strategy

To ensure group equivalence (efficacy of random assignment), theoretically relevant parent and adolescent variables were compared at baseline (please see *Results* for details about specific variables). These variables would have been used as covariates in subsequent data analysis in the unlikely event that the groups differed on these characteristics. In addition, pre-challenge scores were co-varied in order to control for individual differences in baseline levels of each variable

(e.g., worry; Cohen, Cohen, West, & Aiken, 2003) when using the corresponding post-challenge measure as the dependent variable. Descriptive analyses (correlations for continuous variables; group comparisons for categorical variables) were first undertaken to evaluate zero-order relations among the primary independent and dependent variables.

Next, specific hypothesis tests were conducted. First, analyses of covariance were utilized to test the hypotheses that subjects in the worry induction condition, compared to the control condition, would endorse greater self-reported worry, depression, negative affectivity, and muscle tension. Additionally, as a test of divergent validity, groups were not expected to differ in happiness ratings.

Second, repeated measures ANOVAs were utilized to test the hypotheses that subjects in the worry induction condition, compared to the control condition, would report increased negatively valenced mood as well as verbal-linguistic and future-oriented mentations across the challenge interval. Post-hoc analyses were planned to compare group differences at each assessment time point and to compare within group differences at baseline and the post-induction assessment.

Third, a 2 (worry versus neutral group) x 2 (worry versus non-worry words) repeated-measures ANOVA was used to compare group differences for response latency and accuracy in information-processing task. More specifically, differences between worry and neutral words in the lexical task were examined for each condition. It was expected that individuals who were semantically primed (i.e., worry condition) compared those assigned to the neutral comparison group would evidence faster reactions times in the lexical task for worry related verbal information (i.e., worry words) than non worry related information (i.e., neutral words). Consistent with prior work in the area (White et al., 2010), no differences for word accuracy

were expected between word type or condition due to ceiling effects.

Finally, hierarchical multiple regression was utilized to test the hypothesis that meta-worry will predict post-challenge challenge SUDS worry and negative affectivity. These outcome variables were selected to limit the number of analyses conducted; in addition to SUDS worry, which is central to the primary study objective, we reasoned that PANAS-CN scores reflected changes in depressive affect and permitted an examination of generalized negative affectivity in response to the challenge. Baseline SUDS worry or PANAS-CN, as appropriate, were entered at Step 1 of the model. Main effects of condition and MCQ-A were entered at step 2. Finally, the interaction between condition and MCQ-A scores was entered at step 3. This approach allowed for an evaluation of the incremental predictive validity of the interaction term in predicting post-challenge responding. Main effect variables were mean centered prior to calculating the interaction term.

Power Analysis

Given the absence of research examining a worry induction among youth, evidence was gathered from self-report designs with youth and laboratory inductions of worry with adults to inform sample size considerations.

McLaughlin et al., (2007) found in a sample of 60 participants that anxiety, depression, and negative affect reliably increased following worry induction, evidencing a moderate effect size for anxiety ($\eta^2 = .23$) and depression ($\eta^2 = .33$). Furthermore, a medium to large effect size was found for the decrease in relaxation ratings ($\eta^2 = .49$) in response to the mood induction. These findings are especially important because the current study drew heavily from the methodological approach of McLaughlin et al., (2007). Expectation of a medium effect size was supported by similar studies (e.g., Hofmann et al., 2005). In addition, self-report data from

adolescents suggests a medium effect size in terms of the linkage between worry and negative affective outcomes (e.g., anxiety; Weems et al., 2000). Indeed, Weems et al. found in a cross-sectional sample of 119 youth aged 6-16 years that number, frequency, and intensity of worry all predicted anxiety with small- medium effect sizes (r = 0.20- 0.26).

Additionally, Oathes et al., (2010) found in a sample of 56 non-clinical adults that participants evidenced a small-medium effect size (d = 0.15- 0.40) on an information-processing task (i.e., dot probe task) with threat relevant words after completing a worry induction. Finally, in a sample of 98 youth aged 7-17 years, Bacow, May, Brody, and Pincus (2010) found a medium effect size for the association between meta-cognitions and anxiety (η^2 = .08).

This literature provides at least two converging lines of evidence to inform decisions regarding the current sample size. First, many of the sample sizes used in the previous related studies (e.g., Hofmann et al., 2005; McLaughlin et al., 2007; Oathes et al., 2010) were relatively small (i.e., < 60) and were still able to detect main effects. Second, given the moderate effects obtained in both laboratory inductions among adults and relevant self-report data among youth, the current sample size was based on an anticipated moderate effect size to ensure adequate power to observe the main effects proposed in the primary hypotheses. Accordingly, power analyses for the current study suggested a sample of 50 subjects with power of .80 and alpha at .05.

Results

Theoretically, relevant parent (e.g., race, ethnicity, educational attainment, age, household income, worry symptoms) and adolescent (e.g., age, race, ethnicity, cognitive development, GAD/MDD diagnostic status, baseline levels of worry, depression, muscle tension, happiness, verbal-linguistic and future-oriented thoughts) variables were examined across the worry and

neutral comparison groups to determine the efficacy of random assignment and whether any co-variates should be used in subsequent analyses. Results indicated that groups did not differ on any of these variables (see Tables 1 and 2). Descriptive statistics for each of the measures were comparable to those previously reported in the literature (e.g., MCQ-A: *M* = 58.5, *SD* = 15.0; Cartwright-Hatton et al., 2004; PANAS-C NA: *M* = 21.51, *SD* = 6.36; Joiner et al., 1996; PSWQ-C: *M* = 15.44, *SD* = 7.38; Leen-Feldner et al., 2006). Correlations between continuous variables are reported in Table 3.

Next, analyses of covariance (ANCOVA) were utilized to test the hypotheses that subjects in the worry induction condition, compared to the control condition, would endorse greater self-reported worry, depression, negative affect, and muscle tension in response to the challenge procedures. Additionally, as a test of divergent validity, ratings of happiness were not expected to differ across groups. Normality, homogeneity of variance, and linearity were examined. It was determined that while the normality assumption had been violated, the sample size of 50 was adequate to not "cause any major problems" (Pallant, 2007, p. 204). The homogeneity of variance assumption was also violated but given the size of groups was equal the ANCOVA is "reasonably robust to violations of this assumption" (Pallant, 2007, p. 204). The linearity assumption was met. Data and inferential statistics are presented in Table 4. As predicted, and after adjusting for baselines scores, participants assigned to the worry induction reported higher worry, depression, muscle tension, and negative affectivity at the post-challenge assessment compared to those in the neutral condition. Effect sizes were small to moderate (see Table 4; Ferguson, 2009). Unexpectedly, there was a difference between groups in happiness ratings, with participants in the experimental group evidencing significantly greater pre- to post-challenge changes in happiness compared to those in the worry condition. Specifically, both

groups evidenced decreases in happiness and participants in the worry group ($M_{baseline}$ = 69.44*;* $M_{post\text{-}challenge}$ = 47.54) were less happy after the challenge than were those in the neutral group ($M_{baseline}$ = *71.13; M* = 64.52).

Repeated measures analyses of variance were next conducted to assess the impact of group assignment (worry, neutral) on participant report of mood valence as well as verbal-linguistic and future-orientation of mentation across 6 time points (pre-mood induction and after each minute of the 5 minute induction). Planned independent samples t-tests were conducted to assess group differences for dependent variables at each time point. A paired-samples t-test was used when needed for within group comparisons between baseline and post-induction scores. Means for each dependent variable at each time point are presented in Table 5. Sphericity, which measures the extent to which the variance in each set of repeated measures scores is equal, was checked for each analysis; Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated in each of the three analyses presented below. However, as recommended (Tabachnick & Fidell, 2007) the Greenhouse-Geisser and Huynh-Feldt corrections were checked and neither changed the significance of results.

First, in terms of the effects of the worry induction on negatively valenced mood, the hypothesis that the worry induction would increase negatively valenced mood was supported with an interaction between time and condition (Wilks Lambda = .76, F (5,42) = 2.64, $p < 0.05$) indicating the worry condition resulted in a significant increase in negatively valenced mood compared to the neutral control condition. There was also a significant main effect of time (Wilks Lambda = .58, F (5,42) = 6.00, $p < 0.05$) and group assignment (F (1, 46) = 12.78, $p <$ 0.05). Polynomial within-subjects contrasts indicated that participants evidenced a significant quadratic trend in their mood. As illustrated in Figure 1, the worry group evidenced a rapid

decline in mood followed by maintenance of this lower affect. Specific time point comparisons (see Table 5) demonstrate that experimental groups were not significantly different at baseline but were then significantly different in the hypothesized direction at each of the following five time points. See Table 5 for a descriptive data and Figure 1 for a graphical depiction of these data.

Second, in terms of the degree of verbal-linguistic activity across groups, recall that participants were asked to rate how much of their thoughts were words, ranging from 0 to 100, with 100 being "all words." It was hypothesized that participants in the worry condition would report their thoughts as being characterized by proportionally more words. The descriptive data are consistent with this expectation, with participants assigned to the worry condition indicating that the proportion of their thoughts described as words increased from $M = 48.85$ to $M = 64.92$ across the challenge interval. Indeed, compared to baseline the worry group evidenced significantly greater verbal-lingusitic mentation at the post-induction assessment time point ($t(22) = -2.51$, $p < .05$), suggesting that the worry induction did produce a significant increase in verbal-linguistic thoughts. This comparison was not significant within the neutral mood group. Analyses also revealed a main effect of time on verbal-linguistic thoughts (Wilks Lambda = 0.76, $F(5,41) = 2.51$, $p = < .05$), with a significant cubic pattern suggesting verbal-linguistic thoughts increased at the beginning of the induction, followed by a plateau or moderate decrease, followed by another increase in verbal-linguistic thoughts. See Figure 2 for a graphical depiction of these results. However, there was no interaction between group assignment and time (Wilks Lambda = 0.94, $F(2,41) = 0.51$, $p > .05$), nor was there a main effect for condition ($F(1,45) = 1.50$, $p > .05$). As can be seen in Table 5, between-group comparisons at each time point show no significant difference between groups at any of the time points.

Finally, for future-oriented thoughts, participants were asked to rate, from 0 to 100, the degree to which their thoughts were future-oriented. Consistent with hypotheses, there was a significant interaction between time and condition (Wilks Lambda = .74, F (5,41) = 2.94, p < .05) indicating the worry induction increased the percentage of future-oriented thoughts compared to the neutral control condition. There was a significant quadratic and cubic trend for the interaction as can be seen in Figure 3. A comparison of the group means at each time point revealed that the experimental groups were not different at baseline; however, they were significantly different at each of the four time points during the induction. Surprisingly, future oriented thoughts were not significantly different between the worry and neutral group at the post-induction assessment point. There was no main effect of time on future-oriented thoughts (Wilks Lambda = 0.86, F (5,41) = 1.29, p = >.05) but there was a main effect of group assignment (F (1,45) = 9.95, p = < .01); see Table 5 for a descriptive data and Figure 3 for a plot of the future-oriented data.

Next, a 2 (worry versus neutral group) x 2 (anxiety versus non-anxiety words) repeated-measures ANOVA was used to compare group differences in both reaction time and accuracy for the information-processing task. To remove outliers, the means and standard deviations for each participant were calculated and trials that were more than two standard deviations above or below the subject's mean were removed resulting in 11.3% of data being excluded (i.e., 565 trials). Additionally, in reaction time analyses, only correct responses were included, which resulted in an additional 7.0% of data being excluded (i.e., 310 trials). Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated for either the reaction time or accuracy data. Real words were responded to significantly faster than non-words t (49) = -5.77 p < .001. For reaction times, neither an interaction (Wilks' Lambda = 1, F (1,48) = .25, p

>.05) nor main effects were observed for either word type (Wilks' Lambda = .98, F (1,48) = 1.19, p >.05) or condition [F (1,48) = 2.72, p >.05]; see Table 6 for descriptive data. These data are in contrast to the hypothesis that the induction would serve as a sematic prime. In terms of accuracy, no interaction was found between condition and word type suggesting that accuracy was not significantly different between the worry and neutral groups (Wilks' Lambda = 0.99, F (1,48) = .29, p >.05). Results also revealed a main effect of word type for accuracy (Wilks' Lambda = .84, F (1,48) = 9.20, p <.01) but not for condition (F (1,48) = .18, p >.05). More specifically, participants responded significantly more accurately to anxiety words than non-anxiety words but there were no accuracy differences between conditions.

Finally, the effect of meta-worry on challenge responding was tested using multiple regression. Results of the regression analyses are presented in Table 7. To limit the number of analyses and protect against Type II error, the two broadest and most relevant outcome measures were chosen for regression analyses. Prior to analysis, variables were mean centered to address multicollinearity. Normality, linearity, and homoscedasticity were also examined. No violations of normality or linearity were found, however, the homoscedasticty assumption for negative affect was violated (Levene statistic (1,47) = 0.78 p <.05) which potentially weakened the results with regard to negative affectivity. In terms of SUDS-worry, baseline level of worry was a significant predictor and accounted for nearly 10% of the variance in post-induction worry. At step two, both condition and MCQ-A scores predicted SUDS-worry, with participants in the worry condition as well as those who were relatively higher in meta-worry evidencing greater post-challenge worry ($\Delta R^2 = 0.37$, $p < .01$). The interaction term was not significant. With regard to negative affectivity, baseline level of negative affect was a significant predictor accounting for nearly 20% of the variance. At step two, condition was a significant predictor, with individuals in

the worry group evidencing greater post-challenge negative affectivity. Meta-worry scores were not significantly predictive of post-induction PANAS-CN scores, nor was the interaction significant.

In light of the unexpected findings for total MCQ-A scores, it was reasoned that perhaps a more fine-grained analysis was indicated. Specifically, the scale with the most conceptual relevance to challenge response, Uncontrollability and Danger (UD) was examined in post hoc analyses. The results of these analyses revealed no main effect of the UD scale or condition on either post-challenge worry or PANAS-CN scores. Interaction terms were also non-significant.

Discussion

Research to date highlights the negative consequences of worry and emphasizes the need for empirical study of the construct among adolescents. However, while a large experimental literature has used worry induction procedures in adult populations, the youth worry literature has been limited primarily to retrospective self-report focusing on the content, frequency, intensity, and cognitive correlates of worry. The current study was designed to fill this gap in the literature by experimentally testing the validity of a worry induction procedure in a community sample of adolescents.

In terms of affective and physical reactivity to the worry induction, findings were consistent with expectation, suggesting that the procedure produces greater self-reported worry, depression, negative affect, and muscle-tension compared to the control group. Importantly, these effects were significant after accounting for pre-experimental differences in each of these variables. These data are consistent with theoretical accounts of worry indicating this state is accompanied by increased negatively affectivity as well as muscle tension (Newman & Llera, 2011). Further, the data fit with findings from a wealth of previous adult research using worry

induction paradigms (McLaughlin et al., 2007, Pluess, Conrad, & Wilhelm, 2009). Collectively, these findings support the utility of the worry induction procedure in effectively eliciting a "worried" state among youth, positioning researchers to utilize this approach in systematic efforts to better understand the nature and consequences of worry among youth. As a test of divergent validity it was predicted that happiness ratings would be similar across conditions, but participants in the worry condition evidenced a greater decrease in happiness than those in the neutral control condition. This finding is in contrast to adult data suggesting induced worry does not diminish positive affect (McLaughlin et al. 2007). One reason for this discrepancy may be that "happiness" is too narrow an exemplar of positive affectivity. For example, this construct may have been understood by our adolescent participants to be the opposite of a general negative feeling (which, as noted above, was increased by the worry induction) and thus rated themselves as having a decrease in happiness. Indeed, previous research utilized the positive affect scale of the PANAS to index rather than the single item (SUDS) employed in the current study. The single-item approach was based on concerns regarding the effects of time on reactivity to the challenge procedure (e.g., decay effects). Thus, it was reasoned that, in order to balance the measurement of multiple post-challenge outcomes, positive affect should be indexed using a single "happiness" item. An alternative to this explanation is that the process of worry does indeed reduce positive affectivity among adolescents exposed to a worry induction compared to those assigned to a neutral control condition. Such an interpretation would fit with extant work supporting affective lability among adolescents (e.g., Arnett, 1999). A critical next step in future research will be to utilize a more multi-faceted index of positive affectivity to clarify whether the current observed findings are best explained by methodological and/or developmental factors.

The set of findings suggesting the worry induction produced enhanced negative affectivity is further bolstered by significant time, condition, and time by condition interaction effects in terms of negative mood valence. These results suggest that the worry condition elicited increasing negative affectivity across the worry induction interval and post-hoc analyses indicated that participants in the worry group evidenced elevated negative mood at every assessment point (except baseline). Figure 1 shows that this change (recall that the SAM is reverse scored; so lower scores indicate elevated negative mood valence) occurs primarily in the first two minutes of the challenge, after which participants evidenced stable, sustained negatively valenced mood. These data complement findings discussed above and are consistent with the adult literature (McLaughlin et al., 2007) providing additional evidence that the induction procedure is effective in producing a negative affective state.

The second hypothesis focused on the nature of participant thought during the worry induction. Specifically, this set of analyses focused on the degree to which participant thought, among those assigned to the worry condition, was more future-oriented and verbal-linguistic in nature as compared to those in the control group. First, in terms of future orientation, there was a main effect of group assignment indicating that overall the worry group evidenced more future-oriented thoughts than the neutral comparison group. There was no main effect for time suggesting that when collapsed across condition, participants did not evidence a significant overall increase in future-oriented thoughts across the six assessment points Importantly, main effects were qualified by significant time by condition interaction obtained for future-oriented thoughts, suggesting the worry elicitation was effective in increasing the percentage of future-oriented thoughts among participants in the worry condition across the provocation interval. This finding is important because while both worry and the conceptually related construct of

rumination are characterized by repetitive thought (Segerstrom, Tsao,Alden, & Craske, 2000) rumination is typified by past focused thoughts (McLaughlin et al., 2007; Papageorgiou and Wells, 1999) while worry is more uniquely associated with future focused thoughts (McLaughlin et al., 2007). Interestingly, comparisons of group differences at each time point revealed that although there were significant differences at each of the four time points during the mood induction, there was not a significant difference between the worry and neutral group at the post-induction assessment. This finding may be an experimental artifact of having intervening assessments (e.g., SUDS) between the end of the mood manipulation and the assessment of future-oriented thoughts which caused participants thoughts to become more present focused (due to the need to fill out post-induction assessment measures). This methodological issue requires further investigation (e.g., restricting the post-challenge interval). Overall, the current data fit with the contention that the worry induction procedure utilized herein is effective in producing specific worry-relevant mentation among youth.

This conclusion may be tempered, however, by the contrasting findings in terms of verbal-linguistic mentation. Specifically, a main effect of time was observed for verbal-linguistic mentations, suggesting increased verbal-linguistic thoughts among participants assigned to both the worry and control conditions. There was neither a main effect of group, indicating when averaged across time points participants in the worry group did not evidence a significantly greater degree of verbal-linguistic mentation, nor was there a significant time by condition interaction. However, when baseline and post-induction scores were compared within groups, the worry group evidenced a significant increase in verbal-linguistic mentations while the neutral control condition did not. This result is suggestive of the fact that the worry induction does impact the nature of mentation, although the absence of group or interaction effects is surprising.

It is noteworthy that the adult research literature typically compares mentation among participants in a worry condition to mentation among participants assigned to other types of mood inductions (e.g., rumination, McLaughlin et al., 2007; trauma, Behar, Zuelig, & Borkovec, 2005). Indeed, several studies report significant differences in the degree of verbal-linguistic mentation between worry and rumination conditions but not between worry condition and a neutral mood state (McLaughlin et al., 2007; Goldwin & Behar, 2011). The current comparison to a neutral control condition rather than a different mood state may have weakened the expected effect of worry on verbal-linguistic mentations. Indeed, it is plausible that the main effect of time might be due to a general increase in verbal thoughts in response to the instructional set (e.g., close your eyes and think as much as you can) and the lack of between-group differences may be a consequence of the fact that the verbal content elicited during an induced worried episode may not be significantly greater than that produced by a neutral instructional set (where a mix of verbal and imagery based thoughts may be expected). Such group differences may only be discernable when worry episodes are compared to inductions of states theoretically and empirically shown to increase imagery-based mentations (e.g., “pictures in your mind”; McLaughlin et al., 2007). Future work could begin to address this empirical question by adding a group to the current design, which would allow researchers to compare verbal-linguistic versus imagery-based mentation among individuals exposed to a worry, neutral, and another affective induction, such as rumination.

In terms of the third hypothesis, a lexical decision task was included in the current study because a large adult literature supports an information processing bias associated with anxiety generally and worry specifically (e.g., Mathews & MacLeod, 1985; Mathews, Mogg, Kentish, & Eysnck, 1995). Further, this effect demonstrates some specificity, having not been consistently

associated with depressed affect (Mogg & Bradley, 2005). Unexpectedly, the results of the current study were inconsistent with this literature. Specifically, there was no main effect of group (worry/neutral) or word (anxiety/non-anxiety) on response latency or accuracy, nor was there an interaction effect of group and word on latency or accuracy. These non-significant findings may be due to at least four factors. First, much of the existing information processing research on anxiety has been done using clinical populations (see Mogg and Bradley, 2005 for a review). Thus, the pattern of responding for a chronically worried adolescent with GAD may differ from the acutely worried adolescent in the present study (Vasey, Dalgleish, & Silverman, 2003). Chronically pathologically worried individuals may experience more intense worry than can be induced in a laboratory setting or the chronicity of their worry may allow for the development of longstanding information processing biases that are not characteristic of acute worry regardless of intensity. While research with clinical samples provides information linking pathological levels of worry with information processing biases, it has not established a causal link between worry and these biases. While it is possible that high levels of worry creates a bias in how youth attend to the information in their environment, these quasi-experimental designs with clinical populations also leave open the possibility that information processing biases are epiphenomenal to the disorder itself. Additional research utilizing experimental psychopathology methodology (e.g., worry inductions) that seek to compare clinical and non-clinical samples is needed in order to begin to establish a casual link between worry and information processing biases and delineate the degree to which the presence of psychopathology drives observed associations between these variables among youth. Second, there may be developmental differences in the way adolescents respond to information processing tasks compared adult to populations (Vasey et al., 2003). Vasey and colleagues (2003) suggest that

information processing tasks may be especially sensitive to developmental differences across childhood and adolescence because of the variation in the content of children's worries across development (e.g., young children worry more about physical threat while older children have more social concerns; Vasey et al., 1994). Therefore it is possible that the anxiety relevant words (e.g., danger, panic, accident; see Appendix E for a complete list of words) utilized in the present study did not reflect the unique worries of the participants, thereby failing to produce the expected effect. Future research would benefit from using an idiographic approach in which words specific to participant's identified worries are utilized during the lexical decision task. Indeed, it would be particularly informative to compare lexical decision making using a standardized word list (as in the present study) to an ideographic word list to replicate and expand upon the current findings. Third, the lexical decision task was chosen for the current study because of its relevance to attention biases that might be theoretically expected as a result of an anxious lexical prime (i.e., worry induction) and was modeled after information processing tasks used after worry inductions in the adult literature (Hirsch et al., 2011). However, there is not a precedent for the use of a lexical decision task with adolescents; the youth information processing literature has instead relied more heavily on the dot probe task (Dalgleish et al., 2003; Oathes et al., 2010; Lonigan & Vasey, 2009) and the Stroop task (see Vasey & MacLeod, 2001, for a review). Accordingly, it is difficult to determine the extent to which "methodological and psychometric problems posed by development" (Vasey et al., 2003, p. 88) may have impacted findings. More specifically, the reliability and validity of information processing task data may be negatively affected by fatigue effects, difficulty in understanding or following task instructions, and variability in vocabulary comprehension (see the Method section for information about vocabulary comprehension in the current sample). These methodological

factors may help to explain the current null effects. Future work could beneficially utilize information processing tasks for which there is adequate psychometric data. Finally, it is possible that the absence of findings in relation to the lexical decision task are due a "decay effect" (Gendolla & Brinkmann, 2005). That is, the semantic priming effects dissipated during the approximately three minute period between the end of the induction and the administration of the lexical decision-making task. This interval was necessary to assess the other primary dependent measures in the current study (e.g., SUDS). In addition, the lexical task itself took approximately 10 minutes to complete. This span of time exceeds typical post-induction recovery periods used in worry inductions (~5min; Goldwin & Behar, in press; Hirsch et al., 2011). While the duration of the "worry effect" produced by worry inductions has not been empirically investigated, other negative mood induction procedures (e.g., Velten mood induction, Velten, 1968) evidence a relatively brief duration (i.e., 6-12 min). Similarly, research using guided imagery to induce sad, happy, or neutral moods suggests that mood can be reliably induced for a six-minute duration (Sedikides, 1994). Collectively, it appears that researchers could conservatively constrain the post-induction assessment interval to approximately six minutes and that the interval between the worry induction and the lexical decision making task was potentially too long in the current study. This recommendation however, is derived from research utilizing mood induction generally, rather than worry induction specifically. Additional research is needed to empirically establish the duration of the worry induction paradigm in both adults and adolescents (Brenner, 2000).

Finally, contrary to expectation, metacognitive worry was not related to reactivity to the worry induction. Neither the total score nor the Uncontrollability and Danger subscale scores evidenced significant relations with challenge response as a function of condition. Previous

research supports a relationship between metacognitive worry and trait worry (Cartwright-Hatton et al., 2004) and suggests that metacognitive worry distinguishes a GAD group from a non-anxious group (Wells, 2005). However, no work has examined the link between metacognitive worry and laboratory induced worry. It is possible that the fundamental attributes of a worry induction in a laboratory setting (e.g., time-limited, effortful) are in opposition to the characteristics of metacognitive worry. For example, beliefs that worry is useful, worry is uncontrollable and problematic, and one must avoid worrying (characteristics of metacognitive worry) are arguably antithetical to the effortful worry requested by the researcher in a laboratory setting. These important differences between laboratory induced and naturalistic worry may account for the lack relation between metacognitive worry challenge responses among participants exposed to the worry induction in the current study. Indeed, the metacognitive model of worry (Wells, 1995; 1999) suggests that worry can be described in two basic stages. In the first stage, which could arguably be described as normative worry, the individual engages in worry about stressors in one's life (e.g., financial matters, work responsibilities). In the second stage, one begins to worry about worry (believing worry is harmful or out of control). The metacognitive model proposes that this second stage of worry is what is pathogenic about the worry process and leads to GAD. This second type of (metacognitive) worry would only be expected to be present in a small percentage of a community-recruited sample. It will thus be important to evaluate the association between metacognitive worry and reactivity to the worry induction among pathological worriers. Indeed, in order to downward extend the existing adult research and as suggested by previous researchers (Ellis & Hudson, 2010) research is needed comparing the nature and consequences of worry using induction paradigms among youth with GAD, other anxiety disorders, and non-clinical controls.

In addition to the limitations of the current study noted above, a number of other issues warrant addition consideration. First, the generalizability of the current study findings may be constrained by the fact that the sample was predominantly Caucasian and participants received monetary compensation for taking part in the investigation, which may have resulted in a self-selection bias. Future investigations would benefit from the use of more diverse recruitment and compensation strategies. Second, some evidence (Vasey et al., 1994) suggests that worry may evidence significant variability during this developmental epoch, however, the current sample size prohibited fine-grained analyses of age effects or cognitive development on response to the worry induction. Future research would benefit from using a cross-sequential design to examine developmental changes in responding to a worry induction across the adolescent and young adulthood period. Employment of sophisticated indices of cognitive stage (cf., age as proxy) would further enhance the contribution of such a study. Third, psychophysiological reactivity was not assessed in the current study. The adult literature suggests that a worry induction should produce an array of physiological effects, including increased parasympathetic nervous system activation marked by lower heart rate variability (Borkovec & Hu, 1990; Hofman et al., 2005), increased corticospinal motor response (Oathes, Bruce, & Nitschke, 2008), and changes in regional cerebral blood flow (Hoehn-Saric, Lee, McLeod, & Wong, 2005). There are currently no data that speak to the psychophysiological effects of worry induction among youth; this is a promising avenue for future work.

These limitations notwithstanding, the present study provides initial evidence supporting the validity of using a worry induction paradigm with adolescents. Specifically, such an approach produced significantly greater self-reported negative affectivity, muscle tension, and future-oriented mentation as compared to a control group. These data are promising and suggest

that worry induction is likely a useful tool for examining the nature and correlates among youth. This is an important contribution to the literature, as researchers can utilize a worry induction procedure to rigorously and systematically evaluate the developmental course of worry, as well as factors that may enhance or protect against the transition from normative to pathological worry during the critical developmental phase of adolescence.

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Table 1
Descriptive Data for Continuous Variables

		M_{total} (SD)	M_{worry} (SD)	$M_{neutral}$ (SD)	*t*	*p*
Parent Variables						
	PSWQ	35.09 (10.49)	36.6 (10.22)	33.92 (10.96)	0.60	ns
	Age	42.12 (7.47)	40.2 (6.96)	44.04 (7.61)	-1.86	ns
	Household Income	55,025.00 (35,599.01)	56,328.00 (32,802.79)	53,608.70 (39,109.10)	0.26	ns
Child Variables						
	PSWQ-C	17.31 (9.24)	15.17 (8.76)	19.36 (9.39)	-1.62	ns
	MCQ-A	55.92 (12.26)	53.12 (11.48)	58.72 (12.60)	-1.64	ns
	Age	14.99 (1.73)	15.43 (1.77)	14.54 (1.61)	1.88	ns
	Year in School	9.22 (1.74)	15.17 (8.76)	19.36 (9.39)	-1.62	ns
	Logical Reasoning Test	2.98 (1.53)	2.88 (1.53)	3.08 (1.55)	-0.46	ns
	Baseline PANAS-CN	17.51 (3.34)	16.84 (2.36)	18.21 (4.08)	-1.45	ns
	Baseline FLOVAS-Word	45.19 (31.65)	48.75 (30.63)	41.63 (32.82)	0.78	ns
	Baseline FLOVAS-Future	36.02 (29.70)	34.50 (30.63)	37.54 (29.23)	-0.35	ns
	Baseline SUDS Worry	20.44 (19.04)	16.64 (17.30)	24.24 (20.28)	-1.43	ns
	Baseline SUDS Depression	7.56 (15.37)	6.24 (14.40)	8.88 (16.45)	-0.60	ns
	Baseline SUDS Happy	70.27 (17.50)	69.44 (17.32)	71.13 (18.02)	-0.33	ns
	Baseline SUDS Muscle Tension	23.43 (21.85)	23.88 (23.13)	22.96 (20.94)	-0.15	ns
	Baseline SAM	6.31 (1.19)	6.21 (1.14)	6.42 (1.25)	-0.60	ns

Note. MCQ-A: Meta-Cognitions Questionnaire-Adolescent (Cartwright-Hatton et al., 2004), PANAS-C: Positive and Negative Affect Schedule for Children (Joiner et al., 1996); PSWQ: Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990), PSWQ-C: Penn State Worry Questionnaire-Children (Chorpita et al., 1997); SAM: Self-Assessment Manikin Scales (Lang, 1980); SUDS: Subjective Units of Distress (Wolpe, 1958). SAM was reverse scored.

Table 2
Descriptive Data for Categorical Variables

			$Count_{total}$ (%)	$Count_{worry}$ (%)	$Count_{neutral}$ (%)	X_2	*p*
Parent Variables							
	Parent Education					2.50	ns
		Grade 6 or less	0 (0%)	0 (0%)	0 (0%)		
		Grades 7-12 w/o graduating	3 (6%)	1 (4%)	2 (8%)		
		High school grad or GED	11 (22%)	5 (20%)	6 (24%)		
		Part College	11 (22%)	6 (24%)	5 (20%)		
		Graduated from 2yr College	3 (6%)	2 (8%)	1 (4%)		
		Graduated from 4yr College	11 (22%)	4 (16%)	7 (28%)		
		Graduate/Professional School	8 (16%)	5 (20%)	3 (12%)		
		Completed Graduate/Professional School	3 (6%)	2 (8%)	1 (4%)		
	Parent Race					1.09	ns
		White/Caucasian	46 (92%)	22 (88%)	46 (96%)		
		African American	4 (8%)	3 (12%)	1 (4%)		
	Parent Ethnicity					1.02	ns
		Not Hispanic/Latino	49 (98%)	25 (100%)	24 (96%)		
		Hispanic/Latino	1 (2%)	0 (0%)	1 (4%)		
Child Variables							
	Gender					0.00	ns
		Male	24 (48%)	12 (48%)	12 (48%)		
		Female	26 (52%)	13 (52%)	13 (52%)		
	Education (current level)					2.50	ns
		Grade 6	1 (2%)	1 (4%)	0 (0%)		
		Grade 7	11 (22%)	4 (16%)	7 (63.6%)		
		Grade 8	3 (12%)	4 (16%)	7 (14%)		
		Grade 9	8 (16%)	4 (16%)	4 (16%)		
		Grade 10	3 (12%)	4 (16%)	7 (14%)		

	Grade 11	12 (24%)	8 (32%)	4 (16%)		
	Grade 12	3 (12%)	1 (4%)	2 (8%)		
	College	1 (2%)	1 (4%)	0 (0%)		
5. Race					0.17	ns
	White/Caucasian	43 (86%)	21 (84%)	22 (88%)		
	African American	7 (14%)	4 (16%)	3 (12%)		
6. Ethnicity					2.08	ns
	Not Hispanic/Latino	48 (96%)	25 (100%)	28 (92%)		
	Hispanic/Latino	2 (4%)	0 (0%)	2 (8%)		
7. Concrete Operations Test					0.6	ns
	Pass	42 (84%)	20 (80%)	22 (88%)		
	Fail	8 (16%)	5 (20%)	3 (12%)		
8. Major Depressive Disorder					1.5	ns
	Diagnosed	7 (14%)	5 (20%)	2 (8%)		
	Not Diagnosed	43 (86%)	20 (80%)	23 (92%)		
9. Generalized Anxiety Disorder					1	ns
	Diagnosed	4 (8.2%)	3 (12%)	1 (4.2%)		
	Not Diagnosed	45 (91.8%)	22 (88%)	23 (95.8%)		

Table 3

Correlational Data for Continuous Predictor and Criterion Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Parent PSWQ	-	-0.36	-0.18	0.40	0.17	-0.21	-0.11	0.64**	-0.39	0.27	-0.26	0.31	0.03	0.11	-0.10	-0.31
2. Parent Age		-	0.12	0.14	0.34*	0.22	0.23	0.15	0.32*	-0.04	0.09	0.17	.50**	-0.12	0.26	0.05
3. Household Income			-	0.09	-0.07	-0.03	-0.12	0.09	-0.21	0.00	0.07	-0.11	-0.03	-0.01	-0.21	0.08
4. PSWQ-C				-	0.56**	-0.13	-0.05	0.19	0.38**	0.25	0.11	0.52**	0.38**	-0.26	0.02	-0.24
5. MCQ-A					-	0.09	0.24	0.15	0.51**	0.29*	0.32*	0.32*	0.34*	-.29*	-0.09	-0.25
6. Age						-	0.89**	0.17	0.15	0.18	-0.05	-0.15	0.16	-.30*	0.15	-0.32
7. Year in School							-	0.27	0.23	0.22	0.03	-0.29	0.89	-0.24	0.04	-0.30
8. Logical Reasoning Test								-	0.11	0.29*	-0.11	0.17	0.02	-0.18	-0.12	-0.23
9. Baseline PANAS-CN									-	0.15	0.30*	.46**	0.32*	-.32*	0.14	-0.27
10. Baseline FLOVAS-Word										-	0.02	0.01	-0.03	-0.18	0.03	-0.31
11. Baseline FLOVAS-Future											-	0.29**	0.25	-0.13	0.05	0.02
12. Baseline SUDS Worry												-	0.38**	0.00	0.15	-0.23
13. Baseline SUDS Depression													-	-.40**	0.25	-0.24
14. Baseline SUDS Happy														-	0.03	0.60**
15. Baseline SUDS Muscle Tension															-	0.16
16. Baseline SAM																-

Note. * = p <.05, ** = p < .01; MCQ-A: Meta-Cognitions Questionnaire-Adolescent (Cartwright-Hatton et al., 2004), PANAS-C: Positive and Negative Affect Schedule for Children (Joiner et al., 1996); PSWQ: Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990), PSWQ-C: Penn State Worry Questionnaire-Children (Chorpita et al., 1997); SAM: Self-Assessment Manikin Scales (Lang, 1980); SUDS: Subjective Units of Distress (Wolpe, 1958). SAM was reverse scored.

Table 4
Condition Differences Controlling for Baseline Scores

		M_{worry} (SD)	$M_{neutral}$ (SD)	(df) *F*	*p*	η^2
Baseline Scores						
	SUDS worry	16.64 (17.30)	24.24 (20.28)			
	SUDS depression	6.24 (14.40)	8.88 (16.46)			
	SUDS muscle tension	23.88 (23.13)	22.96 (20.94)			
	SUDS happiness	69.44 (17.32)	71.13 (18.02)			
	PANAS-CN	16.84 (2.36)	18.21 (4.08)			
Post-Induction Scores						
	SUDS worry	46.32 (29.10)	16.40 (25.07)	(1,49) 14.13	<.01	0.35
	SUDS depression	10.84 (19.75)	3.76 (10.81)	(1,49) 6.89	<.05	0.13
	SUDS muscle tension	25.33 (25.77)	18.52 (21.36)	(1,47) 1.71	<.05	0.22
	SUDS happiness	47.54 (24.56)	64.52 (23.49)	(1,47) 5.98	<.05	0.12
	PANAS-CN	23.00 (8.41)	17.80 (6.14)	(1,47) 12.86	<.01	0.22

Note: The effect of condition on post-induction scores was analyzed using the baseline score as a covariate; PANAS-C: Positive and Negative Affect Schedule for Children (Joiner et al., 1996); SUDS: Subjective Units of Distress (Wolpe, 1958).

Table 5
Means for Repeated Measures Analyses During Mood Induction

		M_{total} (SD)	M_{worry} (SD)	$M_{neutral}$ (SD)	*t* (df)	*p*
Verbal-Linguistic						
	Baseline	45.19 (31.65)	48.75 (30.70)	41.63 (32.82)	.78 (46)	ns
	Minute 1	54.92 (32.66)	58.24 (29.32)	51.60 (35.98)	.72 (48)	ns
	Minute 2	56.82 (31.96)	60.16 (27.14)	53.48 (36.41)	.74 (48)	ns
	Minute 3	52.98 (32.02)	59.64 (24.47)	46.32 (37.45)	1.49 (48)	ns
	Minute 4	53.96 (34.35)	58.20 (25.73)	49.72 (41.34)	.87 (48)	ns
	Post-Challenge	56.65 (34.00)	64.92 (28.63)	48.72 (37.33)	1.70 (47)	ns
Future-Oriented						
	Baseline	36.02 (29.66)	34.50 (30.63)	37.54 (29.23)	-.35 (46)	ns
	Minute 1	37.96 (32.07)	51.08 (30.78)	24.84 (28.16)	3.14 (48)	<.01
	Minute 2	40.84 (32.96)	53.80 (30.96)	27.88 (30.16)	3.00 (48)	<.01
	Minute 3	40.10 (33.57)	54.84 (28.75)	25.36 (31.95)	3.43 (48)	<.01
	Minute 4	44.64 (34.32)	53.68 (30.78)	35.60 (35.87)	1.91 (48)	<.01
	Post-Challenge	40.96 (38.72)	49.04 (37.16)	33.20 (39.33)	1.45 (47)	ns
Negative Mood						
	Baseline	6.31 (1.19)	6.21 (1.14)	6.42 (1.25)	-.60 (46)	ns
	Minute 1	6.12 (2.99)	5.24 (1.09)	7.00 (3.94)	-2.15 (48)	<.05
	Minute 2	5.38 (1.64)	4.68 (1.57)	6.08 (1.41)	-3.31 (48)	<.01
	Minute 3	5.58 (1.67)	4.80 (1.53)	6.36 (1.44)	-3.72 (48)	<.01
	Minute 4	5.68 (1.77)	4.80 (1.76)	6.56 (1.29)	-4.04 (48)	<.01
	Post-Challenge	5.48 (1.88)	4.60 (1.73)	6.36 (1.60)	-3.73 (48)	<.01

Table 6
Descriptive Data for Lexical Decision Task

		M_{total} (SD)	M_{worry} (SD)	$M_{neutral}$ (SD)
Mean Reaction Times				
	Anxiety Words	891.82 (384.95)	981.76 (465.26)	801.88 (263.11)
	Non-Anxiety Words	903.46 (379.49)	988.04 (465.02)	818.87 (250.76)
	Non-Words	1085.69 (480.00)	1149.20 (490.51)	1022.19 (470.52)
Mean Accuracy				
	Anxiety Words	0.96 (0.06)	0.96 (0.07)	0.96 (0.04)
	Non-Anxiety Words	0.94 (0.07)	0.95 (0.08)	0.94 (0.07)
	Non-Words	0.90 (0.10)	0.89 (0.13)	0.91 (0.06)

Note. Reaction times are reported in milliseconds. An accuracy score of 1 represents perfect accuracy while a score of 0 indicates the participant did not select correctly on any trials.

Table 7

Meta-Worry Predicting Change in Worry & Negative Affectivity

	ΔR^2	*t* (each predictor)	β	sr^2	*p*
Dependent Variable: Post-Challenge SUDS-Worry					
Step 1	0.10				< .05
Baseline SUDS-Worry		2.27	0.31	0.10	< .05
Step 2	0.37				<.01
MCQ-A Scores		2.15	0.25	0.05	< .05
Condition		-5.55	-0.62	0.36	<.01
Step 3	0.02				ns
MCQ-A Scores*Condition		1.39	0.49	.02	ns
Dependent Variable: Negative Affectivity					
Step 1	0.19				< .01
Baseline PANAS-CN		3.26	0.43	0.19	< .01
Step 2	0.23				< .01
MCQ-A Scores		1.92	0.26	0.05	ns
Condition		-3.92	-0.46	0.20	< .01
Step 3	0.02				ns
MCQ-A Scores*Condition		-0.13	-0.05	-0.02	ns

Note. Worry condition was coded "1" and neutral condition was coded "2". MCQ-A: Meta-cognitions Questionnaire for Adolescents (Cartwright-Hatton, Roberts, Chitsabesan, Forthergill, & Harrington, 2004). PANAS-CN: Positive and Negative Affect Schedule for Children – Negative Affect Subscale (Joiner et al., 1996); SUDS: Subjective Units of Distress (Wolpe, 1958).

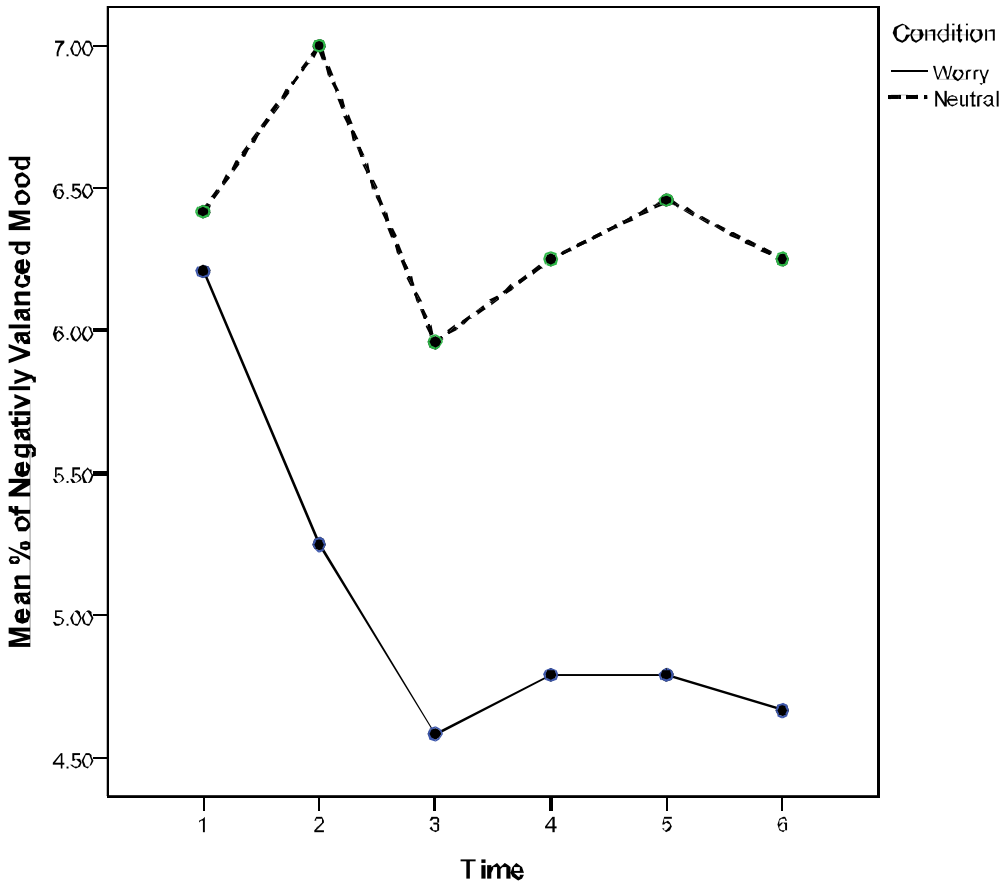


Figure 1. Negatively Valenced Mood Across Time as a Function of Group.

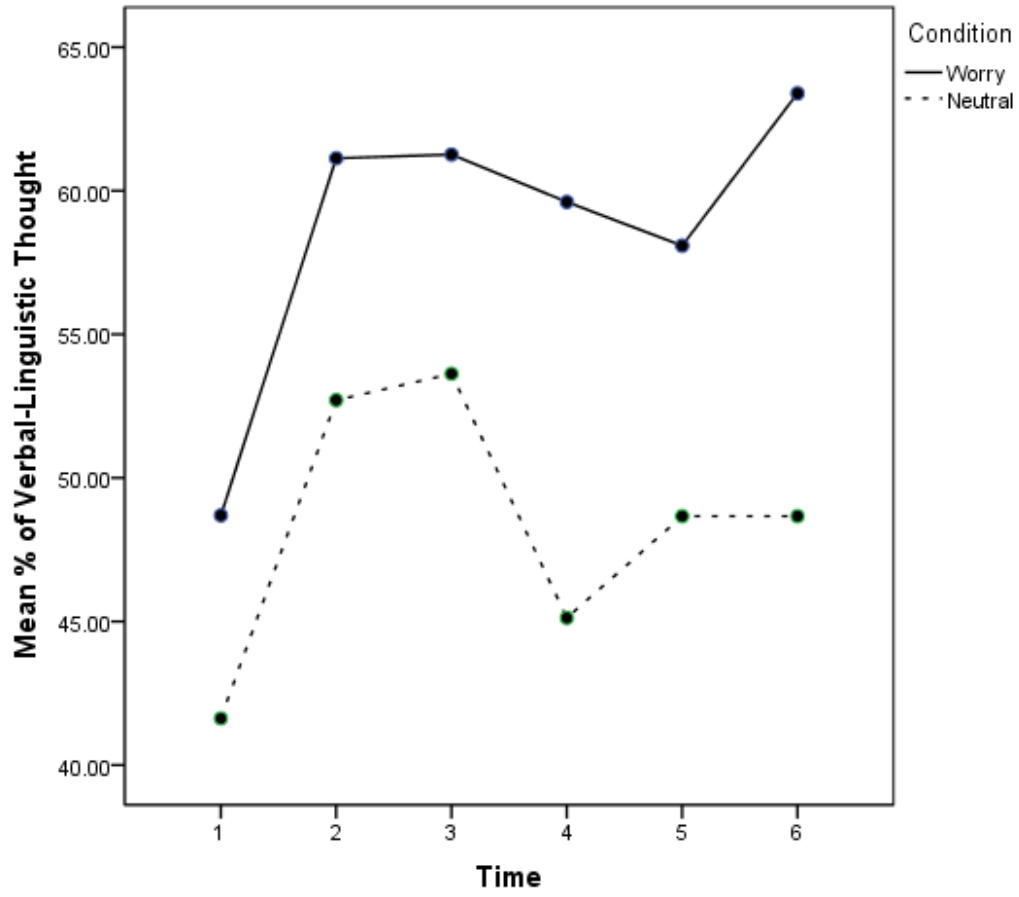


Figure 2. Verbal-Linguistic Thoughts Across Time as a Function of Group

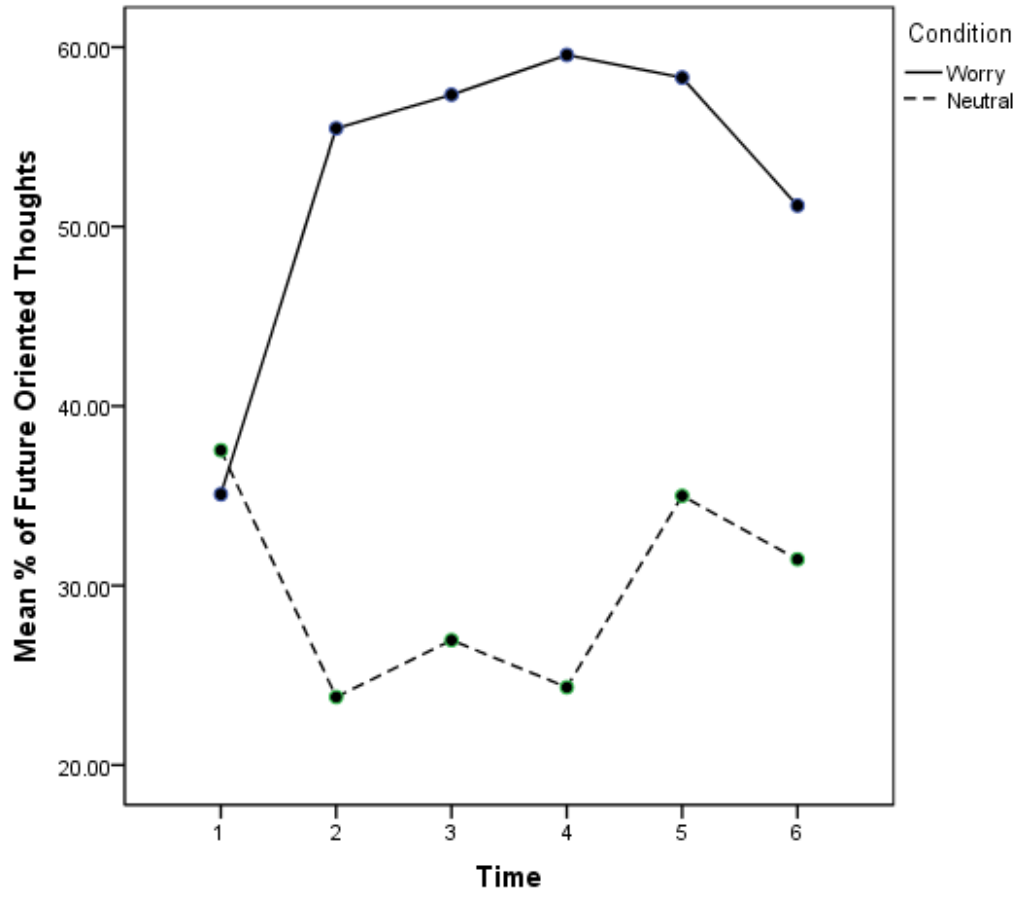


Figure 3. Future Oriented Thoughts Across Time as a Function of Group

Appendix A

Logical Reasoning Test

Questions 1-3 are called syllogisms. Each syllogism consists of two premises and a conclusion. You are to determine whether each conclusion is valid or not.

Example:

P_1: No one-year-old babies can walk.
P_2: Paul is a one-year-old baby.
C: Paul cannot walk.
This is a valid conclusion.

1. P_1: Not all R's are T's
   P_2: All T's are M's

   ___
   C: Some R's may not be M's

   (a) True
   (b)False

2. P_1: All coal is white
   P_2: All white coal produces red smoke when burning

   ___
   C: Therefore when coal burns, the smoke is grey

   (a) True
   (b)False

3. P_1: When John gets angry at Mary he hits her.
   P_2: John is not angry at Mary.

   ___
   C: Therefore John will not hit Mary.

   (a) True
   (b)False

Questions 4-8 are called verbal analogies. Verbal analogies consist of two pairs of words, each pair having the same relationship. For example, in is to out as up is to down. The common relationship between in-out and up-down is that they are opposites. Order of the pair of words is also important. Although peel is to banana as paint is to house is correct, peel is to banana as house is to paint in incorrect. In the following questions you are to choose two or three words that will best complete each analogy.

Example:

a) tire			e)anchor	
b) motor	**is to car as**		f) deck	**is to ship**
c) highway			g) captain	
d) map			h) ocean	

The correct answers are (c) highway and (h) ocean.
Highways is to car as ocean is to ship. A car operates on a highway and a ship operates on the ocean.

4.

	a) attempt		e)problem	
task is to	b) completion	**as**	f) chemical	**is to solution**
	c) work		g) man	
	d) question		h) answer	

5.

a) music		e) chair	
b) house	**is to piano as**	f) leg	**is to table**
c) bench		g) eat	
d) tuner		h) furniture	

6.

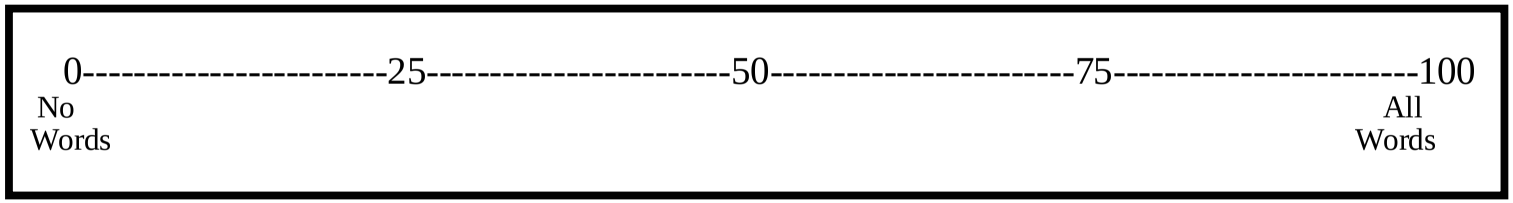
a) walk		e) roll
b) toe	**is to body as wheel is to**	f) machine
c) knee		g) bicycle
d) foot		h) spokes

Allen, J. L. (1984). *Levels of cognitive development and attribution behavior relationships.* (Doctoral dissertation).

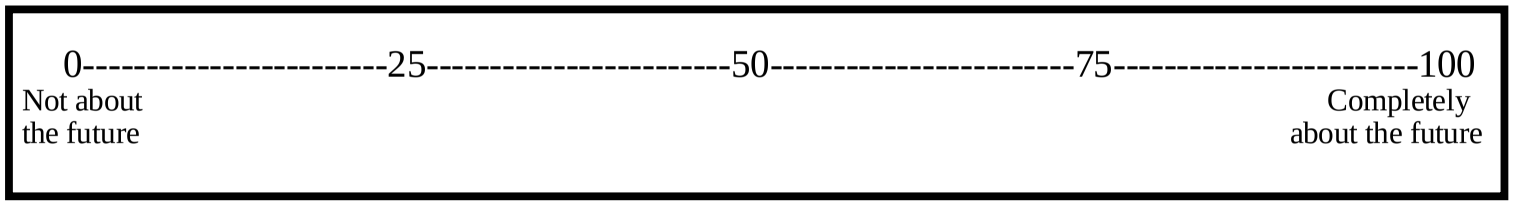
Appendix B

Future-Oriented/Verbal-Linguistic Visual Analog Scale for Children

Please circle how much of your thoughts right now are **WORDS** that you are saying to yourself in your head



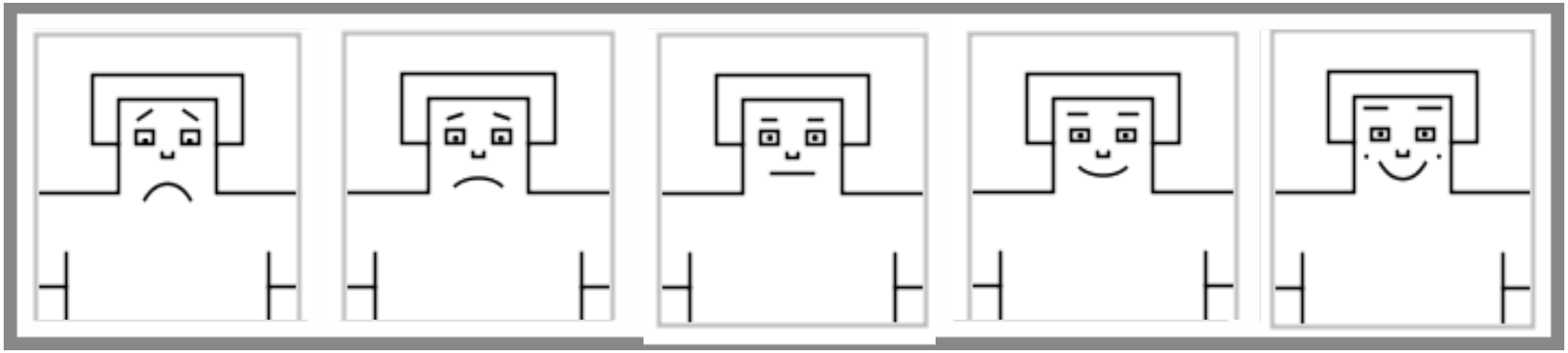
Please circle how much of your thoughts right now are about things that will happen in the **FUTURE**



Appendix C

SAM

Please indicate on the picture below to represent your mood at this moment. You may mark in or between the boxes.



Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: Computer applications. In J. B. Sidowski, J. H. Johnson, & T. A. Williams (Eds.), *Technology in mental health care delivery systems* (pp. 119-137). Norwood, NJ: Ablex.

Appendix D

SUDS
(Wolpe, 1958)

Please rate your current level of **worry** by placing an X between 0 to 100 on the scale below

0	25	50	75	100
No Worry	A little bit	Some	A lot	Very Very Much Worry

Please rate your current level of **depression** by placing an X between 0 to 100 on the scale below

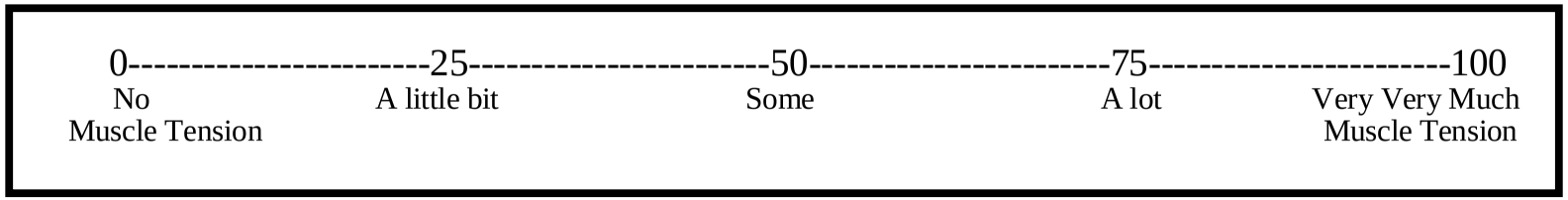
0	25	50	75	100
No Depression	A little bit	Some	A lot	Very Very Much Depression

Please rate your current level of **happiness** by placing an X between 0 to 100 on the scale below

0	25	50	75	100
No Happiness	A little bit	Some	A lot	Very Very Much Happiness

Appendix D continued

Please rate your current level of **muscle tension** by placing an X between 0 to 100 on the scale below



Wolpe, J. (1958). Psychotherapy by reciprocal inhibition. Stanford, CA: Stanford University Press.

Appendix E

Anxiety Words

accident	concern	doubt	hazard	punishment
alarm	danger	dread	insecure	suspense
anxiety	disaster	emergency	nervous	trouble
avoid	distress	failure	panic	uneasy
burden	disturbed	fear	problem	worry

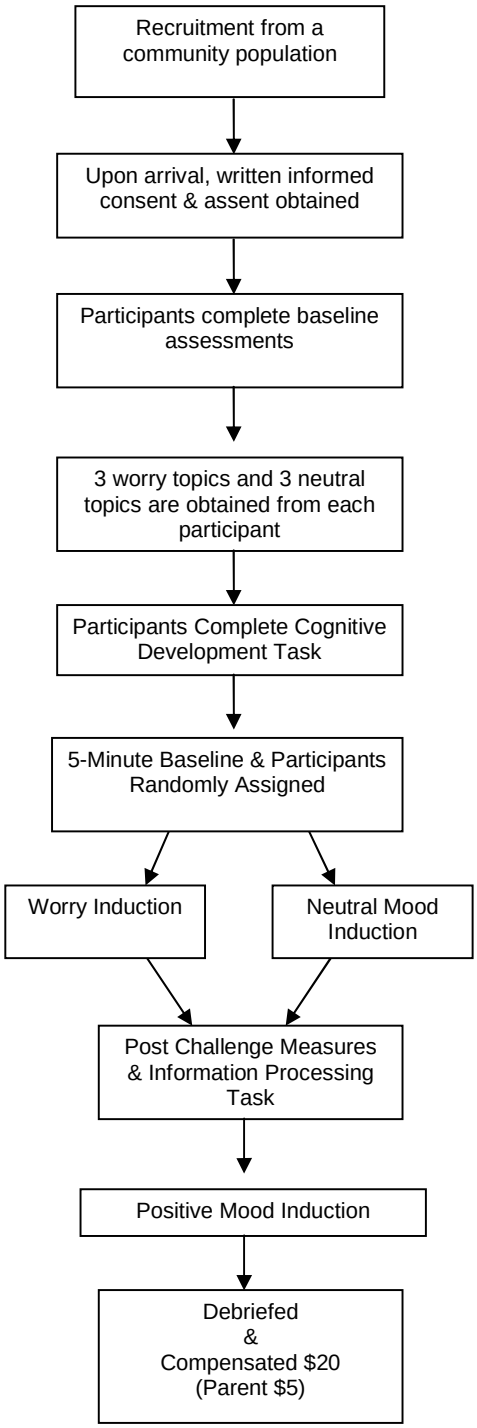
Neutral Words

floating	wisdom	scent	reminder	whispers
grasp	estimate	tradition	charity	suggest
harvest	umbrella	utility	fuzzy	soften
brain	resemble	host	through	serve
trading	stand	greedy	adventures	reveal

Non-Words

atrobats	treaking	felc	elormity	wolls
novic	drescent	powors	profond	ubrupt
cleerly	hemanded	oarliest	tubble	amolish
rapiw	plent	jokking	thunb	houdes
bissuit	younj	rougg	krescent	pressang
dappet	sprunkles	laghtly	smish	fidedity
gloumi	inllude	resurcaced	vuctoro	cruation
loung	nelarious	crin	andulate	uppes
meeds	driggle	tobles	infides	remmant
schmoogles	bridlet	vubble	crescelt	welme

Appendix F


Recruitment from a community population
Upon arrival, written informed consent & assent obtained
Participants complete baseline assessments
3 worry topics and 3 neutral topics are obtained from each participant
Participants Complete Cognitive Development Task
5-Minute Baseline & Participants Randomly Assigned
Worry Induction
Neutral Mood Induction
Post Challenge Measures & Information Processing Task
Positive Mood Induction
Debriefed & Compensated $20 (Parent $5)