

Tables and Figures: 2

Cognitive risk profiles for anxiety disorders in a high-risk population

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Abstract

The purpose of the present study was to identify subgroups of participants who may be at particularly high risk for anxiety pathology based on specific combinations of demographic characteristics and higher-order cognitive abilities in a population at disproportionate risk for deficits in cognitive abilities (i.e., smokers within the criminal justice system). Participants ($N = 495$) provided demographic information, were administered a semi-structured diagnostic interview, and completed a number of measures assessing cognitive abilities. A receiver-operating characteristic (ROC) model using signal detection theory indicated that the strongest predictor of anxiety disorder diagnosis was race, with White participants having a 30.6% likelihood of diagnosis and participants in the non-White category (97% of which identified as Black/African American) having a 18.9% likelihood of diagnosis. Interestingly, the individual risk profile associated with the highest probability of having a current anxiety disorder was characterized by White participants with impaired response inhibition (58.6%), and the lowest probability of having a current anxiety disorder was among non-White males (13.9%). The findings, which indicated that White individuals with impaired response inhibition are at a disproportionately high risk for anxiety disorders, suggest a potential target for prevention and intervention.

Keywords: Anxiety/anxiety disorders, cognition, ROC analyses, smoking, race

1. Introduction

In a given year, more people in the United States (U.S.) meet criteria for an anxiety disorder diagnosis (18% of the population) than any other mental health disorder (Kessler et al., 2005b). Anxiety disorders are predictive of poor physical health and a poorer quality of life (Hoffman et al., 2008). Additionally, the economic impact of anxiety is staggering (e.g., treatment costs, lost workplace productivity), with costs estimated at over 42 billion dollars per year in the U.S. (Kessler and Greenberg, 2002). Because of the severe human suffering and substantial economic burden associated with anxiety disorders, researchers have spent a great deal of time identifying risk and resiliency factors for anxiety pathology in hopes of reducing or ameliorating these negative outcomes.

Higher-order cognitive processes (e.g., inhibition, working memory) have received increased attention in the anxiety literature because relative deficits in these processes have been found to be related to maladaptive psychological outcomes in general, and to anxiety pathology more specifically (Casteneda et al., 2008). For example, anxiety has been shown to be associated with relative deficits in long- and short-term working memory (Asmundson et al., 1995; Airaksinen et al., 2005), cognitive flexibility/set-shifting (Airaksinen et al., 2005; Beaudreau and O'Hara, 2009), processing speed (Martin et al., 1995; Beaudreau and O'Hara, 2009), and inhibition of dominant response tendencies (Beaudreau and O'Hara, 2009). Although it can be methodologically difficult to determine the temporal precedence of associations among cognitive processes and anxiety pathology, evidence suggests that deficits in higher-order cognitive processes precede the development of anxiety pathology, and thus, are likely a risk factor for anxiety rather than a consequence of such pathology (Degnan and Fox, 2007). For example, relative deficits in both inhibition and attentional control may be a risk factor for the later

development of anxiety pathology (Muris, 2006). Moreover, a lower level of intelligence in childhood has been found to be predictive of psychological distress, and notably anxiety symptoms, in adulthood (Gale et al., 2009). Gale et al. (2009) surmised that neurocognitive deficits present in childhood may increase the likelihood of future internalizing pathology.

Although considerable evidence suggests that deficits in higher-order cognitive processes may put one at risk for developing anxiety pathology, evidence to the contrary does exist. For example, Price and Mohlman (2007) found that inhibitory control was significantly positively associated with worry and trait anxiety, but not anxious arousal. These results were interpreted as suggesting that relatively higher inhibitory control may increase anxiety by facilitating worry and rumination as a strategy to inhibit, or avoid, the processing of threat information (Price and Mohlman, 2007). However, some have suggested that equivocal findings regarding relations between higher-order cognitive processes and anxiety may be due to a third variable confound, such as demographic differences in anxiety and cognitive abilities (e.g., Bardeen and Stevens, 2015).

A number of demographic variables have been shown to be associated with anxiety pathology. For example, anxiety disorder prevalence rates appear to be highest in midlife (Wittchen, 2002), and among those with relatively less education (Bjelland et al., 2008) and lower income (i.e., < \$20,000 per year; Sareen et al., 2011). Females are diagnosed with anxiety disorders at a significantly higher rate than males, and non-Hispanic whites are at significantly higher risk for an anxiety disorder diagnosis than Non-Hispanic blacks and Hispanics (Kessler et al., 2005a). Furthermore, preliminary evidence suggests that the role that specific higher-order cognitive processes play in anxiety pathology may be sex-dependent. Bardeen and Stevens (2015) found that relatively higher response inhibition may be a protective factor against anxiety

among males, but not females, and relatively higher abstract reasoning abilities may be a risk factor for anxiety among females, but not males. While these findings are preliminary in nature, they nonetheless speak to the potential importance of accounting for demographic variables - and sex in particular - when trying to better understand risk profiles for anxiety pathology.

As described, empirical evidence has broadly implicated higher-order cognitive processes in the development of anxiety pathology. Thus, to get a more fine grained understanding of the cognitive ability-anxiety association, it is important to explore the role that specific higher-order cognitive processes play in anxiety pathology in populations that are at disproportionate risk for deficits in cognitive abilities, as these populations may also be at greater risk for anxiety pathology. Several empirical studies have shown that individuals in the criminal justice system have significantly lower levels of intelligence in comparison to the general population (Wilson and Herrnstein, 1985; Herrnstein and Murray, 1994; Herrero et al., 2010), as well as relative deficits across a number of higher-order cognitive processes when compared to non-criminal justice involved peers. For example, both violent and non-violent offenders performed significantly worse than control participants on tasks assessing associative learning and working memory (Hoaken et al., 2007). Interestingly, males in the criminal justice system ($N = 80$) scored significantly lower on some, but not all, measures assessing a wide variety of higher-order cognitive abilities (Hancock et al., 2010). Similarly, Herrero et al. (2010) found that criminal justice system participants scored significantly lower than non-criminal justice involved peers on memory and updating measures, but not on inhibition and set shifting measures.

Relative to any other disadvantaged population, individuals in the criminal justice system have the highest rate of smoking (i.e., 70-80% of the criminal justice population; Cropsey et al., 2010). This is particularly important in the context of the present study because, like anxiety,

smoking is also associated with relative deficits in higher-order cognitive abilities (Nooyen et al., 2008; Durazzo et al., 2012). Smoking has been shown to be associated with deficits in working memory (Ernst et al., 2001), attention (Friend et al., 2005), cognitive flexibility and set-shifting abilities (Kalmijn et al., 2002; Friend et al., 2005; Nooyens et al., 2008), and psychomotor processing speed (Kalmijn et al., 2002; Nooyens et al., 2008). In addition to being associated with deficits in cognitive abilities, smoking has been shown to be associated with anxiety. For example, nicotine-dependent smokers have been shown to have greater severity of mood and anxiety symptoms, and also to have slower improvements in mood and anxiety symptoms, even after controlling for demographic covariates (Jamal et al., 2012). Furthermore, studies have demonstrated that smokers who attempt to quit but are unsuccessful are at greater risk for anxiety and depression than non-quitters or successful quitters (e.g., McClave et al., 2009; McDermott et al., 2013). Thus, individuals in the criminal justice system who smoke may be a particularly important group in which to explore the role of specific higher-order cognitive processes in anxiety pathology, as they appear to be at disproportionate risk for both deficits in cognitive abilities and anxiety pathology.

The purpose of the present study was to identify subgroups of smokers within the criminal justice system who may be at particularly high risk for anxiety pathology based on specific combinations of demographic characteristics (i.e., race, age, income, education, gender) and cognitive abilities (i.e., IQ, cognitive flexibility/set-shifting, response inhibition, working memory). To obtain a hierarchy of the predictors which have the highest predictive power for an anxiety disorder diagnosis, we included demographic and higher-order cognitive ability predictors in a receiver-operating characteristic (ROC) model using signal detection theory (Kiernan et al., 2001). The iterative nature of the analytic approach is such that it can identify

individual difference variables which have the highest predictive power for a binary outcome, so that moderators or characteristics of participants who are at differential risk can be delineated.

2. Materials and Methods

2.1. Participants

Participants were recruited from a larger clinical trial aimed at examining the effects of a smoking cessation intervention for individuals under criminal justice supervision ($N = 673$). Participants who had missing data (i.e., no behavioral assessments, $n = 169$), or for whom multivariate outlier analysis revealed extreme scores ($n = 9$), were excluded from analyses. The final sample ($N = 495$; 34% female) had a mean age of 36.5 years ($SD = 11.1$), and 63% self-identified as Black/African American, 35% as White, 1% as Biracial, and 1% endorsed "Other". Given the limited variability in racial status, race was collapsed into a single dummy coded variable (coded as White [$n = 173$, 35%] vs. non-White [$n = 322$, 65%]).

2.2. Procedure

Participants were recruited via flyers. The smoking cessation intervention included the provision of 12 weeks of bupropion and brief physician advice to quit smoking and randomized individuals to either four 20-30 minutes sessions of behavioral counseling for smoking or no additional counseling. Since all participants were to receive medication, inclusionary criteria required that participants be at least 19 years of age (the age of adulthood in Alabama), were current smokers and reported wanting to quit smoking, and were under criminal justice supervision (e.g., probation, parole, drug court, community corrections, etc.). All interested participants were screened for study eligibility. Participants were excluded from participation if they were non-English speaking, had a cognitive impairment resulting in an inability to provide informed consent, were pregnant or lactating, were medically unstable (e.g., seizure disorder),

evidenced current suicidal ideation or a recent suicide attempt (within the past 6 months), or had a history of bipolar disorder or an eating disorder. During the study visit, eligible participants provided written informed consent, demographic information, and were administered a semi-structured diagnostic interview and a number of measures assessing cognitive abilities.

Participants were compensated \$40 for their time. All procedures were approved by the institutional review board and a Certificate of Confidentiality was obtained from the federal government. The trial was registered with ClinicalTrials.gov (NCT01257490).

2.3. Measures

Anxiety disorders were assessed using the Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998). The MINI is a semi-structured interview for Axis I psychopathology which corresponds to diagnostic criteria presented in the DSM-IV and ICD-10. The MINI takes less time to administer than other structured clinical interviews (i.e., approximately 15-25 minutes), and validity and reliability data on the MINI indicate it is comparable to the Structured Clinical Interview for DSM (Sheehan et al., 1998). The specific anxiety disorders assessed by the MINI include panic disorder, generalized anxiety disorder, obsessive-compulsive disorder, social phobia, and posttraumatic stress disorder.

A series of cognitive and neuropsychological measures was administered and scored according to standard protocol and normative information. From the administered tests, five scores were selected for use in ROC analyses to provide a range of various cognitive abilities including estimated intelligence, response inhibition, psychomotor processing speed, cognitive flexibility/set-shifting, and working memory. Estimated full-scale IQ (FSIQ) was assessed using the Wechsler Test of Adult Reading (WTAR; Wechsler, 2001). The WTAR is a brief, five-minute assessment of adult reading ability. The WTAR was developed and co-normed with the

Wechsler Adult Intelligence Scale-III (WAIS-III; Wechsler, 1997), and provides an accurate estimate of FSIQ based upon the participants' overall reading ability. The Trail Making Test (TMT; Reitan and Wolfson, 1993) is a timed task which requires participants to connect numbered dots in numerical order (TMT-A), as well as connect numbers in order and letters in alphabetical order while alternating between numbers and letters (TMT-B), as quickly as possible. The TMT-A and TMT-B scaled scores are such that higher values indicate better psychomotor speed and cognitive flexibility/set-shifting abilities, respectively. Response inhibition was measured using the Stroop Color Word Interference Test (Stroop; Golden, 1978), during which participants are instructed to quickly and correctly identify the color in which color-words are printed while paying no attention to word meaning. Thus, participants must inhibit the more automatic tendency to read in favor of naming the dissonant ink color. The time it took participants to complete each condition was converted to a T-score for use in analyses. Working memory was assessed using the digit span subtest of the WAIS-III (Wechsler, 1997). For this subtest, the participant hears a series of numbers and is asked by the examiner to immediately recall the numbers in the exact same order as they were presented.

2.4. Data Analytic Approach

To determine the predictive power of individual demographic and higher-order cognitive variables on anxiety disorder diagnosis, a signal detection analysis was performed using a ROC algorithm (<http://www.stanford.edu/~yesavage/ROC.html>). In the current study, the signal was a binary outcome (0 = no current anxiety disorder, 1 = current anxiety disorder) and the detection was for the set of demographic and cognitive predictor variables. The ROC algorithm identifies optimal cut-points for the predictor variables to split the participants into two subgroups, and then ranks the variables according to their predictive power (i.e., κ , defined as sensitivity and

specificity for detecting the outcome). After the optimal predictor variable (i.e., the split variable with the highest κ) is identified, the process is repeated with the remaining variables to identify the next best predictor for the higher-risk subsample. There is a stopping rule of $p < .01$, so every time an optimal predictor is identified, a χ^2 test is performed and the variable is retained if $p < .01$. The process continues until the next best predictor is $p > .01$. This method determines the optimal cut point across all increments of a variable and across all variables. As such, the ROC algorithm generates hierarchical predictive profiles for the presence of an anxiety disorder based on the predictor variables iteratively identified in the algorithm. The demographic variables selected for use in the analyses included gender, age, race, income, and education. The cognitive process variables included estimated FSIQ, cognitive flexibility/set-shifting ability, response inhibition, working memory, and psychomotor processing speed.

3. Results

3.1. Preliminary Analyses

Univariate outliers (z-score > 3.3) were corrected to one unit larger than the next most extreme score in the distribution, and, as noted, multivariate outliers were excluded (Tabachnick and Fidell, 2007). Descriptive statistics are presented in Table 1. Twenty-three percent of the sample ($n = 114$) had at least one current anxiety disorder diagnosis, as determined by the MINI. When examining rates of specific anxiety disorders, 12.5% of participants had a diagnosis of generalized anxiety disorder ($n = 62$), 6.9% obsessive-compulsive disorder ($n = 34$), 6.3% social phobia ($n = 31$), 4.6% panic disorder ($n = 23$), and 3.4% posttraumatic stress disorder ($n = 17$).

3.2. Risk Profiles for a Current Anxiety Disorder Diagnosis

In the ROC model, the significant demographic and cognitive process predictors of a current anxiety disorder were race, response inhibition ability, and gender (see Figure 1). The

other variables included in the model did not exceed the cut point of $p < .01$. As illustrated in Figure 1, the best predictor of a current anxiety disorder was race. If a participant in the sample was White, the likelihood of having a current anxiety disorder was 30.6%, whereas if a participant was in the non-White category (97% of which identified as Black/African American), the likelihood of having a current anxiety disorder was 18.9%. For the White participants, the next best predictor of having a current anxiety disorder was the level of inhibition. White participants with relatively higher inhibitory ability (i.e., Stroop Color Word T-score ≥ 37) had a 25.0% likelihood of having a current anxiety disorder, whereas those with relatively low inhibitory ability (i.e., Stroop Color Word T-score < 37) had a 58.6% likelihood of having a current anxiety disorder. For the non-White participants, the next best predictor associated with a current anxiety disorder was gender. Non-White females had a 32.2% likelihood of having a current anxiety disorder, whereas non-White males had only a 13.9% chance of having a current anxiety disorder. The individual risk profile associated with the highest probability of having a current anxiety disorder was characterized by White participants with relatively low response inhibition (58.6%), and the individual risk profile associated with the lowest probability of having a current anxiety disorder was characterized by being a non-White male (13.9%).

4. Discussion

The goal of the present study was to use signal detection methodology to identify individual difference variables which put smokers in the criminal justice system at high risk for anxiety pathology. Results indicated that race was the best predictor of anxiety disorder diagnosis. Participants who self-identified as White were significantly more likely to have an anxiety disorder diagnosis than participants from the non-White category, which was primarily made up of Black/African American participants (i.e., 97%). One explanation for this finding

may be related to the well-documented phenomenon of mental health stigmatization in the African-American community (Alvidrez et al., 2008). In comparison to Whites, African-Americans have significantly higher levels of negative perceptions of the mentally ill (Whaley, 1997; Anglin et al., 2006), and are more likely to endorse beliefs that mental illness is a sign of personal weakness or due to immoral actions/improper lifestyle (Alvidrez et al., 2008). Moreover, there are often negative consequences for African-Americans who disclose a mental health problem, such as being mocked, belittled, and gossiped about within the family and the larger social context (Alvidrez et al., 2008). As such, African-Americans are less likely to disclose, and seek help for, mental health problems (Wells et al., 2001; Snowden and Yamada, 2005). Thus, consistent with research which has shown that African-Americans are significantly less likely than Whites to report mental health problems in the context of the criminal justice system (Wasserman et al., 2010; Prins et al., 2012), and in the community more generally (Breslau et al., 2005; Breslau et al., 2006), African-American participants in the present study may have been hesitant to disclose information regarding anxiety symptoms.

Among participants in the non-White category, gender was the next best predictor of an anxiety disorder diagnosis, with men being significantly less likely than women to report anxiety pathology. This finding may again be an issue of underreporting. That is, given the noted mental health stigma in the African-American community (Alvidrez et al., 2008), men may be particularly inclined not to disclose psychological distress for fear of being viewed as weak or 'unmanly,' and for fear of the reprisals that could come from being viewed in such a light. Moreover, the motivation not to disclose mental health information may be especially salient in the context of the criminal justice system, as inmates and parolees who are viewed as being weak may experience greater difficulties.

Among White participants, the ability to inhibit dominant response tendencies was the next best predictor of anxiety disorder status, with individuals with relatively low inhibitory ability having a 58.6% likelihood of a current anxiety disorder. Anxiety disorder prevalence for this specific risk profile (i.e., White with poor inhibitory ability) may seem shockingly high. However, it is important to consider the optimal cut-point that was identified for splitting the participants into subgroups (i.e., Stroop Inhibition T-score < 37). A T-score of less than 37 indicates borderline impaired inhibitory ability. Thus, participants in the low inhibition subgroup were exhibiting a level of inhibitory ability outside of the typical range of functioning. Having the ability to inhibit goal-irrelevant stimuli, whether internal (e.g., intrusive or repetitive thoughts) or external (e.g., background noise while talking on the phone), is critically important for meeting the demands of everyday life, as well as for maintaining psychological health. Thus, the noted subgroup likely experiences some degree of impairment in everyday functioning, as well as clearly meeting criteria for an anxiety disorder diagnosis.

The ability to inhibit bottom-up emotional responding appears to be especially important in the anxiety disorder domain, and has been linked to adaptive regulation of emotion. In a recent study examining emotion regulation as a mediator of the relation between inhibitory ability and anxiety, Bardeen and Stevens (2015) found that, among males, higher inhibitory ability (measured via the Stroop) was associated with better emotion regulation expectancies (i.e., one's perception of their ability to alleviate their emotional distress), which in turn predicted relatively lower levels of anxiety. In the present study, the majority of the White/low inhibition subgroup was male (72.4%), and thus, it is possible that gender may be driving the observed effect. It will be important in this line of research in the future to examine the mechanism(s), such as domains of emotion regulation, through which low inhibitory ability relates to anxiety pathology.

The present findings should be considered with the following limitations in mind. Although the use of a sample at disproportionate risk for deficits in cognitive abilities may be a strength for examining the cognitive ability-anxiety association, caution is warranted in generalizing study findings to the general population, who on average, have higher levels of cognitive functioning. In future research, it will be important to replicate study findings in the general population, as well as in clinical samples. As described, African-American participants in the present study may have been hesitant to disclose information regarding anxiety symptoms. To address this limitation in future research, it may be helpful to use other indicators of anxiety symptomatology to corroborate participant self-report (e.g., behavioral indicators, other-report). In addition, although neuropsychological testing should be considered a strength of the present study, study logistics (e.g., participant burden) limited our ability to administer a more comprehensive battery of neuropsychological tests. In future research, it will be important to include additional tests of higher-order cognitive functioning in order to expand our understanding of the cognitive predictors of anxiety pathology. Although some evidence indicates that deficits in higher-order cognitive processes precede the development of anxiety pathology (Muris, 2006; Gale et al., 2009), the cross-sectional nature of the data precludes firm conclusions regarding directionality; that is, we are unable to say with certainty that deficits in inhibitory control are a risk factor for the later development of anxiety pathology for our White participants. It will be important to use longitudinal study designs in future research in order to determine the temporal relations among study variables. Finally, our monomethod assessment technique may have inflated the estimated relations among study variables. Use of a multimethod approach in future research will be helpful in addressing this potential limitation.

Despite the aforementioned limitations, the present study provides an important step in identifying risk profiles for individuals within the criminal justice system that may be at particularly high risk for the development of anxiety pathology. Given the psychological suffering and economic burden associated with anxiety disorders, identifying high risk groups is incredibly important. Such individuals can be identified early, perhaps through institution-wide (e.g., criminal justice system, workplace, academic) screenings, and offered early intervention before anxiety pathology develops or progresses to an extreme level of impairment. For example, Bomyea and Amir (2011) found that a single-session of computerized training, which specifically targeted inhibitory control, significantly reduced intrusive thoughts (which tend to be pervasive across anxiety pathology and internalizing disorders more generally) and increased working memory capacity. Results from the present study suggest that this type of training may be especially warranted for White smokers in the criminal justice system who have impaired inhibitory ability.

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References

- Airaksinen, E., Larsson, M., Forsell, Y., 2005. Neuropsychological functions in anxiety disorders in population-based samples: evidence of episodic memory dysfunction. *Journal of Psychiatric Research* 39, 207–214.
- Alvidrez, J., Snowden, L.R., Kaiser, D.M., 2008. The experience of stigma among black mental health consumers. *Journal of Health Care for the Poor and Underserved* 19, 874-893.
- Anglin, D.M., Link, B.G., Phelan, J., 2006. Racial differences in stigmatizing attitudes about people with mental illness: extending the literature. *Psychiatric Services* 57(6), 857-62.
- Asmundson, G.J.G., Stein, M.B., Larsen, D.K., Walker, J.R., 1995. Neurocognitive function in panic disorder and social phobia patients. *Anxiety* 1, 201–207.
- Bardeen, J.R., Stevens, E.N., 2015. Sex differences in the indirect effects of cognitive processes on anxiety through emotion regulation difficulties. *Personality and Individual Differences* 81, 180-187.
- Beaudreau, S.A., O'Hara, R., 2009. The association of anxiety and depressive symptoms with cognitive performance in community-dwelling older adults. *Psychology and Aging* 24(2), 507-512.
- Bjelland, I., Krokstad, S., Mykletun, A., Dahl, A.A., Tels, G.S., Tambs, K., 2007. Does a higher educational level protect against anxiety and depression? The HUNT study. *Social Science Medicine* 66, 1334-1345.
- Bomyea, J., Amir, N., 2011. The effect of an executive functioning training program on working memory capacity and intrusive thoughts. *Cognitive Therapy and Research* 35, 529-535.

- Breslau, J., Aguilar-Gaxiola, A., Kendler, K.S., Su, M., Williams, D., Kessler, R.C., 2006. Specifying race-ethnic differences in risk for psychiatric disorder in a USA national sample. *Psychological Medicine* 36, 57-68.
- Breslau, J., Kendler, K.S., Su, M., Gaxiola-Aguilar, A., Kessler, R.C., 2005. Lifetime risk and persistence of psychiatric disorders across ethnic groups in the United States. *Psychological Medicine* 35, 317-327.
- Casteneda, A.E., Tuulio-Henriksson, A., Marttunen, M., Suvisaari, J., Lonnqvist, J., 2008. A review on cognitive impairments in depressive and anxiety disorders with a focus on young adults. *Journal of Affective Disorders* 106, 1-27.
- Cropsey, K.L., Jones-Whaley, S., Jackson, D.O., Hale, G.J., 2010. Smoking characteristics of community corrections clients. *Nicotine & Tobacco Research* 12, 53-58.
- Degnan, K.A., Fox, N.A., 2007. Behavioral inhibition and anxiety disorders: Multiple levels of a resilience process. *Development and Psychopathology* 19, 729-746.
- Durazzo, T.C., Meyerhoff, D.J., Nixon, S.J., 2012. A comprehensive assessment of neurocognition in middle-age chronic cigarette smokers. *Drug and Alcohol Dependence* 122, 105-111.
- Ernst, M., Heishman, S.J., Spurgeon, L., London, E.D., 2001. Smoking history and nicotine effects on cognitive performance. *Neuropsychopharmacology* 25, 313-319.
- Friend, K.B., Malloy, P.F., Sindelar, H.A., 2005. The effects of chronic nicotine and alcohol use on neurocognitive function. *Addictive Behaviors* 30, 193-202.
- Gale, C.R., Hatch, S.L., Batty, G.D., Deary, I.J., 2009. Intelligence in childhood and risk of psychological distress in adulthood: The 1958 National Child Development Survey and the 1970 British Cohort Study. *Intelligence* 37, 592-599.

Golden, C.J., 1978. Stroop Color and Word Test: A manual for clinical and experimental uses. Chicago, IL: Stoelting, CO.

Hancock, M., Tapscott, J.L., Hoaken, N.S., 2010. Role of executive dysfunction in predicting frequency and severity of violence. *Aggressive Behavior* 36, 338-349.

Herrero, O., Escorial, S., Colom, R., 2010. Basic executive processes in incarcerated offenders. *Personality and Individual Differences* 48, 133-137.

Herrnstein, R.J., Murray, C.H., 1994. *The Bell Curve*. New York, Free Press.

Hoaken, P.N.S., Allaby, D.B., Earle, J., 2007. Executive cognitive functioning and the recognition of facial expressions of emotion in incarcerated violent offenders, non-violent offenders, and controls. *Aggressive Behavior* 33, 412-421.

Hoffman, D.L., Dukes, E.M., Wittchen, H.U., 2008. Human and economic burden of generalized anxiety disorder. *Depression and Anxiety* 25, 72-90.

Jamal, M., Van der Does, A.J.M., Cuijpers, P., Penninx, B.W.J.H., 2012. Association of smoking and nicotine dependence with severity and course of symptoms in patients with depressive or anxiety disorder. *Drug and Alcohol Dependence* 126, 138-146.

Kalmijn, S., van Boxtel, M.P.J., Verschuren, M.W.M., Jolles, J., Launer, L.J., 2002. Cigarette smoking and alcohol consumption in relation to cognitive performance in middle age. *American Journal of Epidemiology* 156, 936-944.

Kessler, R.C., Berglund, P., Demler, O., Jin, R., Merikangas, K.R., Walters, E.E., 2005a. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry* 62(6), 593-602.

- Kessler, R.C., Chiu, W.T., Demler, O., Walters, E.E., 2005. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the national comorbidity survey replication. *Archives of General Psychiatry* 62, 617–627.
- Kessler, R.C., Greenberg, P.E., 2002. The economic burden of anxiety and stress disorders. In K. Davis, ed. *Neuropsychopharmacology: the Fifth Generation of Progress*. Baltimore, MD.
- Kiernan, M., Kraemer, H.C., Winkleby, M.A., King, A.C., Taylor, C.B., 2001. Do logistic regression and signal detection identify different subgroups at risk? Implications for the design of tailored interventions. *Psychological Methods* 6, 35-48.
- Martin, A., Wiggs, C.L., Altemus, M., Rubenstein, C., Murphy, D.L., 1995. Working memory as assessed by subject-ordered tasks in patients with obsessive–compulsive disorder. *Journal of Clinical and Experimental Neuropsychology* 17, 786–792.
- McClave, A.K., Dube, S.R., Strine, T.W., Kroenke, K., Caraballo, R.S., Mokdad, A.H., 2009. Associations between smoking cessation and anxiety and depression among U.S. adults. *Addictive Behaviors* 34, 491-497.
- McDermott, M.S., Marteau, T.M., Hollands, G.J., Hankins, M., Aveyard, P., 2013. Change in anxiety following successful and unsuccessful attempts at smoking cessation: Cohort study. *The British Journal of Psychiatry* 202, 62-67.
- Muris, P., 2006. The pathogenesis of childhood anxiety disorders: Considerations from a developmental psychopathology perspective. *International Journal of Behavioral Development* 30, 5-11.
- Nooyens, A.C.J., van Gelder, B.M., Verschuren, W.M.M., 2008. Smoking and cognitive decline among middle-aged men and women: The Doetinchem Cohort Study. *American Journal of Public Health* 98, 2244-2250.

Price, R.B., Mohlman, J., 2007. Inhibitory control and symptom severity in late life generalized anxiety disorder. *Behaviour Research and Therapy* 45(11), 2628-2639.

Prins, S.J., Osher, F.C., Steadman, H.J., Robbins, P.C., Case, B., 2012. Exploring racial disparities in the brief jail mental health screen. *Criminal Justice and Behavior* 39, 635-645.

Reitan, R.M., Wolfson, D., 1993. *The Halstead–Reitan Neuropsychological Test Battery: Theory and clinical interpretation* (2nd ed.). Tucson, AZ.

Sareen, J., Afifi, T.O., McMillan, K.A., Asmundson J.G.J., 2011. Relationship between household income and mental disorders: Findings from a population-based longitudinal study. *Archives of General Psychiatry* 68, 419-427.

Sheehan, D.V., Lecrubier, Y., Sheehan, K.H., Amorim, P., Janavs, J., Weiller, E...Dunbar, G.C., 1998. The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry* 59, 22-33.

Snowden, L.R., Yamada, A.M., 2005. Cultural differences in access to care. *Annual Review of Clinical Psychology* 2005, 143–166.

Tabachnick, B.G., Fidell, L.S., 2007. *Using multivariate statistics* (5th ed.). Boston, Allyn & Bacon.

Wasserman, G.A., McReynolds, L.S., Schwalbe, C.S., Keating, J.M., Jones, S.A., 2010. Psychiatric disorder, comorbidity, and suicidal behavior in juvenile justice youth. *Criminal Justice and Behavior* 37, 1361- 1376.

Wechsler, D., 2001. *Wechsler Test of Adult Reading*. Psychological Corporation, San Antonio, TX.

Wechsler, D., 1997. *Wechsler Adult Intelligence Scale-third edition*. The Psychological

Corporation, San Antonio, TX.

Wells, K., Klap, R., Koike, A., Sherbourne, C., 2001. Ethnic disparities in unmet need for alcoholism, drug abuse, and mental health care. *The American Journal of Psychiatry* 158, 2027–2032.

Whaley, A., 1997. Ethnic and racial differences in perceptions of dangerousness of persons with mental illness. *Psychiatry Services* 48(10), 1328-30.

Wilson, J.Q., Herrnstein, R.J., 1985. *Crime and human nature*. Simon and Schuster, New York.

Wittchen, H.U., 2002. Generalized anxiety disorder: Prevalence, burden, and cost to society. *Depression and Anxiety* 16, 162-171.

Table 1

Means and Standard Deviations of Study Variables

Variable	Total Sample (<i>N</i> = 495)		Anxiety Dx (<i>n</i> = 114)		No Anxiety Dx (<i>n</i> = 381)	
	%/ <i>M</i>	<i>SD</i>	%/ <i>M</i>	<i>SD</i>	%/ <i>M</i>	<i>SD</i>
Gender (Male)	66%	--	55%	--	69%	--
Race/Ethnicity (White) ^a	35%	--	47%	--	32%	--
Education (High School/GED)	72%	--	68%	--	73%	--
Age	36.52	11.08	36.88	11.05	36.41	11.19
Monthly Income	556.92	670.04	479.50	519.21	579.94	707.69
WTAR FSIQ Standard Score	90.45	12.91	92.65	13.12	89.79	12.79
TMT-A Scaled Score	8.43	2.43	8.41	2.61	8.43	2.37
TMT-B Scaled Score	8.20	2.68	8.19	2.79	8.20	2.65
Stroop Inhibition T-score	42.85	10.53	41.12	10.93	43.37	10.37
WAIS-III Digit Span Scaled Score	8.99	2.82	9.08	3.02	8.97	2.77

Note. WTAR = Wechsler Test of Adult Reading; TMT = Trail Making Test; WAIS-III = Wechsler Adult Intelligence Scale – III.

^a Race/ethnicity is dichotomized as White versus non-White.

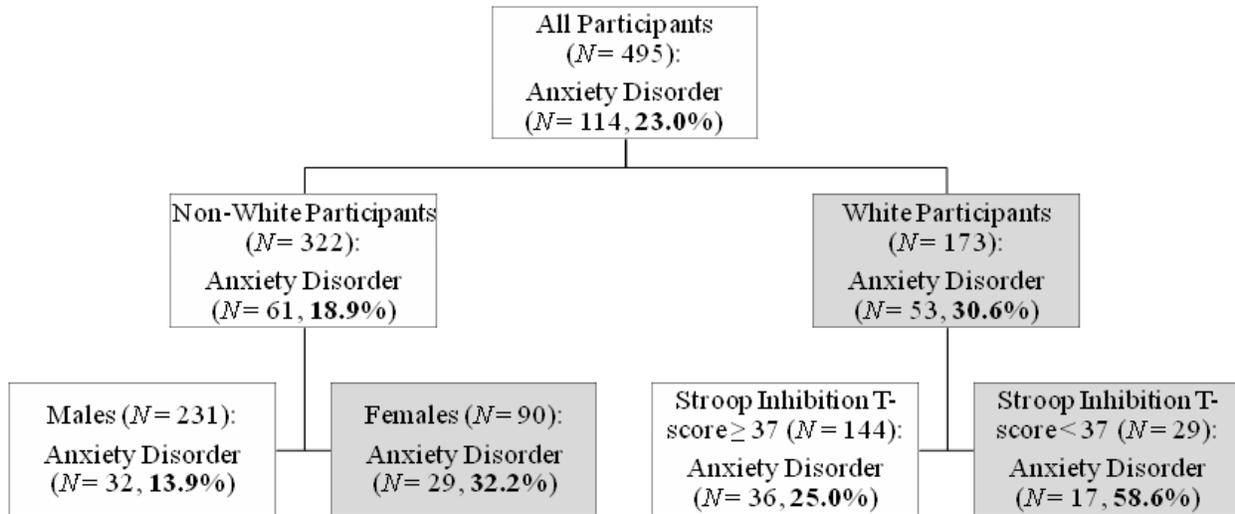


Figure 1. Hierarchy of predictors from signal detection analysis for an anxiety disorder diagnosis.