Published in final edited form as:

Am J Drug Alcohol Abuse. 2015 May ; 41(3): 264–268. doi:10.3109/00952990.2015.1011744.

Does the Transmissible Liability Index (TLI) Assessed in Late Childhood Predict Suicidal Symptoms at Young Adulthood?

Jack R. Cornelius*, Levent Kirisci, Maureen Reynolds, Michael Vanyukov, and Ralph Tarter
Center for Education and Drug Abuse Research (CEDAR), University of Pittsburgh, 3811 O'Hara Street, PAARC Suite, Pittsburgh, PA 15213, USA

Abstract

Objective—Our previous work demonstrated that the Transmissible Liability Index (TLI), an instrument designed as an index of liability for substance use disorder (SUD), is associated with risk of substance use disorder. This longitudinal study assessed whether TLI measured in 10–12 year olds (late childhood) predicts suicidal behavior from age 12–14 (preadolescence) to age 25 (young adulthood). We hypothesized that TLI would predict number and severity of suicide attempts.

Methods—Subjects were sons of men who had lifetime history of SUD (N=250), called the High Average Risk (HAR) group, and sons of men with no lifetime history of a SUD (N=250), called the Low Average Risk (LAR) group. The TLI was delineated at baseline (age 10–12), and age-specific versions were administered at 12–14, 16, 19, 22, and 25 years of age.

Results—TLI was significantly associated with number and severity of lifetime suicide attempts.

Conclusions—These findings confirm the hypothesis that TLI assessed at late childhood is a predictor of frequency and severity of suicidal behavior from preadolescence to young adulthood.

Long term longitudinal studies designed to predict suicidal symptoms years in advance of the onset of those symptoms are rare (Sourander et al, 2009). Consequently, parents and clinicians currently know little concerning the characteristics in children that might predispose them to a lifetime history of suicidal symptoms.

During the last 25 years, our research group has been conducting a large longitudinal study of the development of substance use disorders (SUD) and related phenomena among subjects as they make the transition from preadolescence to adulthood. This study has focused on the role of transmissible liability to substance use disorders, as measured by a construct called the Transmissible Liability Index (TLI) (Vanyukov et al., 2003 a, b; Kirisci et al, 2009). The behavior genetic construct “transmissible risk” includes all genetic and environmental mechanisms underlying parent-child correlation for liability to an illness (Rice et al., 1980; Vanyukov et al., 2003b; Ridenour et al, 2011). The TLI (Vanyukov et al., 2009) includes 45 items, with items originating from the symptoms of disruptive behavior

*Corresponding author: Jack R. Cornelius, M.D., M.P.H., 3811 O'Hara Street, Pittsburgh PA 15213. Telephone: 412-246-5186. corneliusjr@upmc.edu.

Address reprint requests to: Jack R. Cornelius, M.D., M.P.H., University of Pittsburgh, 3811 O'Hara Street, Pittsburgh, PA 15213

Presented in part at the 22nd Annual Meeting of the Society of Prevention Research (SPR), May 26–30, 2014

disorders (26 items), restless sleep (5 items), appetite (4 items), difficulty with changes in routines (4 items), compulsive habits (2 items), thoughts of death or suicide (2 items), and somatic pain without medical causes (2 items).

Our previous results demonstrated that TLI assessed during pre-adolescent years serves a significant predictor of various substance use disorders among young adults (Kirisici et al., 2009; Vanyukov et al., 2009). TLI scores have been shown to account for variation in SUD risk over and above parental lifetime SUD, conduct and antisocial personality disorder criteria, and frequency of substance use (Ridenour et al, 2011). Emotional disturbances such as negative affect and irritability have also been shown to be facets of SUD liability (Clark et al., 1999; Chassin et al., 1999). Tarter et al. (2003) and Kirisici et al. (2004) demonstrated that emotion dysregulation, behavior undercontrol, and executive cognitive capacity are indicators of a unidimensional latent trait that predicts early age at onset of substance use disorder. Furthermore, substance use disorders have been shown to be associated with an increased risk of suicidal symptoms among adults (Hawton et al., 1989; Cornelius et al., 1995). That association between substance use disorders and suicidal ideations suggests the possibility that constructs which predict substance use disorders, such as the TLI, may also predict suicidal symptoms. However, to date, no assessment has been made of the possible association of TLI and suicidal symptoms. Therefore, currently, it is unclear whether TLI assessed during preadolescent years also serves as a predictor of suicidal symptoms as determined at young adulthood. The few studies involving long-term prediction of suicidal symptoms which have been conducted to date have generally been limited by their use of a cross-sectional rather than longitudinal study design (Cornelius, Bukstein, Salloum, Clark, 2005). That information concerning the possible predictive utility of TLI could potentially facilitate identification of individuals at increased risk for suicidal symptoms, and thus could facilitate targeted early evaluation and intervention. The current study was designed to assess whether TLI measured at age 10–12 (late childhood/ preadolescence) predicts suicidal symptoms from age 12–14 to age 25 (young adulthood). We hypothesized that TLI, as assessed at age 10–12 (late childhood), would predict suicidal behavior from preadolescence (age 12–14) to young adulthood (age 25).

METHODS

Subjects

The subjects in this ongoing study were sons of men with a lifetime history of a SUD (SUD + probands, N=250, the High Average Risk or HAR group) and men with no lifetime history of a SUD (SUD – probands, N=250, the Low Average Risk or LAR group). They included 378 (75.6%) white subjects, 107 (21.2 %) black subjects, and 16 (3.2%) other. These subjects had been recruited for participation in a longitudinal study designed to elucidate the etiology of SUD, known as the Center for Education and Drug Abuse Research (CEDAR). Additional demographic data is provided in Table 1.

Proband fathers were considered to have a lifetime history of SUDs if they met DSM-III-R dependence or abuse criteria for any substance other than nicotine, caffeine, or alcohol (Spitzer et al., 1987). Their children were recruited when they were 10–12 years of age, and subsequent assessments were conducted at age 12–14, 16, 19, and then annually until age

30, which covered the peak years for initiation of SUD. The recruitment procedure was designed to yield a group of children at high average risk for SUD, identified by having fathers with a lifetime history of drug use disorders (abuse or dependence involving illicit substances) and a comparison group at low average risk, identified by having fathers without SUD or other major mental disorders. Fathers were the focus of recruitment rather than mothers because of the higher rate of SUD among the fathers. Diagnoses were made according to DSM-III-R, the most recent DSM edition when the study was initiated.

Multiple recruitment sources were used to minimize bias that could potentially occur if all of the subjects were recruited from one source. Approximately 89% of the families were recruited from the community through public service announcements and advertisements as well as by direct telephone contact conducted by a market research firm, and 11% were recruited from clinical sources (Cornelius et al, 2007; Cornelius et al., 2008). Psychosis, mental retardation, and neurological injury were exclusionary criteria for participation of the family. Prior to participation in the study, written informed consent was obtained from husbands and wives, and assent was obtained from offspring. Attrition data is provided in Table 2. Those data demonstrate a relatively low level of attrition by age 25 (34%). The study was approved by the University of Pittsburgh Institutional Review Board.

Table 2 presents the demographic characteristics of the sample at baseline who participated in the age 25 evaluation (N=302) and those who attrited (N=157). Attrition, defined as either a failure to locate the individual or refusal to participate at the age 25 evaluation, was 34%. As can be seen, the participants who attrited scored about six points lower on the Hollingshead index of socioeconomic status (SES) and 25% of standard deviation lower on the TLI. SES did not correlate with any outcome measures. No differences were observed between the retained and attrited segments on the grade in school at baseline, or ethnicity.

Assessment

Diagnostic evaluation was conducted with an expanded version of the Structured Clinical Interview for DSM-III-R (SCID)(Spitzer et al., 1987), which was the most recent DSM edition when the study was initiated. Offspring psychopathology was assessed with the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Epidemiologic Version (K-SADS-E) (Orvaschel et al., 1982). The onset date of each diagnosis was determined to the nearest month. Each family member was individually administered the research protocol in a private room by a different clinical associate. The diagnostic interviews were documented by a staff of experienced clinical associates. Training the clinical associates involved observation of several interviews and conducting joint interviews in the presence of an experienced interviewer. The training procedures were found to produce inter-rater reliabilities exceeding 0.80 for all major diagnostic categories. Diagnoses were determined in a consensus conference using the best estimate diagnostic procedure (Kosten & Rounsaville, 1992). The diagnostic data, in conjunction with all available pertinent medical records and social and legal history, were reviewed in a clinical case conference chaired by a board-certified psychiatrist and another psychiatrist or psychologist and the clinical associates who conducted the interviews. Suicidal ideations were assessed using the Scale for Suicide ideation (SSI) (Beck et al, 1979). Lifetime

Suicidal Ideations were scored as the sum of the items of the SSI after recoding 1 (no suicidal ideations) to 0, recoding 2 (mild to moderate suicidal ideation) to 1, and recoding 3 (severe) to 2. Intensity of the suicide attempter's wish to die at the time of the attempt was assessed with the Suicide Intent Scale (SIS) (Beck, Schuyler, and Herman, 2008).

Additional information concerning the assessments and the validity of those assessment instruments has been provided elsewhere (Clark et al., 2001; Cornelius, et al., 2010; Cornelius et al., 2014).

Transmissible liability Index

Based on the concept of common transmissible liability to SUD, the transmissible liability index has been developed at the Center for Education and Drug Abuse Research (CEDAR) and has been utilized in this project. The TLI enables quantification of this latent trait utilizing high risk design for a SUD and item response theory. The rationale and method of deriving the TLI have been described in prior reports (Vanyukov et al., 2003a, b; Vanyukov et al., 2009; Kirisci et al., 2009). The construction of the Transmissible Liability Index (TLI) was a multi-stage process. First, items were selected from psychological and psychiatric questionnaires and aggregated into conceptual domains. Emphasis in item selection focused on characteristics indicating deficient psychological self-regulation spanning cognitive, emotion, and behavior domains of measurement. After the selection of the initial pool of items was completed, exploratory and confirmatory factor analysis conducted. Constructs reflecting the measurement domains that distinguished sons of fathers with and without substance use disorders (indicating transmissible SUD liability) were retained. Next, the constructs were submitted to confirmatory factor analysis to ensure unidimensionality of the index. Lastly, item response theory (IRT) analysis was performed to calibrate the items (determine item discrimination and threshold parameters). The TLI derived in this fashion thus contained the fewest and most robust items, accounting for 26% of item variance and having internal reliability of 0.87 (Kirisci et al., 2009).

Statistical Analyses

In the current study, negative binomial regression was utilized to predict number of suicidal symptoms (Hosmer et al., 2000). Path analyses were conducted to assess mediation and moderation effects associated with TLI, after allowing for factors such as demographic variables and socioeconomic status (SES) (Dohrenwend et al., 1992). Mediation paths were tested using the method described by Sobel (1982), as updated by MacKinnon (Mackinnon, 2008). Path analyses using that method have been found to be a productive method of assessing mediated paths in our previous work involving adolescent substance use disorders (Kirisci et al., 2004; Kirisci et al., 2009). ROC analyses were performed to assess the extent to which TLI discriminated between those who developed SUD versus those who did not develop SUD (Fawcett, 2006). Variables included in the ROC analyses included socio-economic status, TLI, and DUSI Drug Use Chart current drug use at age 19. Negative binomial regression analysis was conducted using IBM SPSS Statistics Version 22 and MPLUS was used to analyze the path model.

RESULTS

Lifetime suicide plan was noted in 29 subjects (5.8%), suicide threat in 22 subjects (4.4%), suicide gesture in 21 subjects (4.2%), and suicide attempt in 17 subjects (3.4%). No significant differences were observed between the HAR and LAR groups. Negative binomial regression was used to evaluate the possible contribution of TLI to symptoms involving suicidality, including total SSI lifetime score, the number of lifetime suicide attempts, and the severity of suicide attempts. In those analyses, TLI was found to be significantly associated with SSI Total Lifetime Score ($\beta = .49$, Wald $\chi^2=44.43$, $df=1$, $p<0.001$), with the Number of Lifetime Suicide Attempts ($\beta = .36$, Wald $\chi^2=6.68$, $df=1$, $p=0.01$), and with Severity of Lifetime Suicide Attempts ($\beta = .38$, Wald $\chi^2=17.59$, $df=1$, $p<0.001$).

Next, a path analysis was conducted involving at least one lifetime suicidal symptom, which demonstrated a good model fit: $\chi^2=.38$, $df=2$, $p=.83$, root mean square error of approximation $<.001$, Tucker-Lewis Index $=1.0$, Comparative-Fit Index $=1.0$. TLI at age 10–12 significantly predicted the presence of at least one lifetime suicidal symptom at age 19 ($b=.19$, $p=.029$) and current drug use at age 16 ($b=.20$, $p=.006$), as shown in Figure 1; however TLI did not predict current drug use at age 19 ($b=.08$, $p=.087$). ROC analysis was conducted using the predictors included in the path analysis, which demonstrated fair to good prediction of suicidal symptoms. The dependent variable for that analysis was at least one lifetime suicidal symptom. The overall correct classification $=.67$, sensitivity $=.69$, specificity $=.62$.

DISCUSSION

The findings of this study supported our hypothesis, which states that TLI, an index designed to predict substance use disorders, assessed at age 10–12 (late childhood) can predict suicidal symptoms from age 12–14 (preadolescence) to age 25 (young adulthood). These findings suggest commonalities between the liability for substance use disorders and the liability for suicidal symptoms. Previous studies, including our own previous studies, have reported a link between the presence of substance use disorders and the presence of suicidal symptoms among adults (Cornelius et al., 1995; Cornelius et al., 1996; Grant et al., 1999). However, those previous studies were typically cross-sectional studies rather than being longitudinal in study design. Also, previous studies often were limited in sample size and did not involve the use of standardized instruments for assessing substance use disorders and for assessing suicidal symptoms, and few of those studies involved adolescents (Schilling et al., 2009). Thus, our current report confirms and extends the findings of previous studies involving adults to a younger population involving adolescents, using rigorous methodology and a longitudinal study design.

The inability to quantify the risk for adverse outcomes, such as suicidal ideations or substance use disorders, has hindered etiology research and research involving development of targeted interventions (Vanyukov et al., 2009). The development of the TLI has allowed a quantitative assessment of risk for SUD, utilizing an instrument with proven predictive validity and reliability (Vanyukov et al., 2009; Cornelius et al, 2010). TLI scores have been

shown to account for variation in SUD risk over and above risks associated with demographic factors, family history, or comorbid diagnosis (Ridenour et al, 2011). For example, the TLI allows prediction of cannabis use disorders before cannabis use begins (Kircisci et al, 2013). Therefore, risk for cannabis use disorder can be screened in childhood (Kircisci et al, 2009). However, a comparable proven instrument for assessing future level of risk for suicidal symptoms has not been available. Findings from the current paper suggest that the TLI might also be helpful in assessing future risk for suicidal symptoms. Studies involving our investigators are underway to evaluate the clinical utility of the TLI for various adverse outcomes (Cornelius et al., 2010; Ridenour et al, 2011).

The factors underlying the association between substance use disorders and suicidal symptoms among adolescents and young adults remain incompletely understood (Brent, 1995; Cornelius et al, 1995; Cornelius et al, 1996; Cornelius et al., 2005). Recent research suggests that psychological dysregulation during adolescence mediates the association of parent-child attachment in childhood and substance use disorder in adulthood (Zhai et al., 2014), but it is not clear to what extent psychological dysregulation contributes to the development of suicidal symptoms. Behavioral under control has also been suggested as a possible mechanism to explain substance use disorders and suicidal symptoms and the association between those symptoms Kelly et al., 2004; Groholt et al., 2000). Further research is warranted to clarify the reasons for the commonalities between the liability for substance use disorders and the liability for suicidal symptoms. Further studies are also warranted to clarify the etiology of suicidal symptoms and the etiology of substance use disorders among youth (Sourander et al, 2009; Kelly et al., 2004). In addition, studies are warranted to evaluate strategies for early assessment and treatment of suicidal symptoms among youth and young adults, and to evaluate the potential role of TLI in that effort (Brent, 1995; Cornelius et al., 2004; Cornelius et al, 2007; Schilling et al., 2009).

There are limitations to our research design that should be noted when interpreting our findings. First, the sample was not a random sample from across the United States. The sampling frame utilized a high risk-low risk paradigm, so it is not representative of the general population, but rather focuses on the extremes of the population in relation to SUD among the probands (fathers). Also, the study sample was male, so the results of the study may not generalize to women. However, this study had the methodological advantage of being a longitudinal study, while most studies evaluating the development of suicidal symptoms among youth and young adults have been cross-sectional studies or brief longitudinal studies.

Acknowledgements

This research was supported in part by grants from the National Institute on Drug Abuse (P50 DA005605, R01 DA019142, R01 DA14635, R01 AA014357, K02 DA017822, K05 DA031248, K02 AA018195, and the NIDA Clinical Trials Network); and from the National Institute on Alcohol Abuse and Alcoholism (R21 AA022123, R21 AA022863, R01 AA015173, R01 AA14357, R01 AA13397, K24 AA15320, and K02 AA000291).

References

- Beck AT, Kovacs M, Weissman A. Assessment of suicidal intention: the Scale for Suicide Ideation. *Journal of Consulting and Clinical Psychology*. 1979; 47:343–352. [PubMed: 469082]

- Beck, A.; Schuyler, D.; Herman, I. Suicide Intent Scale (SIS). In: Rush, A John, Jr.; First, Michael B.; Blacker, Deborah, editors. *Handbook of Psychiatric Measures*. Second Edition. 2008. p. 244-245.
- Brent DA. Risk factors for adolescent suicide and suicidal behavior: mental and substance abuse disorders, family environmental factors, and life stress. *Suicide and Life-Threatening Behaviors*. 1995; 25:52–63.
- Chassin L, Pitts SC, Delucia C, Todd M. A longitudinal study of children of alcoholics: predicting young adult substance use disorders, anxiety and depression. *Journal of Abnormal Psychology*. 1999; 108:106–119. [PubMed: 10066997]
- Clark DB, Pollock NK, Mezzich A, Cornelius J, Martin C. Diachronic assessment and the emergence of substance use disorders. *Journal of Child and Adolescent Substance Abuse*. 2001; 10:13–22.
- Clark DB, Parker AM, Lynch KD. Psychopathology and substance-related problems during early adolescence: a survival analysis. *Journal of Clinical Child Psychology*. 1999; 28:333–341. [PubMed: 10446682]
- Cornelius, JR.; Clark, DB.; Bukstein, OG.; Salloum, I. Treatment of co-occurring alcohol, drug, and psychiatric disorders, Chapter 16, in volume XVII entitled *Alcohol Problems in Adolescents and Young Adults*, in the series of books entitled *Recent Developments in Alcoholism*. Galanter, Marc, editor. New York: Kluwer Academic/Plenum Publishers; 2005. p. 349-366.2005
- Cornelius, JR.; Clark, DB. Translational research involving adolescent substance abuse,” Chapter 16. In: Miller, Peter; Kavanagh, David, editors. *Translation of Addictions Science into Practice: Update and Future Directions*. New York, NY: Elsevier Press; 2007. p. 341-360.
- Cornelius JR, Clark DB, Salloum IM, Bukstein OG, Kelly TM. Interventions in suicidal alcoholics. *Alcoholism: Clinical and Experimental Research*. 2004; 28:89S–96S.
- Cornelius JR, Kirisci L, Reynolds M, Clark DB, Hayes J, Tarter R. PTSD contributes to teen and young adult cannabis use disorders. *Addictive Behaviors*. 2010; 35:91–94. [PubMed: 19773127]
- Cornelius JR, Kirisci L, Reynolds M, Tarter R. Does stress mediate the development of substance use disorders among youth transitioning to young adulthood? *The American Journal of Drug and Alcohol Abuse*. 2014; 40(3):225–229. 2014, published online 15 April 2014. [PubMed: 24735415]
- Cornelius JR, Reynolds M, Martz BM, Clark DB, Kirisci L, Tarter R. Premature mortality among males with substance use disorders. *Addictive Behaviors*. 2008; 33:156–160. [PubMed: 17553623]
- Cornelius JR, Salloum IM, Day NL, Thase ME, Mann JJ. Patterns of suicidality and alcohol use in alcoholics with major depression. *Alcoholism: Clinical and Experimental Research*. 1996; 20:1451–1455.
- Cornelius JR, Salloum IM, Mezzich J, Cornelius MD, Fabrega H, Ehler JG, Ulrich RF, Thase ME, Mann JJ. Disproportionate suicidality in patients presenting with comorbid major depression and alcoholism. *American Journal of Psychiatry*. 1995; 152:358–364. [PubMed: 7864260]
- Dohrenwend B, Levav I, Shrout P, Schwartz S, Naveh G, Link B, Skodal A, Steuve A. Socioeconomic status and psychiatric disorder. the causation-selection issue. *Science*. 1992; 225:946–952. [PubMed: 1546291]
- Grant BF, Hasin DS. Suicidal ideation among the United States drinking population: results from the National Longitudinal Alcohol Epidemiology Survey. *Journal of Studies on Alcohol*. 1999; 60:422–429. [PubMed: 10371272]
- Groholt B, Ekeberg O, Wichstrom L, Haldorsen T. Young suicide attempters: a comparison between a clinical and an epidemiological sample. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2000; 39:868–875. [PubMed: 10892228]
- Hosmer, DW.; Lemeshow, S. *Applied Logistic Regression*. Second Edition. New York: John Wiley and Sons; 2000. .
- IBM Corp.. Released 2013. *IBM SPSS Statistics for Windows*, Version 22.0. Armonk, NY: IBM Corporation;
- Kelly TM, Cornelius JR, Clark DB. Psychiatric disorders and attempted suicide among adolescents with substance use disorders. *Drug and Alcohol Dependence*. 2004; 73:87–97. [PubMed: 14687963]
- Kirisci L, Tarter R, Mezzich A, Ridenour T, Reynolds M, Vanyukov M. Prediction of cannabis use disorder between boyhood and young adulthood: clarifying the phenotype and envirotype. *The American Journal on Addictions*. 2009; 18:36–47. [PubMed: 19219664]

- Kirisci L, Tarter RE, Ridenour R, Reynolds M, Vanyukov M. Longitudinal modeling of transmissible risk in boys who subsequently develop cannabis use disorder. *The American Journal of Drug and Alcohol Abuse*. 2013; 39(3):180–185. [PubMed: 23721533]
- Kirisci L, Tarter RE, Vanyukov M, Reynolds M, Habeych M. Relation Between cognitive distortions and neurobehavior disinhibition on the development of substance use during adolescence and substance use disorder by young adulthood: a prospective study. *Drug and Alcohol Dependence*. 2004; 76:125–133. [PubMed: 15488336]
- Kosten TA, Rounsaville BJ. Sensitivity of psychiatric diagnosis based on the best estimate procedure. *American Journal of Psychiatry*. 1992; 149:1225–1227. [PubMed: 1503136]
- MacKinnon, DP. *Introduction to Statistical Mediation Analysis*. New York, NY: Lawrence Erlbaum Associates; 2008.
- Muthen, LK.; Muthen, BO. *Mplus User's Guide*. Fourth Edition. Los Angeles, CA: Muthen & Muthen; 1998–2006.
- Orvaschel H, Puig-Antich J, Chambers WJ, Tabrizi MA, Johnson R. Retrospective assessment of prepubertal major depression with the Kiddie-SADS-E. *Journal of the American Academy of Child Psychiatry*. 1982; 21:392–397. [PubMed: 7119313]
- Rice JP, Cloninger CR, Reich T. General causal models for sex differences in the familial transmission of multifactorial traits: an application to human spatial visualizing ability. *Social Biology*. 1980; 26:36–47. [PubMed: 7292035]
- Ridenour TA, Kirisci L, Tarter R, Vanyukov MM. Could a continuous measure of individual transmissible risk be useful in clinical assessment of substance use disorder?: Findings from the National Epidemiological Survey on Alcohol and Related Conditions. *Drug and Alcohol Dependence*. 2011; 119:10–17. [PubMed: 21715106]
- Schilling EA, Aseltine RH, Glanovsky JL, James A, Jacobs D. Adolescent alcohol use, suicidal ideation, and suicide attempts. *Journal of Adolescent Health*. 2009; 44:335–341. [PubMed: 19306791]
- Sobel, MD. Asymptotic confidence intervals for indirect effects in structural equation models. In: Leinhardt, S., editor. *Sociological Methodology*. Washington, DDS: American Sociological Association; 1982. p. 290–312.
- Sourander A, Klomek AB, Niemela S, Haavisto A, Gyllenberg D, Helenius H, Sillanmaki L, Ristkari T, Kumpulainen K, Tamminen T, Moilanen I, Piha J, Almqvist F, Gould MS. Childhood predictors of completed and severe suicide attempts: findings from the Finnish 1981 Birth Cohort Study. *Archives of General Psychiatry*. 2009; 66:398–406. [PubMed: 19349309]
- Spitzer, R.; Williams, J.; Gibbon, M. *Instruction Manual for the Structured Clinical Interview for DSM-III-R (SCID, 4/1/87 revision)*. New York: New York State Psychiatric Institute; 1987.
- Tarter RE, Kirisci L, Mezzich A, Cornelius JR, Pajer K, Vanyukov M, Gardner W, Blackson T, Clark D. Neurobehavioral disinhibition in childhood predicts early age at onset of substance use disorder. *American Journal of Psychiatry*. 2003; 160:1078–1085. [PubMed: 12777265]
- Vanyukov MM, Kirisci L, Moss L, Tarter RE, Reynolds MD, Maher BS, Kirillova GP, Ridenour T, Clark DB. Measurement of the risk for substance use disorders: Phenotypic and genetic analysis of an index of common liability. *Behavior Genetics*. 2009; 39:233–244. [PubMed: 19377872]
- Vanyukov MM, Kirisci L, Tarter RE, Simkevitz HF, Kirillova GP, Maher BS, Clark DB. Liability to substance use disorders: 2. A measurement approach. *Neuroscience and Biobehavioral Reviews*. 2003; 27:517–526. 2003. [PubMed: 14599433]
- Vanyukov MM, Tarter RE, Kirisci L, Kirillova GP, Maher BS, Clark DB. Liability to substance use disorders: common mechanisms and manifestations. *Neuroscience and Biobehavioral Reviews*. 2003; 27:507–515. [PubMed: 14599432]
- Zhai ZW, Kirisci L, Tarter RE, Ridenour TA. Psychological dysregulation during adolescence mediates the association of parent-child attachment in childhood and substance use disorder in adulthood. *The American Journal of Drug and Alcohol Abuse*. 2014; 40(1):67–74. [PubMed: 24359508]

Figure 1.**Path Analysis**

Model fit statistics: Chi-square=.65, df=2, p=.72, Root mean square error approximation (RMSEA)<.001, Tucker-Lewis Index (TLI)=1.0, Comparative-Fit Index (CFI)=1.0. a:p<.10, b:p<.01, c:p<.001

Table 1

Comparison of high risk (HAR) and low risk (LAR) sample.

	Overall	HAR	LAR
Race			
White	75.6%	71.6%	79.6%
Black	21.2%	25.6%	16.8%
other	3.2%	2.8%	3.6%
		Chi-square=5.87, p=.053	
SES	40.82(13.29)	37.64(12.24)	44.00(13.58)
		F=30.37 (p<.001)	
Age at baseline	11.37(.93)		

Table 2

Comparison of retained and attrited segment of the sample.

	Attrited (n=157)	Retained (n=302)	
White	71.0%	79.1%	Chi-square=5.41, p.07
Black	25.9%	17.0%	
Other	3.1%	3.8%	
SES	37.25 (12.12)	43.53(13.56)	F=27.26, p<.001

Attrition rate=.34, 302 subjects assessed, 157 subjects refused to participate, and 41 subjects are not old enough to be assessed