The efficacy and mechanisms of personality-targeted interventions for alcohol misuse and mental disorders in adolescents.

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Abstract

This thesis includes four studies pertaining to the efficacy and mechanisms of a personality-targeted intervention program for youth alcohol misuse and psychopathology. Study 1 examines the efficacy of the Preventure personality-targeted intervention program on internalising and externalising symptoms in high-risk youth when delivered by educational professionals. Results demonstrate that intervention participants report global reductions in depressive, anxiety and conduct symptoms relative to their control group counterparts, as well as reduced odds of severe depressive symptoms and conduct problems over two years. There is also some evidence for personality-specific intervention effects in youth most at risk for anxiety and conduct disorders. Study 2 explores the relationship between personality, attentional biases and mental disorders in a community adolescent sample. This study provides a preliminary examination of whether attentional biases may be a suitable target for preventive interventions to supplement the Preventure program. Results suggest that attentional biases to emotional faces are not concurrently or prospectively associated with symptoms of mental disorders. Instead, results provide further validation for a personality-targeted approach, as personality traits are associated with concurrent and prospective risk for mental disorders whilst accounting for baseline mental health symptoms. Studies 3 and 4 focus on understanding the mechanisms and process of the Preventure program across two randomised controlled trials. Study 3 explores mediators of two-year intervention effects on alcohol misuse and mental health symptoms. Results suggest that two-year intervention effects on binge drinking and alcohol-related problems are partially mediated by early changes in drinking behaviours. Global improvements in mood during the six months post-intervention were found to partially mediate two-year intervention effects on both internalising and externalising symptoms. The results suggest that early reductions in the growth in alcohol consumption or mental health symptoms may represent proximal markers of longer term intervention efficacy. Lastly, study 4 uses a mixed methods design to elucidate candidate process variables accounting for early indicators of treatment efficacy. The study combines both investigator-driven hypotheses and youth-generated feedback in order to elucidate key intervention features associated with positive behavioural changes. Findings suggest that youth experiences during group personality-targeted intervention

sessions can influence the development of their subsequent alcohol-related behaviours (and, in some cases, in mental health symptoms) over twelve months. This study suggests that youth feedback can be used as an early indicator of treatment fidelity and efficacy. Together, these studies contribute to the literature in support of a personality-targeted approach to prevention and demonstrate the utility of process research in informing and refining the intervention approach.

Résumé

La présente thèse inclut quatre études traitant de l'efficacité et des mécanismes d'action de Preventure, un programme ciblé à la personnalité, pour prévenir les psychopathologies et la consommation d'alcool problématique chez les jeunes. L'étude 1 examine l'efficacité de Preventure sur les symptômes internalisés et externalisés de jeunes à haut risque lorsque l'intervention est offerte par des professionnels de l'éducation. Les résultats démontrent une réduction des symptômes de dépression, d'anxiété et des troubles de conduite chez les adolescents ayant participé à l'intervention en comparaison au groupe contrôle, ainsi qu'une reduction du taux de symptômes sévères de dépression et de troubles de conduite sur plus de deux ans. Des preuves de l'effet de l'intervention spécifique à la personnalité chez les jeunes les plus à risque pour l'anxiété et les troubles de comportement ont également été trouvés. L'étude 2 explore la relation entre la personnalité, les biais attentionnels et les troubles mentaux sur un échantillon d'adolescents. Cette étude rapporte des résultats préliminaires sur l'implication des biais attentionels comme outil préventif additionnel au programme Preventure. Les résultats suggèrent que les biais attentionnels face aux émotions faciales ne sont pas associés aux symptômes de santé mentale de façon concomitante ou prospective. Plutôt, les résultats apportent de plus amples validations pour une approche centrée sur la personnalité, étant donné que certains traits de personnalité sont eux-mêmes associés aux symptômes de santé mentale de façon concomitante et prospective, tout en tenant compte de ces mêmes symptômes au début de l'étude. Les études 3 et 4 se concentrent sur la compréhension des mécanismes d'action et processus du programme Preventure à travers deux essais randomisés contrôlés. L'étude 3 explore les médiateurs des effets de l'intervention sur la consommation d'alcool et les symptômes de santé mentale sur deux ans. Les résultats suggèrent que l'impact de l'intervention après deux ans sur le calage d'alcool et les problèmes associés à la consommation sont partiellement induits par des changements précoces de consommation d'alcool. Une amélioration globale de l'humeur six mois après l'intervention a été trouvée comme induisant partiellement un effet sur des symptômes internalisés et externalisés jusqu'à deux ans après l'intervention. Les résultats dans les premiers six mois suggèrent qu'une réduction du taux de croissance

de la consommation ou des symptômes de troubles mentaux pourraient représenter des déterminants précoces des effets à long terme de l'intervention. Enfin, l'étude 4 utilise un modèle multi-méthodes pour explorer quelles seraient les processus qui expliqueraient l'efficacité d'un traitement sur douze mois. Cette étude combine les hypothèses des chercheurs ainsi que les comptes rendus des jeunes dans le but d'identifier des caractéristiques associées à un changement de comportement positif. Les résultats de l'étude indiquent que l'expérience des jeunes lors des sessions d'intervention ciblant la personnalité peut influencer le développement de leur comportement futur lié à la consommation d'alcool (et, dans certains cas, les symptômes de santé mentale) sur douze mois. Cette étude suggère que les commentaires des adolescents peuvent être utilisés comme indicateur précoce de la fidélité et l'efficacité du traitement. Ensemble, ces recherches contribuent à la littérature soutenant l'approche ciblée à la personnalité en prévention et démontrent l'utilité des recherches sur les processus lorsqu'il s'agit d'informer et d'améliorer les approches d'intervention.

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Statement of Originality

This dissertation presents information that is unique in several aspects. It focuses on the efficacy and mechanisms of a personality-targeted approach to the prevention of substance misuse and associated internalising and externalising symptoms in youth. Although it is not the first examination of the efficacy of this selective prevention program, this dissertation goes beyond existing studies in exploring intervention mechanisms that inform the intervention process and offer the opportunity to optimise the existing intervention strategy. Data are presented from three separate adolescent samples, including two randomised controlled trials (one based in London, U.K. and the other in Montreal, Canada) and one multi-site European study that includes detailed neuropsychological, self- and parent-report data. Study 1 (O'Leary-Barrett et al., 2013) is novel in that it demonstrates clinically significant intervention effects on internalising and externalising symptoms in high-risk youth over a 2-year period, as well as some personality-specific intervention effects in youth most at risk for particular mental health symptoms (*e.g.,* reduced odds of severe conduct problems in youth with high levels of impulsivity) when delivered by trained educational professionals. This is among the longest effect duration reported for prevention programs. The mode of intervention delivery is also significant, as it suggests that personality-targeted interventions may be amenable to wider dissemination by school-based staff. The examination of personality-specific intervention effects provides the first evidence suggesting that personality-targeted intervention may operate through both general and personality-specific mechanisms. Study 2 (O'Leary-Barrett et al., 2015) explores the relationship between personality risk factors for mental disorders and attentional biases to emotional faces. This study examines whether attentional biases can be used as an indicator of prospective risk for mental disorders in adolescence, and thus whether they may be a suitable target for preventive interventions. Although the relationship between attentional biases, personality and mental disorders has been frequently examined in clinical samples, the literature base relating to these associations in community youth samples is limited. This study is also the first to examine the mediational role of attentional biases in the

relationship between personality and symptoms of mental disorders. Results of Study 2 highlight that attentional biases do not appear to be suitable measures of prospective risk for mental disorders in adolescence. This suggests that it would not be appropriate to use attentional bias modification tasks as an adjunct to personality-targeted interventions in youth. This study provides additional validation for the personality-targeted approach, as personality factors identified using the Substance Use Risk Profile Scale (Woicik, Stewart, Pihl, & Conrod, 2009) show incremental validity over the revised NEO Personality Inventory (Costa Jr & McCrae, 1992) in their concurrent and prospective associations with mental disorder symptoms in adolescence. Study 3 (O'Leary-Barrett, Castellanos-Ryan, Pihl, & Conrod, 2016) is the first study to examine mechanisms of personality-targeted interventions. This study assesses three competing hypotheses relating to the potential mediational roles of early changes in alcohol consumption, mental health symptoms and personality factors. The results highlight the clinical significance of early interventions for substance misuse, as delaying and reducing the quantity of alcohol consumption at 13-14 years partially accounts for reductions in subsequent problematic drinking over a 2-year period. In addition, global improvements in mood in the 6 months post-intervention were found to partially mediate intervention effects on both internalising and externalising symptoms over 2 years. The results suggest that early reductions in the growth in alcohol consumption or mental health symptoms may represent proximal markers of longer term intervention efficacy. The results also suggest that intervention effects on alcohol consumption and mental health symptoms may occur through both common and specific processes, likely reflecting a combination of mental health and early onset drinking on adolescent mental health trajectories. Study 4 (O'Leary-Barrett, Pihl, & Conrod, under review) is the first examination of core, active therapeutic ingredients of personality-targeted interventions, and uses an innovative mixed methods design to examine candidate process variable. This study provides some evidence to support using youth experiences as proximal measures of program efficacy. Results suggest that learning, skill development and having a positive group experience during personality-targeted interventions are key to positive behavioural change. This study also identifies youth feedback that may identify vulnerable participants who could benefit from additional intervention. These process variables can be used to improve

future implementations of the Preventure model and may inform change processes relevant to brief interventions with youth more generally. These findings also have implications for the dissemination of personality-targeted interventions in school settings where it may not be feasible to conduct long-term outcome evaluations. Together, these studies contribute significantly to the literature in demonstrating the utility of using a mechanism-informed approach to understanding and optimising an evidence-based prevention program.

Contribution of Authors

For each of the studies of this dissertation, I will detail my contributions, and those of the co-authors. For Study 1 (O'Leary-Barrett, Topper, Al-Khudhairy, Pihl, Castellanos-Ryan, Mackie, Conrod), Dr. Conrod is the Principal Investigator (PI) of the Adventure randomised controlled trial, and I designed the study in collaboration with her. I collected and analysed the data with assistance from Drs. Topper, Castellanos-Ryan and Mackie. Ms. Al-Khudhairy was responsible for training and supervising the school-based professionals in the implementation of personality-targeted interventions, and assisted with data collection. I analysed the data and wrote the paper under Dr. Conrod and Dr. Pihl's supervision. For Study 2, Dr. Schumann is the principal investigator of the IMAGEN study. I designed the research question and wrote the final paper with assistance from Drs. Pihl and Conrod. I analysed the data with assistance from Dr. Conrod. All other co-authors contributed to the study design and data collection. I assisted in the data collection. For Study 3 (O'Leary-Barrett, Castellanos-Ryan, Pihl, Conrod), Dr. Conrod is the PI of the Adventure randomised controlled trial, and I designed the study in collaboration with Drs. Conrod and Pihl. I collected and analysed the data with assistance from Dr. Castellanos-Ryan. I wrote the final paper under the supervision of Drs. Pihl and Conrod. For Study 4 (O'Leary-Barrett, Pihl, Conrod), Dr. Conrod is the principal investigator of the Co-Venture randomised controlled trial, and Dr. Pihl is a co-investigator. I am a collaborator on the grant and assisted in preparing the grant application. I assisted in the training and supervision of educational professionals in the implementation of personality-targeted interventions, and conducted personality-targeted interventions myself. I also assisted in data collection. I designed the study, analysed the data and wrote the final paper under the supervision of Drs. Pihl and Conrod. Studies 1, 2 and 3 have been published, and the journals in which these papers appear are included in the final reference section of the dissertation. Study 4 is currently under review.

GENERAL INTRODUCTION

Consequences of early onset alcohol use

Early exposure to alcohol and illicit substances is associated with a myriad of immediate and long-term negative consequences (Zeigler et al., 2005). Onset of alcohol use at or before 14 years of age is strongly associated with increased risk of developing alcohol use disorders, with rates of adult alcohol dependence in this early onset group estimated at 40% (Grant & Dawson, 1997). Adolescent substance use is associated with an increased risk of mental health problems (Merikangas et al., 1998; Rohde, Lewinsohn, & Seeley, 1996), suicidal behaviour (Crumley, 1990; Woods et al., 1997), drug abuse and dependence (Grant & Dawson, 1998), poor academic performance (Wechsler, Lee, Kuo, & Lee, 2000; Zeigler et al., 2005), impaired cognitive functioning (Parsons, 1998; Squeglia, Spadoni, Infante, Myers, & Tapert, 2009), school drop-out (Wichstrom, 1998; Williams & Wynder, 1993), risky sexual behaviours (Halpern-Felsher, Millstein, & Ellen, 1996; Tapert, Aarons, Sedlar, & Brown, 2001), poor physical health (Clark, Lynch, Donovan, & Block, 2001; Single, Rehm, Robson, & Truong, 2000; World Health Organization, 2014), and injuries (Hicks, Morris, Bass, Holcomb, & Neblett, 1990). A recent World Health Organization study reports that alcohol use alone accounts for 5.1% of the global burden of disease, with 3.3 million deaths every year attributable to alcohol consumption (World Health Organization, 2014). Globally, deaths and disability-adjusted life years (DALYs) attributable to alcohol have increased in the past 25 years, and the World Health Organization now estimates that harmful alcohol use is the leading risk factor for death and disability in 15-49 year olds. Moreover, an evaluation of drinking patterns in 73 countries worldwide reported that hazardous and harmful drinking patterns, such as drinking to intoxication and binge drinking, are on the rise among adolescents and young adults (McAllister, 2003; The Lancet, 2008; World Health Organization, 2014). Compounding this problem are results from major epidemiological studies in the USA (Johnston, O'Malley, Bachman, & Schulenberg, 2011; Substance Abuse and Mental Health Services Administration, 2010) showing that the age of onset of alcohol use has been decreasing over the last 35 years, with youth now initiating alcohol use at 12 years of age on average.

Prevention programs

Unsurprisingly, there is great interest in developing preventive interventions for alcohol and drug misuse. Substance misuse prevention programs are typically delivered within community, family or school settings. Increasingly, schools are being highlighted as the most promising setting for the implementation of alcohol and drug prevention programs (Benningfield, Riggs, & Stephan, 2015; Gresham, 2004), and a recent review of evidence-based prevention programs suggests that the effects of school-based prevention approaches are more favourable than those resulting from community-based, family-based and multifaceted programs (Emmers, Bekkering, & Hannes, 2015). Most school-based alcohol and drug use prevention programs are universal approaches that are based on the social influence model. Programs aim to teach youth about the harms of substance misuse, to increase generic coping skills and to promote balanced attitudes about normative substance use behaviour in adolescence, as youth are shown to overestimate alcohol use among their peers (Wild, 2002). This overestimation is thought to increase youths' own levels of substance use (Lynch, Coley, Sims, Lombardi, & Mahalik, 2015), although note some conflicting views (Pape, 2012). However, a number of systematic reviews have concluded that the evidence in favour of universal school-based programs is limited (Faggiano, Minozzi, Versino, & Buscemi, 2014; Foxcroft & Tsertsvadze, 2011; Tobler et al., 2000), with some programs even showing iatrogenic effects (Werch & Owen, 2002). For instance, the Take Charge of Your Life program was associated with increased alcohol and cigarette use over five years among youth who had reported not using these substances at baseline relative to a no-treatment control group (Sloboda et al., 2009). Certain programs have been identified as being effective in reducing the incidence of drunkenness and binge drinking (*e.g.,* Life Skills Training Program, Unplugged program, Good Behaviour Game; Foxcroft & Tsertsvadze, 2012), although these programs are relatively time and resource-intensive, requiring a minimum of 12 one-hour sessions, and have only mild effects on alcohol and drug use outcomes. Several evidence-based programs have also proven difficult to implement in school settings (Faggiano et al., 2008; Stephens et al., 2009) due to time and resource constraints.

Brief interventions

Recognising these limitations, there is increasing interest in the use of brief alcohol interventions as an option for targeting alcohol use in adolescents, as these programs have the benefit of being less costly and more feasible to implement in real-life settings. A recent systematic review of 185 studies indicated that brief alcohol interventions have modest efficacy in reducing alcohol consumption and alcohol-related problems in adolescent and college age samples, both in high school and other settings (Hennessy & Tanner-Smith, 2015; Tanner-Smith & Lipsey, 2015). Indeed, research has demonstrated that brief interventions are generally as effective as those with longer durations (Gottfredson & Wilson, 2003). Although initial research is promising in demonstrating intervention effects of brief alcohol interventions up to 1 year post-intervention, few studies to date have examined brief alcohol intervention efficacy for longer than 1 year post-intervention with adolescents, and studies with college aged samples have shown that effect sizes were non-significant by 2 years (Tanner-Smith & Lipsey, 2015).

Brief intervention approaches most commonly use cognitive behavioural or skills training and motivational interviewing approaches, and a recent meta-analysis suggests that interactive forms of program delivery are associated with heightened efficacy, as opposed to programs that focus on psychoeducation only (Hennessy & Tanner-Smith, 2015). This finding is also supported by an earlier review of effective school-based programs (Gottfredson & Wilson, 2003). Certain motivational interviewing exercises, such as decisional balancing and goal setting, are associated with larger effect sizes in brief interventions for adolescents (Tanner-Smith & Lipsey, 2015). The importance of using skilled group leaders who are well trained and supervised, and implement programs with fidelity has been highlighted by several studies (*e.g.,* Sloboda et al., 2009). For instance, Dishion and colleagues have discussed the potential adverse effects of grouping high-risk youth in interventions aimed at reducing deviant behaviour, due to the negative influence that deviant peers can have on one another, and the resulting exacerbation in problem behaviours (Dishion, 2000; Dishion & Dodge, 2005). Similarly, the potential counter-productive effect of an authoritarian group leader on deviant behaviour has also been highlighted (Marx, 1981). It is suggested that adverse effects of such "deviancy training"

may be reduced in the presence of a skilled and empathic group leader (Dishion & Dodge, 2005).

The theoretical background to selective prevention approaches

Whilst experimentation with alcohol and drugs is a relatively normative behaviour during adolescence (Kandel, 2002), only a subset of substance users will progress to more problematic use over time (Hartel & Glantz, 1997). It is therefore of particular importance to identify and target those individuals who have a heightened risk of developing problematic substance misuse. Selective approaches to prevention differ from universal programs in that they target known risk factors for addiction. Though less frequently implemented than universal programs, selective prevention approaches are associated with stronger intervention effects (Foxcroft & Tsertsvadze, 2011; Gottfredson & Wilson, 2003), and have the potential to have a large public health impact (Willenbring, 2013). Theoretically, targeting interventions to particular risk profiles can also facilitate change as interventions focus on etiological processes underlying problematic behaviours.

Longitudinal research has highlighted the importance of numerous risk factors on the development of early-onset substance misuse and addiction (Grant, Stinson, & Harford, 2001). Namely, the impacts of family history (Bierut et al., 1998), externalising disorders (Brinkman, Epstein, Auinger, Tamm, & Froehlich, 2015; Flory & Lynam, 2003), internalising disorders (Hussong, Jones, Stein, Baucom, & Boeding, 2011), childhood adversity and trauma (Edalati & Krank, 2015; Harrington, Robinson, Bolton, Sareen, & Bolton, 2011), high school drop-out (Fleming, White, Haggerty, Abbott, & Catalano, 2012) and personality factors (Caspi et al., 1997; George, Connor, Gullo, & Young, 2010) are well established. Moreover, studies suggest that risk factors for addiction tend to cluster together (Burt, Krueger, McGue, & Iacono, 2001; Knopik, Heath, Bucholz, Madden, & Waldron, 2009; Krueger et al., 2002). It is increasingly suggested that personality factors may partially account for the relationship between other risk factors (*e.g.,* externalising behaviours, trauma) and addiction (Brents, Tripathi, Young, James, &

Kilts, 2015; Davis, Cohen, Davids, & Rabindranath, 2015; Kotov, Gamez, Schmidt, & Watson, 2010; Krueger, McGue, & Iacono, 2001). Indeed, some studies suggest that personality factors may mediate the relationship between genetic factors and substance misuse (Laucht, Becker, Blomeyer, & Schmidt, 2007; McGue & Bouchard, 1998).

Targeting personality risk factors for addiction offers a promising intervention approach in that personality traits are differentially associated with motives for substance use (Comeau, Stewart, & Loba, 2001; Cooper, Frone, Russell, & Mudar, 1995), drugs of choice (Conrod, Pihl, Stewart, & Dongier, 2000; Gerra et al., 2008; Le Bon et al., 2004), patterns of coping (Connor-Smith & Flachsbart, 2007), and sensitivity to the effects of drugs (Conrod, Pihl, & Vassileva, 1998; Leyton et al., 2002). Personality-targeted interventions can thus address the specific motivations for use and vulnerability factors associated with a particular personality profile, enhancing the individual relevance and impact of an intervention.

Introducing Preventure: a selective personality-targeted approach

Four personality traits, namely hopelessness, anxiety sensitivity, impulsivity and sensation seeking have been associated with early-onset risk for addiction in youth (Castellanos-Ryan, O'Leary-Barrett, Sully, & Conrod, 2013; Krank et al., 2011; Woicik, Stewart, Pihl, & Conrod, 2009) and patterns of substance use in substance-abusing adults (Castellanos-Ryan et al., 2013; Conrod, Pihl, et al., 2000). Each personality profile is associated with distinct motivational pathways to substance use (Castellanos-Ryan & Conrod, 2012), as well as risk factors for specific mental disorders (Castellanos-Ryan et al., 2013; Conrod, Pihl, et al., 2000). High-risk youth can be identified according using personality scores on a brief personality questionnaire, the Substance Use Risk Profile Scale (Castellanos-Ryan et al., 2013; Krank et al., 2011; Woicik et al., 2009). The Substance Use Risk Profile Scale has been shown to have good sensitivity (72-91%) and specificity in predicting those who will develop substance use or mental health problems over an 18 month period in adolescence (Castellanos-Ryan et al., 2013). These four personality profiles are targeted in the PREventure (Personality Risk Education) program,

a school-based, selective intervention for early-onset alcohol and illicit drug use. A central tenet of this personality-targeted approach is that youth are taught about their personality profiles in personality-matched groups, and interventions focus on personality-specific motivations for substance use in addition to other personality-specific problems (*e.g.,* internalising or externalising symptoms). This contrasts with universal approaches, where youth are provided with general risk information about substance misuse, irrespective of their individual characteristics. Personality-matching has been shown to be crucial to intervention efficacy, as personality mismatched groups are no more effective than motivational control groups in affecting substance use (Conrod, Stewart, et al., 2000).

With regards to the personality profiles in question, hopelessness is associated with the use of substances to dampen feelings of sadness or worthlessness (Mackinnon, Kehayes, Clark, Sherry, & Stewart, 2014), and is a risk factor for depressive disorders (Krank et al., 2011; Woicik et al., 2009). 14-year olds with high levels of hopelessness have 3 times greater odds of developing severe depressive symptoms over 18-months than youth without this high-risk profile (Castellanos-Ryan et al., 2013). Anxiety sensitivity is a risk factor for addiction through the use of substances to dampen fears of the physical sensations of anxiety, and predicts a heightened risk of panic and anxiety disorders (Sandin, Sanchez-Arribas, Chorot, & Valiente, 2015; Stewart & Kushner, 2001). 14-year olds with high levels of anxiety sensitivity have 3.5 times greater odds of developing severe emotional problems over 18-months than youth without this high-risk profile (Castellanos-Ryan et al., 2013). Whilst anxiety sensitivity appears to protect against substance use during adolescence (Krank et al., 2011), possibly due to avoidance of social situations which involve alcohol, or anxiety regarding the impact of alcohol use, this trait emerges as a risk factor for addiction in adulthood (Conrod, Pihl, et al., 2000). Anxiety sensitivity also predicts internalising problems (Olthuis, Watt, & Stewart, 2014) which in themselves are risk factors for the development of problematic substance use (Hussong et al., 2011). With regards to the externalising traits measured by the Substance Use Risk Profile Scale, impulsivity is associated with disinhibition over a range of behaviours, including conduct disorders (Urben, Suter, Pihet, Straccia, & Stephan, 2014), antisocial tendencies (Luengo, Carrillo-de-la-Pena, Otero, & Romero,

1994), attention-deficit/hyperactivity disorder (Winstanley, Eagle, & Robbins, 2006), problem drinking (Sher & Trull, 1994) and polysubstance use (Caspi, Moffitt, Newman, & Silva, 1996; Conrod, Pihl, et al., 2000). 70-80% of 14-year olds with high levels of impulsivity, as measured by the Substance Use Risk Profile Scale, developed conduct or drug use problems over an 18-month period (Castellanos-Ryan et al., 2013). Impulsivity is a risk factor for early-onset alcohol use through multiple, as opposed to specific, drinking motives (Mackinnon et al., 2014). Lastly, sensation seeking is associated with risk-taking behaviours, including heavy alcohol-use (Castellanos-Ryan & Conrod, 2012), but not with other forms of non-addictive psychopathology (Castellanos-Ryan et al., 2013; Conrod, Pihl, et al., 2000). Individuals with high levels of sensation seeking are shown to be sensitive to the rewarding properties of alcohol and to engage in binge drinking in order to maximise their enjoyment of alcohol (Woicik et al., 2009). Sensation seeking is associated with alcohol use for enhancement motives (Castellanos-Ryan & Conrod, 2012), namely to increase positive affect when fatigued, bored or under-aroused (Cooper et al., 1995), or to increase enjoyment in social situations.

Description of the Preventure personality-targeted intervention program in practice

The Preventure personality-targeted intervention program is based on the cognitive behavioural therapy model, an approach which has been found to be effective in addressing substance use problems in adolescents (Waldron & Turner, 2008). Interventions include psycho-educational material, and are delivered according to the "spirit" or essence of the motivational interviewing approach. A novel component to this intervention program is that all materials are targeted to each personality profile, making interventions personally relevant for each participant. The interventions are delivered over 2 90-minute group sessions by a trained facilitator and co-facilitator, with an average of 6 personality-matched adolescents per group. The interventions are manualised, and include real life scenarios shared by youth in specifically-organised focus groups. Particular attention is paid to ensuring that manuals are culturally appropriate, and materials have been specifically developed for youth in United Kingdom (Conrod, Castellanos, & Mackie, 2008), Canada (Conrod, Stewart, Comeau, & Maclean,

2006), Australia (Newton, Teesson, Barrett, Slade, & Conrod, 2012) and The Netherlands (Lammers et al., 2011). Throughout the group, cognitive behavioural and motivational principles are presented and explored using examples of real life scenarios, as well as participants' personal experiences. In the first session, participants are guided in a goal-setting exercise designed to enhance motivation to change behaviour. Psychoeducational strategies are used to teach participants about the target personality variable and associated problematic coping behaviours (*e.g.,* risk taking in youth with high levels of sensation seeking). Substance misuse is referred to as a problematic coping behaviour across all personality profiles, and the groups discuss personality-specific motives for use (*e.g.,* to cope with feelings of sadness in the hopelessness-prone group). Other non substance-related personality-specific maladaptive coping behaviours are also presented (*e.g.,* interpersonal dependence in youth with high levels of anxiety sensitivity), and a decisional balancing exercise is conducted in order to explore the short and long term consequences of a particular maladaptive coping strategy. Participants subsequently generate an alternative, more adaptive coping strategy, which they explore using a second decisional balancing exercise. The cognitive behavioural therapy model is then presented, and participants are guided in breaking down personal experiences according to the physical, cognitive, and behavioural components of an emotional response. All exercises discuss thoughts, emotions, and behaviours in a personality-specific way, *e.g.,* identifying situational triggers and cognitive distortions related to impulsivity specifically. In the second session, participants are encouraged to identify and challenge personality-specific cognitive distortions (*e.g.,* negative, global, self-referent thinking for hopelessness-prone youth) that can lead to problematic behaviours. Participants are then assisted in completing a cognitive restructuring exercise using a personal example, which is associated with an alternative behaviour that is in line with valued life goals.

The Preventure evidence base

The Preventure program has been evaluated in four separate randomised clinical trials in high schools in the United Kingdom (Conrod et al., 2008; Conrod et al., 2013), Canada (Conrod et al., 2006) and the Netherlands (Lammers et al., 2015). This brief program has

resulted in delays and reductions in rates and growth of alcohol consumption, binge drinking, and severity of alcohol-related problems in selected high-risk youth up to a 2-year period when delivered by trained psychologists (Conrod, Castellanos-Ryan, & Mackie, 2011; Conrod et al., 2008; Conrod et al., 2006; Lammers et al., 2015). Effect sizes for intervention effects on alcohol use are striking, as evaluated by numbers needed to treat, which represent the number of participants who need to take part in the intervention in order to prevent one bad outcome, in this case binge drinking. Numbers needed to treat at 6 months post-intervention were between 4 and 6 for alcohol users at baseline across 3 trials (Conrod et al., 2008; Conrod et al., 2006; O'Leary-Barrett, Mackie, Castellanos-Ryan, Al-Khudhairy, & Conrod, 2010), and as low as 2 for sensation seeking youth who had consumed alcohol prior to the intervention, a particularly high-risk group (Conrod et al., 2008). In addition, Preventure interventions have resulted in reduced drug use rates and frequency, with high-risk youth who received interventions reporting a 30% reduced odds of taking up marijuana use, an 80% reduced odds of taking up cocaine and a 50% reduced odds of taking up other drugs over a 2-year period relative to their control counterparts (Conrod, Castellanos-Ryan, & Strang, 2010). The intervention was also associated with personality-specific intervention effects on mental health symptoms and reckless behaviours over 6 months (*e.g.,* reduced depressive symptoms in hopelessness-prone youth, reduced panic attacks and school avoidance in youth with high levels of anxiety sensitivity, and reduced shoplifting in youth with high levels of impulsivity; Castellanos & Conrod, 2006). In recognition of these robust intervention effects, Preventure has been identified as a promising intervention approach in a review of prevention programs for substance abuse and dependence in adolescents with comorbid disorders (Salvo et al., 2012).

The efficacy of personality-targeted interventions as delivered by school-based professionals

In an effort to move towards a sustainable model of program implementation, a randomised controlled trial known as Adventure is investigating the efficacy of the Preventure intervention model as delivered by school-based professionals, such as school

counsellors, teachers and special educational staff, who were trained and supervised by the research team (O'Leary-Barrett et al., 2010). This was considered an important step in addressing the implementation barriers faced by many evidence-based intervention programs (Glasgow, Lichtenstein, & Marcus, 2003), which are not sustainable in real-world settings without continued input from an external agency (*e.g.,* a research team). In the Adventure trial, school-based professionals attended a 3-day training workshop, followed by a minimum of 4-hours supervision in running through a full, 2-session intervention with the trial therapist. The first day of the training workshop presented the rationale and evidence base for the personality-targeted approach, as well as an overview of the psychoeducational, cognitive behavioural and motivational components of the interventions. The second day focused on basic counselling skills (*e.g.,* empathy, reflective listening), and general cognitive behavioural and motivational interviewing principles, using both didactic presentations and role play exercises. The third day reviewed the specific cognitive behavioural and motivational skills necessary for delivery of the Preventure interventions, and trainees were guided in carrying out the core components of the manual using role play exercises. Subsequent to completing the training workshop, trainees ran supervised interventions with groups of students in a different grade, who were not involved in the formal trial. A checklist was devised by the research team to measure whether facilitators demonstrated sufficient mastery of cognitive behavioural, motivational and general counselling skills. 31 trainees (84%) successfully completed the training and supervisions and qualified as facilitators of the intervention. Trainees' adherence to the treatment protocol and intervention quality was monitored during the formal trial, both by trained members of the research team and an independent evaluator, using a scale designed specifically by the principal investigator (Patricia Conrod) and the trial therapist, as well as Young and Beck's Cognitive Therapy Scale (Young & Beck, 1980). The majority of facilitators were rated as having adequate counselling skills and treatment fidelity. Scores suggest the intervention facilitators achieved many of the goals of a cognitive behavioural therapy intervention in practice but did not perform at a therapeutic level equivalent to a trained clinical psychologist.

Evaluation of the Adventure trial results indicated that intervention effects over 2 years reported in previous trials were replicated, with high-risk youth reporting reduced rates and growth in alcohol consumption, binge drinking and alcohol-related problems (Conrod et al., 2013), and reductions in onset of cannabis use in youth most prone to early drug use, namely those with high levels of sensation seeking (Mahu, Doucet, O'Leary-Barrett, & Conrod, 2015). In addition, some herd effects of the intervention on low-risk youth (who did not participate in the interventions) were observed, suggesting that the benefits of the targeted interventions may be transferred to the wider school population (Conrod et al., 2013). Specifically, low-risk youth in intervention schools (where their high-risk peers participated in Preventure interventions) reported significantly reduced rates of alcohol consumption and binge drinking over 2 years, and a reduced growth in binge drinking relative to low-risk youth in control schools, where high-risk youth did not receive interventions. Whilst there is some variability in effects sizes across studies that may be attributable to sample characteristics (*i.e.,* whether or not youth have initiated alcohol consumption prior to participating in the intervention; O'Leary-Barrett et al., 2010), or the levels of training of intervention facilitators (Lammers et al., 2015), comparisons of the efficacy of personality-targeted interventions across trials nevertheless revealed similar effect sizes when delivered by trained psychologists and school-based staff (O'Leary-Barrett et al., 2010).

Mechanisms of change

In addition to evaluating intervention programs' evidence base and potential for dissemination, understanding the underlying mechanisms of change is increasingly recognised as being a vital complement to efficacy studies (Elliott, 2010). In recognition of the value of process research, the National Institute on Alcohol Abuse and Alcoholism (NIAAA) has shifted the focus of their treatment research from comparing different psychotherapy approaches to identifying mechanisms of behaviour change (Willenbring, 2013). A recent review of the state of psychotherapy research has called for the implementation of "complex intervention trials" that investigate both the efficacy and the mechanisms of an intervention (Stiles, Hill, & Elliott, 2014). Understanding treatment

mediators and mechanisms is important for various reasons. Firstly, it can elucidate the components of an effective program that drive change. This will allow researchers to incorporate identified key intervention elements across programs, which will maximise treatment efficiency and minimise iatrogenic effects (Chorpita, Becker, & Daleiden, 2007; Shirk & Karver, 2006). This is vital when disseminating evidence-based treatments to real-world settings (Kazdin, 2007). Secondly, understanding treatment mechanisms can elucidate moderators of treatment (*e.g.,* patient characteristics). This will allow researchers and clinicians to better target treatments to patients who are likely to respond favourably to a particular approach (Kazdin, 2007). Thirdly, as stated by Kazdin (2007), "understanding the mechanisms of change can bring order and parsimony to the current status of multiple interventions" (p.4). In the field of child and youth psychotherapy, for example, more than 550 programs are being implemented (Kazdin, 2000), at least some of which have been proven to lead to positive change. It is thus likely that there are common elements that account for treatment effects across programs. Highlighting these active common elements will allow us to refine and optimise our treatment approaches.

Mechanisms of change in relation to Preventure interventions

The therapeutic components of particular interest to this dissertation are those on which the Preventure program is based, namely cognitive behavioural therapy (CBT) and motivational interviewing. The targeted group format of the Preventure program is also hypothesised to contribute to intervention efficacy in that youth can identify and interact with peers with similar personality profiles, thus theoretically increasing their level of comfort with the group, and promoting insight through the sharing of common experiences. The following paragraphs will summarise the current state of the literature on the role of these intervention components.

The theoretical framework for CBT is based on the notion that problematic behaviours result from unhelpful thinking patterns, or "cognitive distortions" (Beck, 1987). For instance, when faced with the prospect of a job interview, thoughts such as "I will make a fool of myself" and "I'm going to fail" can lead to anxiety and sadness, which can in turn

result in an individual cancelling the interview. CBT interventions focus on identifying and reframing, or challenging, thoughts that may lead to distress or unwanted behaviours. CBT interventions also focus on developing coping skills, and a meta-analysis has shown that improvements in coping skills partially mediate CBT efficacy, both through general coping skills (*e.g.,* improvements in self-efficacy, more adaptive coping) or specific strategies (*e.g.,* cognitions around coping) (Chu & Harrison, 2007). CBT for addiction frames substance misuse as a maladaptive behaviour that reflects a lack of alternative coping skills, and low self-efficacy in the face of negative or distressing situations. With the above example, for instance, in the absence of alternative coping mechanisms (*e.g.,* the ability to challenge maladaptive cognitions, social support), an individual may use alcohol to dampen the feelings of anxiety and sadness resulting from their self-defeating thoughts relating to a job interview.

Despite CBT's strong theoretical foundation (Clark, Beck, & Alford, 1999) and solid evidence base (Beck, 2005; Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012), the evidence in support of its theoretical model is mixed. Specifically, there is substantial debate as to whether changes in cognitions and improvements in coping are the mechanisms through which problematic behaviours decrease, both in CBT treatments for substance use (Morgenstern & Longabaugh, 2000) and other disorders (Burns & Spangler, 2001; Garratt, Ingram, Rand, & Sawalani, 2007; Litt, Kadden, Cooney, & Kabela, 2003). A review article summarises evidence indicating that patients can experience symptom improvements following CBT treatments prior to experiencing changes in cognitions (Longmore & Worrell, 2007), suggesting that cognitive change is not a necessary condition for treatment efficacy. Changes in cognitions may also occur in the absence of cognitive therapy interventions. A recent study demonstrated, for example, that patients exhibited similar cognitive changes accompanying symptom improvement following both CBT and pharmacological treatment for major depression (Farabaugh et al., 2015). Similarly, another recent study has suggested that treatment components not implicated in the CBT model, such as mindfulness, may account for some of the efficacy of this approach (Kocovski, Fleming, Hawley, Ho, & Antony, 2015). Improvements in self-efficacy have been found to partially mediate treatment effects in patients who completed either CBT or a twelve-step facilitation program for alcohol dependence

(Ludwig, Tadayon-Manssuri, Strik, & Moggi, 2013). It is possible, therefore, that the theorised CBT mechanisms may not be unique in accounting for the efficacy of this approach but that effective treatments may instead operate through common processes.

The second posited active ingredient of Preventure is motivational interviewing (Miller & Rollnick, 2002), which is a client-focused approach that aims to enhance intrinsic motivation to change. Motivational interviewing is deemed particularly effective in targeting behaviours where patients are known to experience ambivalence around change, such as substance use. It is often used in a brief intervention format, and has demonstrated efficacy for a range of behaviours in youth and adult populations (Hettema, Steele, & Miller, 2005; Lundahl et al., 2013; Smedslund et al., 2011), although effect sizes are known to be variable (Foxcroft, Coombes, Wood, Allen, & Almeida Santimano, 2014). The motivational interviewing "spirit" refers to the therapist's overarching attitude towards the client in focusing on their intrinsic motivation, and can be applied throughout the intervention in the absence of specific exercises, as well as in conjunction with other therapeutic approaches (such as CBT, in the case of Preventure). Research on change processes in motivational interviewing is in its early stages (Apodaca & Longabaugh, 2009; Dunn, Deroo, & Rivara, 2001). Certain motivational interviewing exercises such as decisional balancing and goal setting exercises are associated with larger effect sizes in brief interventions for adolescents (Tanner-Smith & Lipsey, 2015). A recent study suggests that the motivational interviewing "spirit" is hypothesised to facilitate change (Copeland, McNamara, Kelson, & Simpson, 2015). Some candidate process variables have been identified relating to therapists' behaviours and patient-generated change talk (*i.e.,* statements uttered by the participant in session in favour of making a change), but the evidence for the mediating role of these variables is mixed to date (D'Amico et al., 2015; Gaume, Bertholet, Faouzi, Gmel, & Daeppen, 2013; Magill et al., 2015).

Despite differing theoretical foundations for many psychotherapy models, there is a long-standing debate in the field as to whether common factors may lead to similar processes of therapeutic change across treatment modalities (Heimberg & Ritter, 2008; Messer & Wampold, 2002). This debate stems from decades of efficacy research comparing different psychotherapy approaches that suggests that there is no significant difference in

effectiveness between treatments (Lambert, 2013; Luborsky et al., 2002; Strupp & Hadley, 1979; Wampold, 2001), including those addressing substance misuse (Klimas et al., 2014). Common factors have been identified that are associated with therapeutic outcome, including the establishment of a therapeutic alliance, patient motivation and expectation for change (Oei & Shuttlewood, 1996; Wampold, 2001; Weinberger, 2014). A recent paper suggests that these common factors may be more accurately referred to as "non-specific" factors that are active in many forms of psychotherapy (as opposed to "specific" factors that distinguish CBT and other treatment approaches) (Weinberger, 2014). Common factors in group psychotherapy include social support among group members (Burlingame, Fuhriman, & Johnson, 2004), a positive group environment (Ogrodniczuk & Piper, 2003), and bonding with other group members (Crits-Christoph, Johnson, Connolly Gibbons, & Gallop, 2013; Piper, Ogrodniczuk, Lamarche, Hilscher, & Joyce, 2005). It is thus important to examine the impact of common therapeutic factors alongside specific factors in order to assess the role of a variety of possible treatment components in accounting for therapeutic change.

This dissertation will examine both the efficacy and mechanisms of the Preventure personality-targeted intervention program using data collected from 2 randomised controlled trials (one conducted in London, U.K., and the other in Montreal, Canada), and one longitudinal study multi-site European study.

Introduction to Study 1

Study 1 was designed to evaluate the efficacy of the Preventure personality-targeted intervention program on internalising and externalising symptoms in youth over a 2-year period. Intervention effects were examined in the Adventure cluster randomised controlled trial, which evaluated the impact of the Preventure program in 19 London (U.K.) high schools. The Adventure trial represents the first investigation of whether the Preventure program's efficacy can be maintained when interventions were delivered by trained school-based professionals. An evaluation of the primary study outcomes, namely alcohol and drug use, demonstrated that intervention effects over 2 years reported in previous Preventure trials were replicated, with high-risk youth reporting reduced rates and growth in alcohol consumption, binge drinking and alcohol-related problems in the full high-risk sample (Conrod et al., 2013), and reductions in rates and frequency of cannabis use, particularly in youth with high levels of in sensation seeking youth (those most prone to early drug use) (Mahu et al., 2015). A previous trial Preventure trial demonstrated that the intervention additionally resulted in personality-specific reductions in mental health problems over a 6-month period (Castellanos & Conrod, 2006), such as reduced depressive symptoms in youth with high levels of hopelessness. Study 1 aims to extend on previous findings in examining whether personality-targeted interventions will result in reductions in internalising and externalising symptoms in a high-risk youth sample over a 2-year period when delivered by trained educational professionals. In addition, personality-specific intervention effects will be tested within groups most prone to particular symptoms in comparison to groups with high levels of one of the three other personality profiles targeted (*e.g.,* anxiety symptoms in youth with high levels of anxiety sensitivity versus other personality risk factors). This will allow an examination of whether personality-targeted interventions operate through a personality-specific or a general intervention mechanism. As high-risk youth receive targeted interventions focusing on personality-specific coping strategies (*e.g.,* targeting anxiety-related cognitions only in with youth with high levels of anxiety sensitivity), it can be theorised that the personality-matched interventions may lead to stronger intervention effects in the specific symptoms targeted in each personality group. Alternatively, it is possible that the cognitive behavioural therapy principles applied may operate through a general

therapeutic mechanism, where the tools provided (*e.g.,* distancing oneself from distressing thoughts and challenging distorted cognitions) can be generalised to a range of symptoms across all personality groups, as suggested by Hayes and colleagues (Hayes, 2004; Hayes, Levin, Plumb-Vilardaga, Villatte, & Pistorello, 2013). Thus, testing personality-specific effects will be a preliminary test of intervention mechanisms.

Study 1

Two-year impact of brief, personality-targeted, teacher-delivered interventions on youth internalizing and externalizing problems: a randomized controlled trial.

O'Leary-Barrett, M., Topper, L., Al-Khudhairy, N., Pihl, R.O., Castellanos-Ryan, N., Mackie, C.J., Conrod, P.J. (2013).

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Two-Year Impact of Personality-Targeted, Teacher-Delivered Interventions on Youth Internalizing and Externalizing Problems: A Cluster-Randomized Trial

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Objective: To assess the 2-year impact of teacher-delivered, brief, personality-targeted interventions on internalizing and externalizing symptoms in an adolescent U.K. sample. **Method:** This cluster-randomized trial was run in 19 London schools (N = 1,024 adolescents). Trained school-based professionals delivered two 90-minute, CBT-based group interventions targeting 1 of 4 personality-risk profiles: anxiety sensitivity, hopelessness, impulsivity, or sensation seeking. Self-report depression, anxiety, and conduct disorder symptoms were assessed at 6-month intervals. **Results:** Interventions were associated with significantly reduced depressive, anxiety, and conduct symptoms ($p < .05$) over 2 years in the full sample, reduced odds of severe depressive symptoms (odds ratio [OR] = 0.74, CI = 0.58–0.96), and conduct problems (OR = 0.79, CI = 0.65–0.96), and a nonsignificant reduction in severe anxiety symptoms (OR = 0.79, CI = 0.59–1.05). Evaluating a priori personality-specific hypotheses revealed strong evidence for impulsivity-specific effects on severe conduct problems, modest evidence of anxiety sensitivity–specific effects on severe anxiety, and no evidence for hopelessness-specific effects on severe depressive symptoms. **Conclusions:** Brief, personality-targeted interventions delivered by educational professionals can have a clinically significant impact on mental health outcomes in high-risk youth over 2 years, as well as personality-specific intervention effects in youth most at risk for a particular problem, particularly for youth with high levels of impulsivity. Clinical trial registration information—Adventure: The Efficacy of Personality-Targeted Interventions for Substance Misuse and Other Risky Behaviors as Delivered by Educational Professionals; http://clinicaltrials.gov; NCT00776685. J. Am. Acad. Child Adolesc. Psychiatry, 2013;52(9):911–920. **Key Words:** internalizing and externalizing symptoms, personality-targeted interventions, school-based prevention

The prevalence and burden of psychological problems in youth is substantial, with an estimated 24.4% of American 8- to 15-year-olds experiencing a mental health disorder in the past year,[1] and known associations with a plethora of negative consequences, including substance abuse and dependence[2] and risk for chronic and recurrent mental health problems in adulthood.[3] It is now well accepted that targeting multiple health-risk behaviors through identifying premorbid markers of risk is an efficient, cost-effective, and clinically valid method of implementing preventative strategies.[4] School-based interventions represent the most promising avenue for the implementation and dissemination of effective programs.[5] Although a number of school-based programs have shown improvements in mental health symptoms such as depression,[6] few have shown longer-term benefits, with most intervention effects fading within 6 to 12 months and many programs showing limited evidence of effectiveness,[7] with some even showing iatrogenic effects.[8] In addition, virtually no effective programs have made their way into regular practice[9]; thus, it is important to develop programs that are amenable to wider dissemination.

The personality-targeted approach to drug and alcohol prevention represents a novel strategy

which has shown promise in 3 separate trials across Canada[10] and the United Kingdom.[11-14] Initially designed to target personality risk factors for substance misuse, this approach has demonstrated sustained preventative effects on adolescent alcohol and illicit drug use over a 2-year period.[12,13] Interventions target 4 personality profiles on the Substance Use Risk Profile Scale (SURPS) that have been associated with increased risk for substance misuse and mental health problems.[15,16] A recent article[17] has shown, using the SURPS scales, that high levels of impulsivity (IMP) are associated with 5.4 times greater odds of developing severe conduct problems over 18 months, and the odds of developing severe depressive symptoms (for individuals prone to hopelessness [H]) or emotional problems (for youth with high levels of anxiety sensitivity [AS]) over 18 months are 3 to 3.5 times greater than in youth without these high-risk profiles. The internalizing traits of H and AS are associated with alcohol consumption for self-medication or management of depression symptoms[16,18] or anxiety.[19] Impulsivity (IMP), on the other hand, is associated with disinhibition over a range of behaviors, including antisocial tendencies[20] and polysubstance use.[21] Finally, sensation seeking (SS) is related to risk-taking behaviors, including heavy alcohol use, for enhancement purposes,[16] and is not associated with any particular form of nonaddictive psychopathology.[17,19] Through targeting the personality risk factors and the underlying motivational profiles for substance use, this approach simultaneously addresses the emotional and behavioral consequences of these high-risk traits. The novel component of this intervention approach is that it targets cognitive distortions specific to each personality profile, for instance, "thinking the worst" (AS), "overgeneralization" (i.e. making global assumptions based on one specific situation or event; H), or "not thinking things through" (IMP). Targeting these personality-specific distortions aims to directly improve internalizing and externalizing symptoms in the personality group most at risk for a particular problem (e.g., depression in individuals with high levels of H). In addition to long-term intervention effects on substance use, the intervention demonstrated a short-term reduction in personality-specific emotional and behavioral outcomes, namely, depression in youth with high levels of H, panic attacks in youth with high AS, and conduct problems in youth with high levels of IMP, in parallel with reductions in substance use behavior.[22]

A recent cluster-randomized trial known as Adventure has replicated the preventative effects of personality-targeted interventions on alcohol use over 6 months when delivered by trained school staff,[14] and 2-year outcomes have recently been published.[13] These findings suggest that this intervention approach can operate within an implementation model that has a higher likelihood of being adopted by schools in a sustainable manner. Although intervention effects on substance use are the primary outcomes of the Adventure randomized controlled trial, the current study will present secondary outcomes on mental health symptoms.

This article assesses the following: whether teacher-delivered, personality-targeted interventions on internalizing and externalizing symptoms, and severe symptom levels, in high-risk youth are effective over a 2-year period; whether intervention effects on severe symptom levels are found in accordance with personality-specific hypotheses; and whether intervention effects are mediated by changes in alcohol-related behaviors.

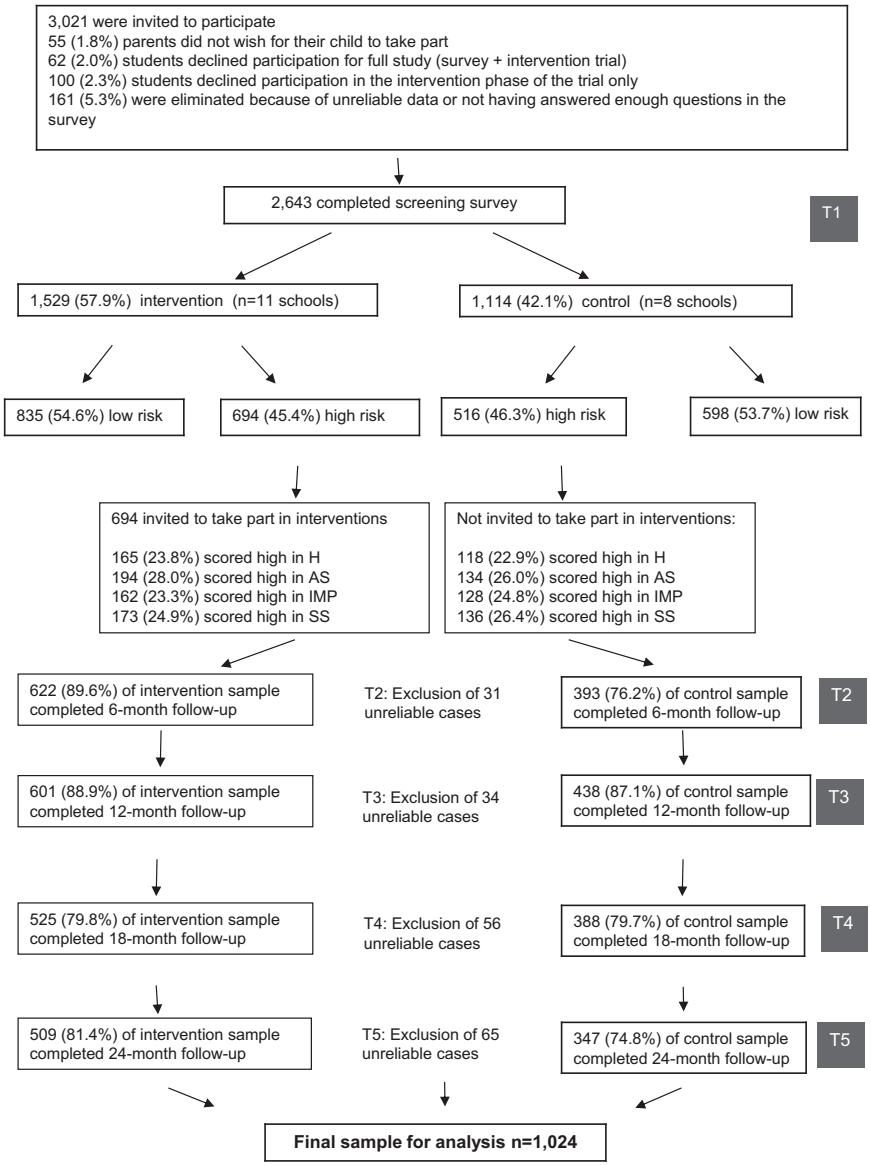
METHOD

Participants and Procedure

This study followed a cluster-randomized design, whereby 19 schools from 9 randomly selected London boroughs were assigned to control (n = 8) or intervention (n = 11) conditions according to a computerized randomization procedure, and all year-9 students (13–14 years of age) were invited to participate. School recruitment began in September 2006, baseline data was collected starting in September 2007, and data collection was finalized by May 2010.

Students completed self-report questionnaires in classroom or assembly formats at 6-month intervals for 2 years. Participation (for both survey and intervention phases) was informed by passive consent from parents and active assent from students, following approval from the King's College London Research Ethics Committee (CREC/06/07-192). Follow-up assessments were conducted for all students who took part at baseline, includ ing low-risk (LR) youth (n = 2,643), but only outcomes for high-risk youth will be reported (Figure 1). One intervention school (n = 198) was excluded from the trial after attending the training workshop because of the lack of resources to be able to commit to the full trial. One control school withdrew from the study after the baseline survey (n = 135) and could not be replaced at that stage of the study. These schools were not included in Figure 1. The sample size was adjusted by removing participants who reported

FIGURE 1 Recruitment and selection protocol. Note: AS = anxiety sensitivity; H = hopelessness; IMP = impulsivity; NT = negative thinking; SS = sensation seeking.



unreliable data at any follow-up time-point (n = 186). Excluded participants were those who responded positively to a sham drug item (n = 121) or whose responses were found to be unreliable after vigorous visual checks by the research team (e.g., zig-zagging, or reporting only the highest symptoms levels across scales indiscriminately; n = 65), to give a final sample of 1,024 (H = 240, AS = 292, IMP = 238, SS = 254, mean age 13.7 years).

High-risk (HR) students were defined as those scoring 1 standard deviation above the school mean on 1 of the 4 subscales of the Substance Use Risk Profile Scale (SURPS).[16] If a student had elevated scores on more than 1 subscale, that individual was assigned to the personality group in which he or she showed the most statistical deviance according to z scores. A total of 574 (82.7%) HR participants received an intervention. Although a small number of HR students did not wish to participate (n = 8), the remaining students did not receive interventions because of time and resource constraints (n = 112). HR students were included in the intent-to-treat follow-up analysis regardless of whether they attended the sessions. Only trained facilitators were informed as to the personality risk status of students, and this information was treated as confidential. Although it was not possible for the research team to be blinded to schools' treatment conditions, they were not aware of which students had participated in

interventions. Data entry was automatized and conducted by an independent data scanning company (Group Sigma Ltd.), and quality checks were conducted by research staff blinded to treatment condition.

Measures

Socioeconomic Status. Participants' socioeconomic status (SES) was assessed using items from the Family Affluence Scale for Adolescents.[23]

Personality Risk. Personality risk was assessed with the SURPS, a 23-item questionnaire assessing variation in personality risk for substance abuse/dependence along 4 dimensions: sensation seeking (SS), impulsivity (IMP), anxiety sensitivity (AS), and hopelessness (H). This scale has good concurrent, predictive, and incremental validity (relative to other personality measures) with regard to differentiating individuals prone to reinforcement-specific patterns of substance use,[11,12,15,16] and is concurrently and prospectively associated with substance misuse and nonsubstance-related externalizing behaviors and internalizing symptoms.[15,16,24] In the present sample, each of the subscales had adequate internal reliability for short scales, with Cronbach alpha coefficients ranging from 0.57 to 0.79 ($\alpha = 0.57$ for SS [6 items]; $\alpha = 0.62$ for AS [5 items]; $\alpha = 0.68$ for IMP [5 items]; and $\alpha = 0.79$ for H [7 items]) and inter-item correlations ranging from 0.19 to 0.35 (0.19 for SS; 0.24 for AS, 0.30 for IMP; 0.35 for H). There was good test–retest reliability over 2 years ($p < .001$ for each subscale).

Internalizing Symptoms. Depression and anxiety symptom severity over the past 6 months were measured using the Depression and Anxiety subscales from the Brief Symptoms Inventory (BSI).[25] Cut-offs for more severe/pathological depression and anxiety experiences were computed according to published guidelines.[25] Frequency of suicidal ideation was measured as part of the BSI depression subscale, and panic attacks were assessed using the revised Panic Attack Questionnaire.[26]

Externalizing Symptoms. Conduct disorder symptoms were assessed using the conduct subscale of the Strengths and Difficulties Questionnaire (SDQ).[27] Cut-offs for abnormal/severe cases were classified according to bandings provided from a large, representative sample of adolescents from the United Kingdom.[28] These cut-off scores were established from approximately the top 10% of a community sample who were likely "cases" with mental health disorders from epidemiological data. However, this is not considered to be equivalent to a clinical diagnosis, as the overall distress and impairment resulting from symptoms was not measured, nor were symptoms evaluated by a clinician.

Inter-rater Reliability. To examine the validity of self-report data items, correlations between self- and teacher-reported SDQ data were calculated for the subscale used in this study (conduct problems), as well as for the mean inter-rater reliability coefficients across all SDQ scales. This was done for a subsample of HR participants at baseline for which the teacher data was collected (n = 785, 76.7%). These inter-rater reliability coefficients were then compared with findings from other studies that used the SDQ[29,30] and other self-report psychopathology measures in youth.[31]

Intervention

School-based interventions were conducted from January to April 2008. The interventions involved two 90-minute group sessions led by a trained facilitator and cofacilitator, with an average of 6 adolescents with personality-matched profiles according to the SURPS per group. The interventions were conducted using manuals based on a cognitive-behavioral therapy (CBT) model, incorporating psychoeducational and motivational enhancement therapy[32] components, and included real life "scenarios" shared by HR U.K. youth in specifically organized focus groups. All exercises discussed thoughts, emotions, and behaviors in a personality-specific way (e.g., identifying problematic coping behaviors, situational triggers, and cognitive distortions related to SS specifically). Participants were then encouraged to identify and to challenge personality-specific cognitive distortions (e.g., not thinking things through for IMP and negative, global, self-referent thinking for H) that lead to problematic behaviors. (More information regarding the content of the interventions is available in previous publications.[10-12,14,22])

Training and Supervision

School-based facilitators included teachers, school counsellors, and pastoral staff. All facilitators and cofacilitators attended a 3-day training workshop, followed by a minimum of 4 hours' supervision in running through a full, 2-session intervention with the clinical trainer (N.A.K) and groups of students not involved in the trial. In all, 41.7% of intervention sessions were supervised and rated by the clinical trainer (N.A.K.; 25.8%) and 4 independent raters (15.9%), to ensure an adequate standard of intervention quality and fidelity. Control schools did not deliver the personality-targeted interventions to youth to trial participants, and were trained at the end of the trial, as an incentive for participation.

Attrition

Follow-up rates are provided in Figure 1, and show significantly higher retention rates in intervention than control schools at 6 months ($\chi^2[1] = 39.7$, $p < .001$) and 2 years postbaseline ($\chi^2[1] = 6.9$, $p = .01$) in the HR sample, because of 1 control school being unable to organize systematic follow-up at 6 months and another at 2 years postbaseline. There were no differences in attrition between treatment conditions at 12- or 18-month follow-up.

Attrition over the 2-year trial was predicted by higher levels of baseline conduct problems ($p = .001$) and male gender ($p = .001$). However, there was no interaction effect with treatment condition for either of these variables on follow-up rates. Attrition was not predicted by ethnicity, socioeconomic status, personality, or baseline symptoms of depression or anxiety.

Missing data were replaced using full information maximum likelihood estimation in SPSS version 15 (SPSS Inc., Chicago, IL), which enabled the use of all available data. As data was Missing Not At Random (MNAR), missing data were computed separately according to intervention condition and personality risk status (high versus low), using demographic and outcome data from previous time points as covariates. This procedure was considered adequate, as the data estimation strategy was conceived according to the model for missingness, and attrition was not strongly associated with outcome measures. This procedure is determined to be valid when less than 25% of a dataset is missing, which was the case here.[33]

Data Analysis

Data analyses were conducted using linear and logistic generalized estimating equations (GEE) for continuous and categorical data, respectively, using an autoregressive correlation structure. Outcome analyses tested whether the symptoms that were reported differed between treatment groups over the 2-year period, using outcomes from 6, 12, 18, and 24 months. There were no time-specific hypotheses regarding outcomes at individual time points; rather, the main aim of the analyses was to investigate overall impact of the interventions across the full 2-year trial. All GEE analyses were conducted using IBM SPSS Statistics 20 (IBM Corp., Armonk, NY, USA), and significant levels were set at $p < 0.05$. Gender, ethnicity, and baseline symptom levels were used as covariates for all analyses. Significant results are reported as standardized regression coefficients and standard errors for continuous outcome variables, and the exponential of the regression coefficient for the dichotomous outcome variables (i.e., odds ratios with 95% CI).

Intracluster correlations (ICCs) indicated that 1% to 2% of the variance in outcomes in the full HR sample was explained by school, and 1% to 15% of the variance in personality-specific outcomes (e.g., depression in the H group). Average design effects ranged from 0.6 to 8. School clusters were therefore accounted for in all analyses and considered as the repeated measure in the generalized estimating equation models.

Because of the trial's primary focus on prevention of substance use, post-hoc analyses investigated whether intervention effects on the full HR sample or personality-specific groups were moderated by alcohol and illicit drug use at baseline or throughout the course of the trial.

RESULTS

Baseline Differences

Table 1 presents baseline sample demographics and symptoms for the LR and HR participants

TABLE 1 Baseline Characteristics for Low-Risk (LR) and High-Risk (HR) Samples

Variable	Low-Risk Total	High-Risk							Significant Contrasts ($p < .05$)
		Total	Intervention Group		Personality Group				
			Intervention	Control	H	AS	IMP	SS	
n	1,433	1,210	694	516	283	328	290	309	
Gender, % male	58.8	57.1	54.5	60.7	51.2	46.3	59.7	71.5	Int>Cont SS>IMP>H, AS
Ethnicity, % White (vs. other)	40.8	42.8	41.1	45.2	47.7	33.8	44.5	46.3	AS<IMP, H, SS
Depression symptoms	10.9	14.1	14.4	13.7	17.4	14.2	13.3	11.7	HR>LR H>AS>IMP>SS
Anxiety symptoms	7.2	9.3	9.4	9.0	10.9	9.9	8.7	7.7	HR>LR H>AS>IMP>SS
Conduct problems	2.5	3.6	3.6	3.7	3.6	3.0	4.6	3.4	HR>LR IMP>H,SS >AS
H score	11.9	13.8[a]	13.8	13.8	—	—	—	—	HR>LR
AS score	10.5	12.0[a]	12.0	12.0	—	—	—	—	HR>LR
IMP score	11.4	13.7[a]	13.7	13.7	—	—	—	—	HR>LR
SS score	15.2	17.2[a]	17.3	17.1	—	—	—	—	HR>LR
Multiple personality elevations (%)	—	29.3	28.7	30.2					

Note: AS = anxiety sensitivity; Cont = control group; H = hopelessness; IMP = impulsivity; Int = intervention group; SS = sensation seeking.
[a]*Levels of personality trait in high-risk participants did not differ between schools in the full sample or within treatment conditions.*

separately, as well as group contrasts. Baseline sample characteristics are also presented by treatment condition and personality group for the HR sample. Significantly greater depression ($t_{1325.16} = -11.58$, $p < .001$), anxiety ($t_{1315.161} = -10.45$, $p < .001$), and conduct problem symptoms ($t_{1733.73} = -12.9$, $p < .001$) were reported in the HR than the LR sample. Significant personality group differences were revealed for depression ($F_{3,1206} = 43.28$, $p < .001$), anxiety ($F_{3,1206} = 28.49$, $p < .001$), and conduct problem ($F_{3,1206} = 47.39$, $p < .001$) scores in theoretically consistent ways.

HR participants excluded from outcome analysis because of unreliable data (n=186) were found to have reduced depressive ($t_{1208} = -2.76$, $p = .01$) and anxiety ($t_{1208} = -2.52$, $p = .01$) symptoms, and increased conduct problem symptoms ($t_{1208} = -3.78$, $p < .001$) relative to the HR sample analysed (N = 1,024). There were no baseline differences in suicidal ideation or panic attack frequency in excluded participants. Excluded participants had lower levels of AS ($t_{1207} = 2.84$, $p < .01$) and higher levels of IMP ($t_{1207} = -2.26$, $p = .02$) and SS ($t_{1207} = -3.07$, $p < .01$), at baseline than HR participants included in the analyses. There were no differences in levels of H reported at baseline between the 2 groups.

Interrater Reliability

Self- and teacher-report data were significantly correlated for the conduct problems subscale of the SDQ (r = 0.29, $p < .001$), and correlation coefficients were comparable with other SDQ validation studies (r = 0.19[29] to 0.33[30]). Inter-rater correlations across all SDQ subscales in our sample (r = 0.19) were also comparable with those obtained from a meta-analysis of self- and teacher-reported correlations from other psychopathology symptom measures (r = 0.2)[31].

Intervention Effects

Table 2 presents intervention effects on internalizing and externalizing symptom severity and severe symptoms in the overall HR sample over the 2-year follow-up period.

Internalizing Symptoms

Depression. There was a significant effect of the intervention in reducing depressive symptoms ($p = .05$) and suicidal ideation ($p = .02$) over 2 years in HR intervention participants. Receiving an intervention was associated with 26% reduced odds of experiencing severe depression symptoms over 2 years ($p = .02$).

Anxiety. Intervention participants reported significantly fewer anxiety symptoms over 2 years ($p = .01$) relative to HR participants in control schools. There was no main effect of intervention on the frequency of panic attacks experienced. Receiving an intervention was associated with 21% reduced odds of experiencing severe anxiety symptoms over 2 years, but these reduced odds were nonsignificant ($p = .10$).

Externalizing Symptoms

Conduct Problems. HR participants in interventions schools reported fewer conduct symptoms over 2 years ($p = .001$). Receiving an intervention was associated with a 21% reduced likelihood of

TABLE 2 Intervention Effects on Internalizing and Externalizing Symptoms Over 2-Year Follow-Up (High Risk [HR] Sample, N=1,024)

		Main Effect of Intervention			
		Symptom Severity			
		Mean (SD)			Severe Symptom levels
Outcome	Symptom Description	Control	Intervention	β (SE)	OR (95% CI)
Internalizing symptoms[a]	Depression	13.15 (3.87)	12.71 (3.85)	0.09 (0.05)*	0.74 (0.58–0.96)*
	Suicidal ideation	0.34 (0.31)	0.31 (0.31)	0.09 (0.04)*	—
	Anxiety	8.60 (2.57)	8.22 (2.57)	0.12 (0.05)**	0.79 (0.59–1.05)
	Panic attacks	1.20 (0.35)	1.23 (0.36)	−0.04 (0.04)	—
Externalizing problems	Conduct problems	3.26 (1.17)	3.07 (1.16)	0.10 (0.03)***	0.79 (0.65–0.96)*

Note: β = standardized beta; OR = odds ratio.

[a]*Although analyses were carried out on log-transformed data, means (SDs) were provided for non–log-transformed variables for ease of interpretation.*

*p < .05, **p ≤ .01, ***p ≤ .001.

reporting severe conduct symptoms over 2 years ($p = .02$).

Personality-Specific Effects

Table 3 presents intervention effects on severe internalizing and externalizing symptoms according to personality-specific hypotheses.

Hopelessness. There was a 23% reduced odds of severe depression symptoms after the H intervention, but this reduction was nonsignificant. There was a 29% reduced odds of severe depressive symptoms after non-H interventions ($p = .03$).

Anxiety Sensitivity. The AS group reported 33% reduced odds of severe anxiety symptoms after the intervention (a nonsignificant trend, $p = .06$), as opposed to a 16% reduced odds of severe anxiety in non-AS group (nonsignificant).

Impulsivity. Intervention effects on severe conduct problem symptoms were stronger after the IMP intervention (36% reduced odds, $p = .04$) than non-IMP interventions (14% reduced odds, nonsignificant).

Effect of Substance Use on Outcomes

Post hoc analyses that included substance use outcomes as covariates indicated that all intervention effects are independent of participants' levels of substance use.

DISCUSSION

This study is the first to demonstrate that teacher-delivered, personality-targeted, brief, coping skills interventions can reduce the severity of internalizing and externalizing symptoms, as well as severe mental health symptoms, in HR youth over a 2-year period. Personality-targeted interventions target a range of psychopathological symptoms using a "risk-focused" preventive approach,[34] and 2 years is one of the longest effect durations reported for prevention programs.[35-37] These findings are of considerable practical significance, as, to the authors' knowledge, no other program to date has resulted in improvements on a broad range of mental health outcomes using an approach that has proven to be both effective and feasible. By training educational professionals to deliver interventions "in-house," schools are provided with a sustainable method to target HR youth before the onset of problem behaviors, and to provide them with ongoing support.

These results are also of considerable clinical significance, as intervention participants were had 21% to 26% reduced odds of reporting severe depression, anxiety, or conduct problem symptoms over the course of 2 years. These findings imply direct benefits of improved psychological well-being on adolescents' mental, social, and academic success.[38,39] In addition, because of the high levels of comorbidity between psychological problems and early-onset substance misuse, improvement in psychological well-being could decrease the risk of maladaptive substance use patterns through a reduction in the need to use alcohol or drugs to regulate one's emotions.[18] Although this hypothesis was not investigated in the current study, previous publications have shown that elevated levels of depression and anxiety predicted greater rates of increase in alcohol use in adolescence,[40] and that alcohol-related problem behaviors are mediated by drinking motives related to coping.[41]

Personality-specific hypotheses were confirmed for IMP-specific intervention effects, indicating that IMP interventions had a stronger impact on reduction in severe conduct problems in the subgroups most at risk for this particular behavioral problem. Support for AS-specific intervention effects was modest, with AS interventions resulting in a 33% reduced odds of in severe anxiety symptoms ($p = .06$, not significant), whereas non-AS interventions were associated with a 16% reduced odds of (not significant) severe AS symptoms. There was no support for H-specific intervention effects on severe depressive symptoms, although overlapping confidence intervals for the reported odds ratios suggest that effect sizes were similar after H and non-H intervention. Nevertheless, these effects on severe depressive symptoms are weaker than intervention effects on

TABLE 3 Intervention Effects on Severe Symptom Outcomes Over 2-Year Follow-Up: High-Risk (HR) Sample and Personality-Specific Effects

Presence of severe symptoms	Personality group	n	OR (95% CI)
Depression	H group	240	0.77 (0.46–1.29)
	Other HR groups	784	0.71 (0.52–0.97)*
Anxiety	AS groups	292	0.67 (0.45–1.02)
	Other HR groups	732	0.84 (0.64–1.09)
Conduct problems	IMP group	238	0.64 (0.41–0.99)*
	Other HR groups	786	0.86 (0.71–1.05)

Note: AS = anxiety sensitivity; H = hopelessness; IMP = impulsivity; OR = odds ratio.
*p < .05.

other severe symptom levels in other personality groups. This suggests that this brief intervention may be insufficient as a stand-alone intervention to target depressive symptomatology in a hopelessness-prone sample. Inclusion of a behavioral activation component may enhance effects,[42] as may the inclusion of interpersonal skills training.[43] Successful treatment approaches for individuals showing depressive symptoms at baseline are typically 8 to 15 weeks long,[43] suggesting that an increased intervention dose may be needed. Finally, as participants were selected based on personality risk traits for substance use, the H sample described may require more extensive intervention because of this comorbid risk. Individuals at heightened risk for depression are known to be less likely to respond to substance use interventions,[44] but post hoc analyses confirmed that the lack of treatment response was unrelated to participants' substance use in this trial. Nonetheless, given this program's demonstrated preventive effects on substance use outcomes in youth experiencing hopelessness,[10-12] and considering the lack of success of more extensive programs on comorbid depression and substance use effects,[44] this approach appears to be appropriate to identify youth with the greatest need for this targeted intervention. Any further investigations should possibly involve an extended version of this program with the aim of developing a dual-focused hopelessness and substance use intervention.[45] Similarly, although a previous personality-targeted intervention trial has shown a reduction in panic attack frequency in the AS group over 6 months,[22] these effects were not found over 2 years. This implies that booster sessions or more exposure exercises (as suggested by previous AS and panic interventions[46]) might further benefit AS youth. Intervention effects on severe depressive symptoms in the total HR sample suggests that the intervention contains generic components, such as emotion-focused coping strategies and problem-solving, that improve emotional wellbeing and problem behaviors across personality groups through a diffuse, rather than a personality-specific mechanism. This is supported by literature on brief interventions, which have shown effects on general, rather than specific, pathology.[32]

The strengths of this trial include its cluster-randomized design and analysis, the large and diverse sample, and the measurement of intervention effects over 2 years. Other strengths include the use of intent-to-treat analyses, and intervention delivery by educational professionals, which adds to the ecological validity and policy implications of the findings. Nevertheless, there were a number of weaknesses to the study. First, despite retention rates over the 2-year period being considered acceptable, there was differential attrition by treatment condition, reflecting the relative difficulty in sustaining control schools' dedication to the project. These differences were, however, accounted for in the estimation of missing data, and thus should not have affected data analysis. Second, the interpretation of self-report data in assessing clinical symptoms should always be considered with caution. Youth typically report higher internalizing and externalizing symptoms than other informants,[47] although it is unclear whether this can be considered as over-reporting, or simply a more accurate representation of subjective experiences. Other studies have found that adolescent self-report data have excellent discriminant[48] and predictive validity.[49] The current trial used a number of procedures to maximize the reliability of the self-report data collected, which, in addition to inter-rater correlations comparable to those in other self-report studies, contribute to establishing the reliability of the data. Participants excluded from analyses because of unreliable data were more likely to have externalizing personality profiles and symptoms at baseline; however, the exclusion of these participants was not thought to bias intervention results, as the prevalence of severe conduct symptoms across the 2-year follow-up period remained sizeable at 49%, and the intervention had a significant impact on these symptoms in the full HR sample as well as youth with high levels of impulsivity. Third, the alpha coefficient indices for the SURPS subscales used to identify HR participants were modest. However, together, both the alpha values (0.57–0.79) and the average inter-item correlations (0.19–0.35) were considered to be acceptable for short scales.[50,51] Fourth, participants excluded from analyses because of unreliable data at follow-up were more likely to have externalizing personality profiles and symptoms at baseline. However, as the strongest intervention effects on conduct symptoms and the prevalence of severe conduct symptoms across the 2-year follow-up period remained sizeable at 49%, the exclusion of these participants was not thought to bias intervention results. Finally, we did not systematically assess whether participants were exposed to substance use or mental illness prevention programs and components during the course of our trial;

however, to our knowledge, no other school-based programs took place to the same intensity as the current program.

In conclusion, these findings are a much-needed contribution to the prevention literature, given a considerable need for integrated, cost-effective, and sustainable programs that concurrently target mental health and substance use vulnerability in adolescents. This study demonstrates that brief, personality-targeted interventions delivered by educational professionals can have a sustained and clinically significant impact on a range of internalizing and externalizing symptoms in a high-risk sample in real-world conditions, as well as modest, personality-specific intervention effects, particularly on conduct symptoms in impulsive youth. &

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Bridging statement to Study 2

Comments on Study 1

Study 1 demonstrates that personality-targeted interventions have a clinically-significant impact on internalising and externalising symptoms in high-risk youth when delivered by educational professionals. Two 90-minute intervention session resulted in global reductions in depressive, anxiety and conduct symptoms in the full high-risk sample relative to their control group counterparts, as well as reduced odds of severe depressive symptoms and conduct problems over 2 years. There is also some evidence for personality-specific intervention effects in youth most at risk for anxiety and conduct disorders (*i.e.*, youth with high levels of anxiety sensitivity and impulsivity, respectively). This study reveals, however, that there is some variability in the strength of intervention effects across symptoms examined, both in the full high-risk sample and in those most at risk for a particular problem. Intervention effects on severe anxiety symptoms in the full high-risk sample were non-significant over 2 years, for instance. Results suggest that personality-targeted interventions result in treatment specificity on symptoms of conduct problems in youth most likely to report problematic externalising behaviours (*i.e.* youth with high levels of impulsivity). However, the Preventure program does not appear to have stronger effects on depressive symptoms in youth prone to hopelessness, suggesting that additional intervention is needed to impact on depressive symptoms in the most vulnerable youth. This suggests that the intervention may operate through both general and personality-specific mechanisms, perhaps relating to internalising and externalising symptoms, respectively. Personality-specific results may also have been more easily detectable for severe conduct problem in youth with high levels of impulsivity, as severe personality-specific problems were more frequent in this personality group: 51% of youth with high levels of impulsivity reported severe conduct problems at baseline, in contrast to 22% of youth with high levels of anxiety sensitivity youth reporting severe anxiety symptoms, and 34% of youth with high levels of hopelessness youth reporting severe depressive symptoms. Nevertheless, it would be of interest to examine whether adding an

additional intervention component to the existing brief intervention structure could strengthen the impact of personality-targeted interventions on internalising symptoms. Mental health symptoms in adolescence are associated with multiple indicators of poorer quality of life, including poorer educational outcomes, higher rates of self-injuries and suicide, and decreased physical health (Campion, Bhui, Bhugra, & European Psychiatric, 2012). The presence of internalising symptoms in adolescence (either alone or in combination with externalising symptoms) also confers an increased risk for the development of problematic substance use (Hussong et al., 2011; Pardini, White, & Stouthamer-Loeber, 2007; Pihl et al., 2014; Wittchen et al., 2007). Maximising the impact of preventive interventions thus has great potential to protect against multiple future harmful outcomes.

Attentional bias modification training: a potential adjunct to Preventure

During the past decade, there has been increasing interest in the development of attentional bias modification training paradigms to address biases in emotional processing that have been detected across mental disorders including depression, anxiety and externalising problems (D'Acremont & Van Der Linden, 2007; Mathews & MacLeod, 2005; Waters, Neumann, Henry, Craske, & Ornitz, 2008). Whilst preferential processing of emotional stimuli (*e.g.,* threat, sadness) is normative, attentional biases towards emotional stimuli are thought to be exaggerated in individuals experiencing symptoms of mental disorders (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007; Yiend, 2010). This is hypothesised to contribute to the maintenance of their distress (Beck & Haigh, 2014). Heavy alcohol users have also been shown to have selective attention (Field et al., 2007) or a tendency to preferentially approach alcohol-related cues (Wiers, Rinck, Dictus, & van den Wildenberg, 2009), which are associated with cognitive biases. Some studies suggest that cognitive biases in childhood may indicate prospective risk for later psychopathology (Lau, Belli, Gregory, & Eley, 2014), although the role of biases has been found to be moderated by a number of factors, including individuals' self-regulation capacity, mood, comorbid disorders and other

characteristics of the attentional bias measures used (Bistricky, Ingram, & Atchley, 2011; Salemink & Wiers, 2012). The evidence regarding the role of attentional biases in emotional processing and risk for mental disorders is also less well established in children and adolescents than in adults (Waters et al., 2008).

The efficacy of attentional and cognitive bias modification training remains subject to debate (Emmelkamp, 2012), but some studies have demonstrated promising effects across a range of mental disorders in adult samples (Beard, Sawyer, & Hofmann, 2012; Macleod, 2012), including on anxiety (Clarke, Notebaert, & MacLeod, 2014) and addiction-related outcomes (Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013). Attentional bias modification have also been shown to be a promising adjunct to existing treatments for post-traumatic stress disorder (Kuckertz et al., 2014) and depression (Williams, Blackwell, Mackenzie, Holmes, & Andrews, 2013). Some studies have demonstrated short-term effects of attentional bias modification training in adolescents in decreasing negative affect (Lau, Molyneaux, Telman, & Belli, 2011; Lothmann, Holmes, Chan, & Lau, 2011), improving stress appraisal (Telman, Holmes, & Lau, 2013) and reducing anxiety (Bar-Haim, Morag, & Glickman, 2011; Lau, Belli, & Chopra, 2013), suggesting that this approach is worthy of further study.

Introduction to Study 2

The framework for Study 2 involves examining the suitability of attentional bias modification training as a potential adjunct to the Preventure personality-targeted intervention program. As a first step, this study will examine whether attentional biases towards emotional stimuli can predict the presence of symptoms of mental disorders over 2 years in adolescence using data from the IMAGEN study, a multi-site European study (Schumann et al., 2010). This analysis will reveal whether attentional biases can be used as an indicator of prospective risk for mental disorders in adolescence, and thus whether they may be a suitable target for preventive interventions. The study will also examine whether the personality risk profiles for substance misuse and associated psychopathology that are targeted in Preventure using the Substance Use Risk Profile

Scale (hopelessness, anxiety sensitivity, sensation seeking and impulsivity; (Castellanos-Ryan et al., 2013) overlap with attentional biases to emotional stimuli, and whether emotional biases may mediate the relationship between personality risk factors and symptoms of mental disorders.

Study 2

Personality, attentional biases towards emotional faces and symptoms of mental disorders in an adolescent sample.

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RESEARCH ARTICLE

Personality, Attentional Biases towards Emotional Faces and Symptoms of Mental Disorders in an Adolescent Sample

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Abstract

Objective

To investigate the role of personality factors and attentional biases towards emotional faces, in establishing concurrent and prospective risk for mental disorder diagnosis in adolescence.

Method

Data were obtained as part of the IMAGEN study, conducted across 8 European sites, with a community sample of 2257 adolescents. At 14 years, participants completed an emotional

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variant of the dot-probe task, as well two personality measures, namely the Substance Use Risk Profile Scale and the revised NEO Personality Inventory. At 14 and 16 years, participants and their parents were interviewed to determine symptoms of mental disorders.

Results

Personality traits were general and specific risk indicators for mental disorders at 14 years. Increased specificity was obtained when investigating the likelihood of mental disorders over a 2-year period, with the Substance Use Risk Profile Scale showing incremental validity over the NEO Personality Inventory. Attentional biases to emotional faces did not characterise or predict mental disorders examined in the current sample.

Discussion

Personality traits can indicate concurrent and prospective risk for mental disorders in a community youth sample, and identify at-risk youth beyond the impact of baseline symptoms. This study does not support the hypothesis that attentional biases mediate the relationship between personality and psychopathology in a community sample. Task and sample characteristics that contribute to differing results among studies are discussed.

Introduction

Personality factors are consistently associated with psychopathology [1, 2] and measures of temperament in early childhood such as inhibition and impulsivity are found to predict psychopathology in adulthood [3, 4]. The nature of this relationship is, however, unclear. Cognitive vulnerability theories [5] posit that biases in attention (as well as memory and interpretation) contribute to the cause and maintenance of psychopathology. Personality is thought to impact the nature of an individual's beliefs and attentional biases [6, 7]. For instance, anxious individuals can overestimate the likelihood of risk and danger and can be hypervigilant to indications of threat. They may adopt safety seeking behaviours such as avoidance as a response to their threat bias, which may in turn maintain the experience of anxiety or escalate into an anxiety disorder [6, 7]. A model of "personality neuroscience" [8] provides an opportunity to integrate trait views of personality with processing of cognitive or affective information, and suggests that information processing styles may mediate the relationship between personality and behaviour. Indeed, personality traits such as anxiety and aggressivity have been shown to influence neural responses to facial emotion processing in adults [9].

Understanding individuals' sub-conscious processing styles and, in particular, biases in information processing, could help to elucidate their tendency to experience recurrent aversive emotional states. Attentional biases towards both positive and negative emotional cues are adaptive features of normal information processing that allow individuals to preferentially attend to emotionally-relevant stimuli. However, pronounced biases in emotional processing are also commonly seen across mental disorders such as depression, anxiety and externalising problems [10–12], with some suggesting that maladaptive functioning can be characterised as an exaggeration of normative [6, 13]. The evidence is, however, less well established within the developmental literature [12].

The emotional dot probe task is one of the most commonly used paradigms for assessing attentional biases to emotional stimuli [14], and involves the presentation of two words or

pictures on a computer screen for a short interval of time, following which participants indicate the location of a dot. The task measures the time taken to respond to the appearance to the dot in the place of emotional (*i.e*. threatening) versus neutral stimuli. Difficulty in disengaging from threatening stimuli has been demonstrated in paediatric and adult anxious clinical and non-clinical populations through a meta-analysis of 172 studies [15]; in other words, anxious participants took longer to disengage from threatening stimuli than controls. Adults with depressive symptoms have been shown to demonstrate an attentional bias towards negative stimuli such as sad faces across 29 studies [16, 17]. With regards to the externalising spectrum, aggressive children and youth have been shown to pay more attention to aggressive than cooperative interactions [18] and impulsivity in 13–17 year-old youth has been associated with greater attentional biases towards angry relative to happy faces [10].

Whilst many studies support the commonly cited finding that anxious individuals have an attentional bias towards threatening stimuli [15], some do not support this association, which suggests that there are several important factors that may moderate this relationship. Firstly, findings in the childhood literature are less consistent than in studies on adults [14], suggesting that findings from the adult literature cannot necessarily be generalised to children. One reason for this may be limited attentional capacities, particularly in young children [19]. The task used to measure attentional bias is equally important. In the case of the dot probe task, some relevant factors are stimulus content and timing. Studies that uses words as target stimuli have reported a threat bias in anxious youth [20–23], whereas several studies that use picture stimuli such as faces did not [24, 25]. Conversely, a meta-analysis reported that results did not differ based on the use of word versus picture stimuli for the detection of a threat bias in anxious individuals [15]. The duration of stimulus exposure also impacts on the results obtained, as an attentional bias to threat is consistently detected at 500ms exposure [26], whereas attentional biases to depression are detected at longer exposures such as 1000ms [16]. The duration of stimulus exposure in the dot probe task associated with externalising problems or anger/hostility biases is, as yet, unclear [27]. The conditions during testing, and the mood of participants can also impact results, as some studies have noted that high state anxiety must be present in order to detect a threat bias in the dot-probe task in high trait-anxious children [28, 29]. Many studies also pre-select participants with high levels of the characteristics of interest (*e.g*. anxiety, depression, aggressivity), either in clinical or non-clinical ranges [15].

The role of attentional biases in healthy, community samples of youth has been examined less often than in clinical samples. Community samples allow us to evaluate the potential role of attentional biases in indicating prospective risk for the development of mental disorders, which could indicate a potential avenue for intervention for the onset of significant problems. Several authors have suggested that attentional biases, and the resulting impact on cognition, may partially mediate the relationship between temperament and mental disorders [30, 31]. The current study uses two personality measures to investigate this hypothesis in a youth community sample. The revised NEO Personality Inventory [32] assesses broad dimensions of personality, namely neuroticism, agreeableness, extraversion, openness and conscientiousness. Whilst they are not constructed as measures of psychopathology, some NEO traits are associated with mental health symptoms. Neuroticism, or the tendency to experience negative emotions, is considered by many to reflect the core of internalising problems, as well to be most important factor in behavioural public health, with its economic costs exceeding those associated with other psychiatric disorders [33]. A meta-analysis on the association between NEO personality traits and specific depressive, anxiety and substance use disorders revealed that all diagnostic groups were high on neuroticism and low on conscientiousness, and many disorders showed low extraversion [34]. Openness and agreeableness was largely unrelated to the analysed diagnoses. The Substance Use Risk Profile Scale (SURPS), on the other hand, was

designed to and validated in the measurement of personality risk factors for the development of substance use and non-addictive psychopathology in youth and adults [35–37]. Namely, the internalising traits of hopelessness and anxiety sensitivity are risk factors for depressive and anxiety disorders, respectively [37, 38]. High levels of impulsivity, on the other hand, are associated with disinhibition over a range of behaviours, including antisocial tendencies [39] and Attention-Deficit/Hyperactivity Disorder [40]. Lastly, sensation seeking is associated with risk-taking behaviours for enhancement purposes, rather than with any particular form of psychopathology. A recent article has shown that using these four personality subscales on the SURPS can identify a high number of those who will develop substance use or mental health problems over 18 months, with sensitivity scores ranging from 72–91% [35]. Each scale is differentially related to specific mental health problems, and good specificity was obtained when examining the association between each personality scale and problematic outcomes. 70–80% of 14-year olds identified as high-risk by the impulsivity scale developed conduct or drug use problems within the next 18 months, and odds of developing severe depressive symptoms (for individuals prone to hopelessness) or emotional problems (for youth with high levels of anxiety sensitivity) over 18-months were 3–3.5 times greater than in youth without these high-risk profiles. One important practical advantage of the SURPS relative to the NEO is the length of the measure (23 versus 240 items), and therefore the ease of completion and potential for use as a systematic screening tool.

The current paper will present data from the IMAGEN study [41], the first multicentre study allowing an in-depth evaluation of risk phenotypes for mental disorders in adolescence using neuropsychological, self- and parent-report data on adolescents (as well as genetic and neuroimaging data, which will not be presented here). This detailed assessment in a large sample (N = 2257) distinguishes this sample from many others, and the longitudinal design allows an examination of prospective risk factors in a community sample. Specifically, this paper will explore whether attentional biases to emotional faces can identify youth at risk for mental disorders, and whether attentional biases to emotional faces overlap with known personality risk factors for psychopathology, and mediate the relationship between personality and psychopathology. The study also provides the opportunity to examine incremental validity of a measure of personality risk for psychopathology (the SURPS) relative to measures of normal variation in personality (the revised NEO).

Materials and Methods

Participants and procedure

Data from this project were obtained as part of the IMAGEN study, a multi-national research project coordinated by the Institute of Psychiatry, King's College London. IMAGEN was conducted in 8 European sites across the United Kingdom, Ireland, France and Germany. 2257 14-year old adolescents and their parents were recruited from schools and using an internet recruitment site (www.imagen-info.com). Geographical areas were selected to maximise ethnic homogeneity, due to the genetic component of the IMAGEN study (not reported here). However, both private and state-funded schools were targeted in order to obtain a diverse sample of socioeconomic status, emotional and cognitive development. Written parental and child consent were required from all participants, following which adolescents were invited to complete a home-based assessment, and both adolescents and parents were invited to come to the local research centre for testing. The recruitment procedure and study protocol was approved by the KCL (King's College London) College Research Ethics Committee CREC/06/07-71. The data presented focus on three tasks from a larger assessment battery. 1602 participants were re-assessed at 16 years of age through a home-based assessment.

Measures

Psytools software (Delosis Ltd, London, UK) was used to assess participants' personality, symptoms of mental disorders and emotional biases via its internet-based platform. Whilst personality and emotional biases were measured as part of a home assessment package, symptoms of mental disorders were assessed at the research facilities.

Personality

Revised NEO Personality Inventory (NEO-PI-R). The NEO-PI-R [32] is a 240-item questionnaire that assesses the "Big Five" dimensions of personality, namely Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness [42]. The NEOPI-R is validated as a method of assessing broad dimensions of personality in adolescence [43, 44]. Whilst it is not a measure of psychopathology, some NEO traits are related to mental health symptoms. A meta-analysis on the association between NEO personality traits and specific depressive, anxiety and substance use disorders revealed that all diagnostic groups were high on neuroticism and low on conscientiousness, and many disorders were associated with low extraversion [34]. Openness and agreeableness were largely unrelated to the analysed diagnoses.

Substance Use Risk Profile Scale (SURPS). The SURPS [37] is a 23-item questionnaire assessing variation in personality risk for substance abuse and non-substance related pathology along 4 dimensions: sensation seeking, impulsivity, anxiety sensitivity and hopelessness. This scale has good concurrent, predictive and incremental validity (relative to other personality measures) with regards to differentiating individuals prone to reinforcement-specific patterns of substance-use, and is concurrently and prospectively associated with substance misuse and non-substance-related externalising behaviours and internalising symptoms [35–37]. The scale was translated, piloted and validated at the French and German sites before use.

Development and Well-Being Assessment (DAWBA)

The DAWBA is a computer-based package of questionnaires, interviews, and rating techniques designed to generate DSM-IV-TR (and ICD-10) psychiatric diagnoses for 5–16-year-olds. The DAWBA has been validated in community and clinical samples, and diagnoses were consistent with those reported in patients' case files [45]. The DAWBA has been validated in German [46], and the French version was developed for IMAGEN in cooperation with the author Robert Goodman. Both the child and parent were asked to respond, separately, to questions regarding the child's psychiatric symptoms, under the supervision of a research assistant. These different types of information were brought together by a computer program which predicted the likelihood of diagnosis from 0 (<0.1%) to 5 (>70%). These likelihood scores were used as an indication of symptom severity. Due to the low prevalence rates of each of these disorders in this community sample, only those disorders which had at least 3% of the sample reporting at least a 15% likelihood of diagnosis at baseline were used for these analyses, namely Generalised Anxiety Disorder (GAD; 6.6%), Major Depressive Disorder (MDD; 3.7%), Attention-Deficit/Hyperactivity Disorder (ADHD; 6.0%), Oppositional Defiant Disorder (ODD; 5.8%) and Conduct Disorder (CD; 8.2%). DAWBA scores were reassessed 2 years post-baseline using a web-based assessment, completed by both children and parents from home.

Emotional dot-probe task

This task is a variant of MacLeod, Mathews & Tata's [47] widely used dot-probe task, and assesses attentional bias for emotional stimuli. Happy, angry and fearful facial expressions were used as emotional variants. 20 adult, greyscale IDs were selected from the MacBrain NimStim

Face Stimulus Set (12 European-America, 8 African-American), and neutral faces of the same ID were used as matching stimuli. Participants were asked to respond indicating which side the probe was on using a computer keyboard. Trials were congruent (probe appeared behind the emotional face) or incongruent (probe appearing behind the neutral face). Each ID appeared once in each emotion in both types of trial (20x3x2 = 120 trials). The probe position (left vs right) was counter-balanced over the whole task and within each emotion condition. Although there is some debate as to whether words or picture stimuli are more sensitive measures of attentional biases, a meta-analysis of 172 studies reported that threat biases in anxious individual were equally consistent when measured with words or picture stimuli [15]. Face stimuli were displayed for 1000ms, following which the screen was cleared and participants' reaction times were measured. The emotional faces were presented head-on, although given that this data was completed as part of a home assessment, it was not possible to control for the participants' positioning relative to the computer during the task. Three attentional bias scores (anger, fear, happiness) were computed by subtracting the mean reaction times to congruent from incongruent probes for each emotion, with a positive bias indicating a greater reaction time latency to the emotional face. A fourth, general attentional bias score was calculated by obtaining the mean attentional bias across the three other emotions- in other words, this variable reflected the level of bias towards emotional stimuli, irrespective of valence (angry, fearful or happy). This study chose a 1000ms stimulus exposure in order to be more sensitive to depression-related [16], as less is known about this topic than threat-related biases in anxiety, which have more often been reported and are more reliably detected at 500ms exposure [26]. The optimal stimulus exposure to detect biases towards emotional faces associated with anger/hostility or externalising problems is, as yet, unknown [27], thus this did not impact the selection of the stimulus exposure.

Data validation and exclusion criteria

A number of validation checks were completed during the home assessment, *i.e.* asking participants whether they were in a hurry, distracted or being watched by others. If participants responded positively to these validation checks, or if their responses were doubtful (*e.g.* with mean reaction times <100ms or if all responses were the same), their data was considered unreliable. These stringent reliability procedures were considered necessary for data completed as part of the home assessment as the research team sought to ensure that all data analysed was collected under similar conditions. Based on these validation checks, data for 191 participants (8.5%) were flagged as being unreliable based on their response to the SURPS, and 54 (2.39%) were flagged as being unreliable based on their responses to the dot probe task according to these criteria. In addition, participants whose mean reaction times were shorter than 200ms or longer than 2000ms on the dot probe task were also removed from the data, following recommendations by Koster, Crombez, Verschuere & De Houser [48]- this was the case for 69 participants (3.0%). The adjusted sample size was 1997 youth at baseline, and 1497 youth at follow-up. Being flagged for unreliable data at baseline was not predicted by any individual-level variables (*e.g.* gender, personality, attentional biases or mental health symptoms), however unreliable data differed significantly across recruitment sites ($p<.001$), with French sites having the smallest percentage of unreliable data (8.8%), followed by German sites (9.2%), then English-speaking sites (10.1%).

Data analysis

Data were analysed using IBM SPSS Statistics version 21 (IBM corp, Armonk, NY) and STATA SE 13.1 (StataCorp, College Station, TX). The associations between personality trait

levels, attentional biases and the likelihood of diagnosis of mental disorders at 14 years were examined using Pearson's correlation analyses with Bonferroni adjustments for multiple comparisons. Separate hierarchical linear regressions were conducted in STATA to examine the prospective relationship between personality trait levels and attentional biases at 14 years with the risk for mental health symptoms at 16 years (*i.e.* GAD, MDD, ADHD, ODD, CD). Regression analyses accounted for recruitment sites as a cluster variable, and non-independence observations were adjusted for using tests based on the Huber-White sandwich estimate of variance [49]. This method provides standard errors that are robust for within-cluster (within-site) correlation. Gender and baseline mental health symptoms were used as covariates in the analyses. Linear regressions were then repeated without including NEO personality factors, in order to examine the incremental validity of the SURPS measure. Lastly, regression analyses were repeated without NEO or SURPS personality variables in order to investigate the capacity of attentional biases towards emotional faces to predict symptom severity without accounting for personality.

Results

Attrition

Attrition at follow-up was not predicted by gender, mental health symptoms or emotional biases. However, rates of follow-up differed significantly across recruitment sites ($p<.001$), with the highest follow-up rates in the English-speaking sites (81.2%), followed by the German sites (70%), then the French sites (51.9%). Participants with higher levels of impulsivity ($p = .01$), higher levels of sensation-seeking ($p = .02$), lower levels of openness ($p = .003$) and a higher likelihood of CD diagnosis ($p = .01$) were less likely to complete the follow up assessment. Other personality variables and mental health symptoms did not impact on the likelihood of participant attrition. Regression analyses were performed accounting for effects of gender, baseline mental health symptoms, personality and attentional biases. In order to account for baseline differences between recruitment sites, regression analyses in STATA accounted for recruitment sites as a cluster variable.

Please see Table 1 for reaction time data for the dot probe task according to emotional valence and trial type.

Table 1. Dot probe task reaction times by emotional stimulus and trial type at 14 years.

Emotional face	Trial type*	Reaction time in milliseconds
		Mean (standard deviation)
Anger	Congruent	463.90 (109.20)
	Incongruent	466.29 (114.84)
Fear	Congruent	467.00 (110.90)
	Incongruent	465.35 (113.09)
Happiness	Congruent	465.83 (112.57)
	Incongruent	464.92 (114.91)
General	Congruent	465.19 (100.74)
	Incongruent	464.84 (103.36)

*In congruent trials, the probe appeared behind the emotional face. In incongruent trials the probe appearing behind the neutral face.

Table 2. Pearson's *r* correlation values between emotional biases, personality traits and mental health symptoms at 14 years.

		Emotional bias				SURPS traits				NEO-FFI traits				
		Anger	Fear	Happy	General	H	AS	IMP	SS	Neur	Ext	Open	Agree	Cons
DAWBA	**GAD**	-.02	-.01	-.02	-.03	.24*	.19*	.11**	-.08*	.39*	-.17*	.05	-.14*	-.07*
	MDD	.03	-.04	.004	-.01	.25*	.08*	.18**	.004	.33*	-.11*	.03	-.20*	-.08*
	ADHD	.02	.05	.02	.04	.14*	-.03	.23*	.05	.08*	-.003	-.04	-.19*	-.26*
	ODD	.01	.04	.04	.05	.11*	-.02	.17*	.01	.10*	-.07	-.06	-.18*	-.17*
	CD	.01	.01	.04	.03	.10*	.002	.23*	.05	.06	.03	-.08*	-.26*	-.20*
SURPS	**H**	.02	.01	.01	.01	-	-	-	-	.49*	-.38*	-.07*	-.29*	-.38*
	AS	-.02	.02	-.03	-.02	-	-	-	-	.35*	-.07	.07*	-.01	.04
	IMP	.02	.02	.01	.02	-	-	-	-	.28*	.11*	-.11*	.43*	-.35*
	SS	-.002	.01	-.02	-.01	-	-	-	-	-.09*	.19*	.17*	-.06	-.04
Emotional bias	**Anger**	-	-	-	-	-	-	-	-	.01	-.03	-.01	-.02	-.04
	Fear	-	-	-	-	-	-	-	-	-.02	-.003	.01	-.03	-.04
	Happy	-	-	-	-	-	-	-	-	-.02	-.01	.004	-.02	-.02
	General	-	-	-	-	-	-	-	-	-.02	-.02	.01	-.04	-.05

Note. *p<.0004 (significance level adjusted for multiple comparisons using the Bonferroni test)

DAWBA = Development and Well-Being Assessment, GAD = Generalised Anxiety Disorder; MDD = Major Depressive Disorder; ADHD = Attention-Deficit/Hyperactivity Disorder, ODD = Oppositional Defiant Disorder; CD = Conduct Disorder, SURPS = Substance Use and Risk Profile Scale, H = Hopelessness, AS = Anxiety-Sensitivity; IMP = Impulsivity, SS = Sensation-Seeking, NEO-FFI = NEO Five-Factor Inventory; Neur = Neuroticism, Extr = Extraversion, Open = Openness, Agree = Agreeableness, Cons = Conscientiousness

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Association between personality, attentional bias to emotional faces and symptoms of mental disorders

Correlation analyses were conducted using Bonferroni-adjusted alpha levels of .0004 per test (.05/121). Impulsivity and hopelessness were positively correlated with risk for all mental health diagnoses at 14 years, and agreeableness and conscientiousness were negatively correlated with the risk for diagnoses (p<.004). Anxiety-sensitivity was associated with risk for internalising disorders (GAD and MDD), and neuroticism were associated with risk for all disorders except CD (p<.004). Sensation-seeking and extraversion were negatively associated with the risk of GAD diagnosis, and extraversion was also negatively correlated with the risk for MDD diagnosis (p<.004). Openness was negatively associated with the risk for CD diagnosis at 14 years. Neither personality traits nor mental health symptoms at 14 years were correlated with attentional biases. Please see Table 2 for further details. The current data did not fulfill the necessary conditions to test whether emotion processing mediate the effects of personality on mental disorders [50] as, although the independent variable (in this case, personality) was related to the dependent variable (psychopathology), the mediator (attentional bias) was related to neither the dependent nor independent variables. Therefore, mediation analyses were not conducted.

Predictors of mental disorders at 16 years

Hopelessness (p = .002), neuroticism (p<.001), openness (p = .003) and conscientiousness (p = .007) positively predicted the likelihood of GAD diagnosis at 16 years, over and above baseline symptom levels. Neuroticism predicted an increased likelihood of MDD diagnosis at 16 years (p = .04). Extraversion predicted an increased likelihood of ADHD diagnosis (p = .03). SURPS traits did not predict MDD or ADHD when controlling for baseline symptom levels and NEO

Table 3. Hierarchical linear regressions predicting symptom severity at 16 years, accounting for site as cluster.

Baseline covariates (14 years)	Symptom severity at 16 years. β (SE)				
	GAD	MDD	ADHD	ODD	CD
Gender	.47(.02)***	.38(.04)***	-.20(.06)*	.01(.07)	-.03(.06)
GAD	.34(.05)***	.12(.03)**	-.03(.02)	.001(.03)	-.02(.03)
MDD	.12(.04)	.23(.03)***	.08(.04)	.04(.03)	.06(.02)*
ADHD	.07(.02)*	.07(.04)	.52(.04)***	.14(.04)**	.08(.03)*
ODD	.003(.04)	-.03(.04)	.04(.04)	.29(.04)***	.09(.02)**
CD	-.02(.03)	.07(.04)	.09(.05)	.12(.03)**	.34(.04)***
H	.10(.02)**	.06(.06)	.05(.04)	.02(.03)	.11(.04)*
AS	.04(.01)	-.02(.02)	.003(.03)	-.05(.02)	-.01(.02)
IMP	.04(.04)	.05(.03)	.004(.03)	.05(.02)*	.09(.03)*
SS	-.02(.02)	-.01(.02)	-.03(.04)	-.02(.03)	-.003(.04)
Neur	.14(.02)***	.08(.03)*	-.01(.02)	.03(.03)	-.01(.03)
Extr	.03(.02)	.004(.02)	.07(.02)*	.01(.02)	.06(.03)
Open	.08(.02)**	.05(.03)	.01(.03)	.03(.02)	.03(.03)
Agree	-.04(.02)	-.07(.03)	-.03(.03)	-.11(.03)**	-.05(.03)
Cons	.10(.03)**	-.02(.03)	-.05(.03)	.04(.03)	.02(.02)
Anger bias†	-.06(.04)	-.02(.05)	-.03(.05)	.04(.03)	-.06(.06)
Fear bias†	.02(.05)	-.10(.06)	.12(.06)	.04(.06)	.02(.06)
Happy bias†	.04(.08)	-.11(.06)	-.08(.09)	.03(.13)	.002(.08)
General emotional bias†	0	0	0	0	0

Note. β = Standardised beta; SE = Standard Error

***$p \leq .001$

**$p \leq .01$

*$p < .05$

GAD = Generalised Anxiety Disorder; MDD = Major Depressive Disorder; ADHD = Attention-Deficit/Hyperactivity Disorder, ODD = Oppositional Defiant Disorder; CD = Conduct Disorder, H = Hopelessness, AS = Anxiety-Sensitivity; IMP = Impulsivity, SS = Sensation-Seeking, Neur = Neuroticism, Extr = Extraversion, Open = Openness, Agree = Agreeableness, Cons = Conscientiousness

† Results remained unchanged when personality was removed from the model.

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traits. Impulsivity predicted an increased likelihood of ODD diagnosis at 16 years ($p = .04$), and agreeableness at 14 years old was negatively associated with ODD at 16 years ($p = .01$). Impulsivity ($p = .02$) and hopelessness ($p = .02$) at 14 years predicted an increased likelihood of CD diagnosis at 16 years, but NEO traits did not. When NEO personality factors were removed from the regression model, impulsivity at 14 years predicted MDD diagnosis at 16 years (β = .09, S.E. = .02, $p = .002$), and anxiety sensitivity at 14 years predicted GAD diagnosis at 16 years (β = .08, S.E. = .01, $p < .001$). No other results changed. Attentional biases towards emotional faces at 14 years did not predict mental disorder diagnosis at 16 years for any of the symptoms examined. Results remained unchanged when personality variables were removed from the regression models. Please see Table 3 for details.

Discussion

The aim of this paper was to investigate the role of personality factors and attentional biases towards emotional faces in the risk for mental disorder diagnosis in adolescence, both concurrently and over two years, and to evaluate whether attentional biases towards emotional faces can be used to identify youth at risk for mental disorders in a community youth sample that

has not been pre-selected for high levels of traits or symptoms of interest (*e.g.* anxiety, depression, externalising problems). Attentional biases towards emotional faces at 14 years did not concurrently or prospectively predict the likelihood of being diagnosed with GAD, MDD, ADHD or CD, suggesting that attentional biases as measured by the dot probe task in the current study do not reliably identify early risk for developing mental disorders in community youth. These results held true when considering attentional biases towards particular emotional faces (angry, happy, fearful) as well as a general attentional bias towards emotions, irrespective of valence. Attentional biases also did not mediate the relationship between personality factors and mental health symptoms. This suggests that, in a healthy community sample, early symptoms of mental disorders are more reliably detected using personality measures than attentional biases to emotional faces. Dysregulation in attentional biases towards emotions may, instead, be present in individuals with a current psychiatric disorder or adults with high levels of certain symptoms (*e.g.* anxiety; [15]).

These null findings contrast with some previous research [15, 17], but are supported by others [24, 25]. Stimulus latency is known to impact on the detection of attentional biases, and our stimulus exposure duration of 1000ms may have been too long to detect an attentional bias to threat (which was expected in youth high in anxiety sensitivity, for instance)- threat biases are more consistently detected at 500ms [26]. However, a 1000ms duration was optimised in order to detect of potential attentional biases in depression-prone youth, following Gotlib and colleagues [16]. Thus, the fact that attentional biases were not associated with personality traits related to depression (*e.g.* hopelessness, neuroticism), or the likelihood of MDD diagnosis suggests that attentional biases cannot be used to indicate risk for depression. The optimal duration of stimulus exposure to identify attentional biases associated with impulsivity or externalising problems using the dot-probe task has not been established thus far, to the authors' knowledge. The results of this study suggest that attentional biases measured using a 1000ms exposure cannot be used to identify risk factors for externalising problems. One possible explanation for the null findings could be that our outcome measure of mental disorder symptoms was not sensitive enough. However, the fact that personality measures were predictive of outcome suggests that the DAWBA was sufficiently sensitive and specific. The findings from this study supported the concurrent and prospective predictive validity of personality traits in indicating risk for mental disorders. There was some cross-sectional specificity between personality traits and mental health symptoms at 14 years (*i.e.* extraversion was negatively associated with GAD and MDD, but not associated with ADHD, ODD or CD), but hopelessness, impulsivity, neuroticism, low agreeableness and low conscientiousness emerged as relatively general indicators of risk for externalising and internalising problems. However, greater specificity emerged over time, with neuroticism at 14 years being the only personality trait to predict an increased likelihood of MDD diagnosis at 16 years, and impulsivity and low agreeableness at 14 years predicting ODD diagnosis at 16 years. These results are fairly consistent with other studies [34, 35]. SURPS traits showed incremental validity over the NEO in predicting the likelihood of GAD, ODD and CD diagnosis at 16 years, but not MDD or ADHD diagnoses. This highlights the value of the SURPS as a short and easy-to-administrate measure in predicting the risk for mental disorders over and above more cumbersome questionnaires such as the NEO [37].

There are several limitations of the current study. Firstly, due to the 1000ms duration of stimulus presentation during the dot probe task, it is not possible to conclude whether the absence of threat-related biases is a feature of the sample or the measure. It would thus be recommended to repeat the dot probe task in a community sample with a 500ms exposure duration. Similarly, it would be informative to measure attentional biases towards anger and hostility using a 500ms exposure to assess whether a shorter stimulus exposure could reveal associations with risk for externalising problems. However, the absence depression-related biases can be

attributed to the sample, as other studies have detected biases at a 1000ms duration. Future studies should consider using a range of timings (*e.g.* 500ms, 1000ms, 1500ms) to disentangle questions of the appropriate time frame to measure attentional biases towards particular emotions. For instance, some studies have noted that a longer response time results in avoidance of threatening stimuli in anxiety-prone individuals, whereas a bias towards threat is typically found at shorter (*e.g.* 500ms) stimuli durations [48, 51]. A recent study has suggested that emotional attention is context and time dependent, and assessing the time-varying nature of attentional biases can predict symptoms of mental disorders more reliably than the traditional bias score as currently measured [52]. In a related comment, some studies have noted that attentional biases are more likely to be expressed in situations where individuals are emotionally aroused (*e.g.* stressed), suggesting that attentional biases influence mood through their interaction with the environment [53]. Indeed, it is increasingly acknowledged that cognitive processes such as attention, memory and interpretation are related to one another and to emotion regulation [54], and that attentional biases should be considered in relation to other cognitive processes [55]. Whilst this was beyond the scope of the current study, an investigation of the interactions between attentional biases, memory, interpretation and mood, as well as the time-varying nature of attentional biases in relation to personality and psychopathology would be worthy of future study. A second limitation is that the dot-probe task used here employs adult grey scale faces and thus may not adequately reflect the social context of youth. Thirdly, using DAWBA computer-rated likelihood scores as a proxy for symptom severity is not equivalent to having symptoms rated by clinicians, however this computer-rated approach has been validated as an adequate manner to evaluate symptom severity [46]. A comparison of clinician and computer ratings in a subsample of 343 youth also showed that ratings were significant correlated ($p<.001$) with Pearson's *r*s in the moderate range [0.35 (GAD)- 0.6 (ODD)]. Fourth, there were differences between recruitment sites in terms of attrition and the likelihood of being flagged for unreliable data. This likely reflects site-specific protocols, and these differences were taken into account in the analyses by conducting cluster based regressions accounting for site. Lastly, the correlations between DAWBA diagnoses and SURPS scores, though significant, are small. The fact that the sample in question was healthy is a strength and a limitation of the study in that there was relatively little mental illness to predict. However, the sample characteristics allowed us to investigate the role of personality and attentional biases towards emotional faces on the risk of mental health diagnosis in a community sample. Other strengths of this study include the detailed data collection across multiple modalities (*e.g.* here, self-report, parent-report and computer tasks) with a large sample across multiple European sites, comprehensive assessment of personality using two well-validated measures, computer and clinician-validated assessment of mental disorder symptoms from both the child and parent's perspectives, as well as the longitudinal design providing an opportunity to examine prospective risk factors for mental disorders.

In conclusion, these findings suggest that the traditional measure of attentional biases towards emotional faces using the dot-probe task does not reliably predict the risk for developing mental health problems in a community sample. Instead, this study highlights instead both "big five" and SURPS personality factors that differentially indicate prospective risk for mental disorders, and suggests that the SURPS has incremental validity over the NEO-PI-R in predicting risk for GAD, ODD and CD diagnoses. These findings suggest that, while attentional biases to emotional faces may characterise participants with high levels of anxiety, depression or hostility, they are not pre-cursors to the development of mental disorders. This suggests that the risk for mental health problems in a community sample may be characterised, not by attentional biases, but in other ways, such as behavioural, cognitive or motivational tendencies. It is well established, for instance, that personality traits predict coping strategies [56], and it may be

that specific cognitive or behavioural tendencies under stressful conditions mediate personality vulnerability to psychiatric disorders. The current study suggests that personality factors appear more implicated in risk for the development of psychiatric disorders, possibly through other cognitive-behavioural indicators such as reinforcement learning or response inhibition [57, 58]. This suggests that preventive interventions should target personality risk factors or coping styles, and indeed some selective approaches have demonstrated that interventions focused on SURPS personality risk factors do indeed decrease the risk for future substance use problems or mental disorders [59, 60].

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Author Contributions

Conceived and designed the experiments: PC GS CB HF HG M-LPM TP MR TR. Performed the experiments: PC GS EA TB AB CB HF VF HG AH BI KM M-LPM FN TP ZP LP MR TR MS AS. Analyzed the data: MO-B PC. Contributed reagents/materials/analysis tools: VF FN. Wrote the paper: MO-B PC RP.

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Bridging statement to Study 3

Comments on Study 2

Study 2 suggests that attentional biases to emotional stimuli as measured by the emotional dot probe task (MacLeod, Mathews, & Tata, 1986) are not concurrently or prospectively associated with symptoms of mental disorders in a community adolescent sample. This study therefore suggests attentional biases to emotional faces are not suitable targets for preventive interventions. Characteristics of the task and sample that may have influenced these results are taken into account in the interpretation of these findings. Results indicate instead that personality traits are associated with concurrent and prospective risk for mental disorders in adolescence whilst accounting for baseline symptoms, with the Substance Use Risk Profile Scale (Woicik et al., 2009) showing incremental validity over the revised NEO Personality Inventory (Costa Jr & McCrae, 1992). These findings support the appropriateness of targeting the four personality profiles indicated by the Substance Use Risk Profile Scale in the Preventure program, namely hopelessness, anxiety sensitivity, impulsivity and sensation seeking.

Introduction to Study 3

In keeping with the broader goal of enhancing the efficacy of personality-targeted intervention, Study 3 examines the mechanisms of intervention effects over 2 years on measures of problematic alcohol use and mental health symptoms. The goal of this study is to elucidate the mechanisms of the Preventure program in order to allow us to further refine and optimise the intervention strategy. This study uses data from the Adventure randomised controlled trial, and seeks to elucidate the mediators of the 2-year intervention effects on both alcohol misuse (Conrod et al., 2013) and mental health symptoms (O'Leary-Barrett et al., 2013); Study 1). In order to do so, Study 3 contrasts three competing hypotheses, namely whether 2-year intervention effects are accounted for by early changes in alcohol use (the "developmental harm" hypothesis), mental health

symptoms (the “affect regulation” hypothesis) or personality (the “common factors” hypothesis).

Study 3

Mechanisms of personality-targeted intervention effects on adolescent alcohol misuse, internalising and externalising symptoms

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Mechanisms of Personality-Targeted Intervention Effects on Adolescent Alcohol Misuse, Internalizing and Externalizing Symptoms

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Objective: This study aims to explore the mechanisms of personality-targeted intervention effects on problematic drinking, internalizing and externalizing symptoms. ***Method:*** As part of a cluster-randomized trial, 1,210 high-risk students (mean age 13.7 years) in 19 London high schools (42.6% White, 54% male) were identified using the Substance Use Risk Profile Scale. Intervention school participants were invited to participate in personality-matched interventions by trained school staff. MacKinnon's products of coefficients method was used to compare 3 complementary mechanism hypotheses, namely, whether early changes in (a) alcohol use, (b) internalizing and externalizing symptoms, or (c) personality during the 6 months postintervention accounted for intervention effects over 2 years. ***Results:*** Early intervention effects on drinking behaviors during the 6 months postintervention partially accounted for longer term intervention effects on the onset of binge drinking (95% confidence interval [CI] [−.349, −.062]) and drinking problems (95% CI [−.206, −.016]) over 2 years. Intervention effects on anxiety symptoms and conduct problems were partially mediated by early reductions in depressive symptoms (95% CI [−.013, −.001]; 95% CI [−.047, −.001]), and intervention effects on internalizing symptoms were also partially mediated by reductions in anxiety sensitivity (95% CI [−.003, 0]). ***Conclusions:*** 2-year intervention effects on problematic drinking were largely accounted for by early changes in drinking behaviors, and were not mediated by changes in mental health symptoms or personality risk factors. Early improvements in mood and anxiety sensitivity partially mediated longer term reductions in mental health problems.

What is the public health significance of this article?
This study suggests that long term personality-targeted intervention effects on problematic drinking in youth are largely accounted for by early changes in drinking behaviors, and are not mediated by changes in mental health symptoms or personality risk factors. Short-term intervention effects on early onset alcohol use may serve as proximal markers of longer-term intervention effects on both substance and nonsubstance related problems.

Keywords: prevention, mechanisms, early onset alcohol use, adolescence

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Substance use and mental disorders are identified as the third leading contributor of global burden of disease (Ferrari et al., 2014). Comorbidity of substance use disorders (SUDs) with other forms of psychopathology is the norm, rather than the exception, both in adult and youth populations, and patients with SUDs and comorbid mental health problems have poorer outcomes in treatment studies (Couwenbergh et al., 2006). Namely, comorbidity is associated with poorer treatment compliance, higher levels of psychopathology, suicidal ideation and attempts, higher treatment cost, and poorer functioning and prognosis (Clark et al., 1997; Deas & Brown, 2006; Faggiano et al., 2008; Grella, Hser, Joshi, & Rounds-Bryant, 2001; King, Gaines, Lambert, Summerfelt, & Bickman, 2000). Indeed, it is widely acknowledged that prevention and treatment programs are underdeveloped for populations with dual diagnoses (Salvo et al., 2012). Simultaneous attention to SUDs and comorbid psychopathology is thought to be more effective than interventions targeting either disorder alone; specifically, an intervention focus on risk factors for comorbid problems is recommended to enhance efficacy (Stice, Shaw, Bohon, Marti, & Rohde, 2009). There is thus a great need for preventive interventions targeting risk factors for the development both of SUDs and other forms of psychopathology, in order to address commonalities in the pathways to mental disorders and to avoid treatment response difficulties in adulthood. Moreover, it is important to understand the mechanisms of effective programs, in order to identify appropriate intervention targets and further enhance treatment effects. Randomized prevention trials provide a unique opportunity to evaluate whether changes in a putative risk factor translate into changes in future pathology (Hinshaw, 2002), and analyses of mediator variables can enhance our understanding of intervention mechanisms, and allow us to further refine treatment strategies.

It is increasingly suggested that personality factors may partially account for the relationship between other risk factors (e.g., internalizing and externalizing symptoms) and substance misuse (Davis, Cohen, Davids, & Rabindranath, 2015; Kotov, Gamez, Schmidt, & Watson, 2010). Indeed, some studies suggest that personality factors may mediate the relationship between genetic factors and substance misuse (Laucht, Becker, Blomeyer, & Schmidt, 2007; McGue & Bouchard, 1998). Targeting personality risk factors for addiction offers a promising prevention approach in that personality traits are differentially associated with motives for substance use (Cooper, Frone, Russell, & Mudar, 1995), drugs of choice (Conrod, Pihl, Stewart, & Dongier, 2000), patterns of coping (Connor-Smith & Flachsbart, 2007), and sensitivity to the effects of drugs (Conrod, Pihl, & Vassileva, 1998; Leyton et al., 2002). Personality-targeted interventions can thus address the specific motivations for use and vulnerability factors associated with a particular personality profile, enhancing the individual relevance and impact of an intervention.

Personality-targeted interventions have demonstrated their efficacy in three separate randomized controlled trials (Conrod, Castellanos-Ryan, & Mackie, 2011; Conrod et al., 2013; Conrod, Stewart, Comeau, & Maclean, 2006). This brief program has resulted in 2-year intervention effects on alcohol and drug misuse (Conrod et al., 2011, 2013; Conrod, Castellanos-Ryan, & Strang, 2010), as well as internalizing and externalizing symptoms (O'Leary-Barrett et al., 2013). The aim of the current paper is to explore the mechanisms of personality-targeted interventions on indicators of problematic drinking (namely, the initiation and growth of binge drinking and alcohol-related problems rates and frequency), and severity of depression, anxiety and conduct problems over 2 years. Comorbidity models suggest that the intervention mechanisms can be understood in one of three ways. Namely, (a) decreases in mental health symptoms may lead to subsequent decreases in alcohol use or improvements in associated internalizing or externalizing symptoms; (b) delays in early onset drinking or decreased early alcohol consumption may lead to decreased hazardous drinking and mental health symptoms over the longer term, through protecting the adolescent brain from the detrimental consequences of early alcohol use; and (c) intervention effects on both alcohol misuse and mental health symptoms may operate through a common factor, that is, personality. This study will examine these three complementary hypotheses. The following section will explain these three pathways in more details.

The affect regulation model suggests that alcohol use can be understood as an attempt to "self-medicate" negative mood states (e.g., sadness, anxiety, or anger) or mental health symptoms (Cooper, Frone, Russell, & Mudar, 1995; Lazareck et al., 2012). This model is supported by a recent meta-analysis on 12 studies for combined cognitive–behavioral therapy (CBT) and motivational interviewing to treat comorbid major depression and alcohol use disorders showing that treatment effects on depression were achieved earlier than those on alcohol use (Riper et al., 2014). Similarly, interventions targeting depressive symptoms in adolescence have resulted in secondary intervention effects on substance use escalation (Rohde, Stice, Gau, & Marti, 2012; Stice, Rohde, Gau, & Wade, 2010). In the realm of externalizing disorders, several interventions targeting disruptive behaviors in childhood and early adolescence have resulted in lower substance use in midadolescence (van Lier, Huizink, & Crijnen, 2009; Zonnevylle-Bender, Matthys, van de Wiel, & Lochman, 2007). This suggests that substance misuse may be associated with externalizing symptoms through an underlying externalizing profile (as opposed to being a behavior related to self-medication, as when associated with internalizing symptoms). The hypothesis to be examined in this study, henceforth referred to as the "psychopathology reduction mechanism," expands on the affect regulation hypothesis in that it assesses a temporal sequence in which a reduction in internalizing or externalizing symptoms in the first 6 months postintervention may account for longer term reductions in substance misuse. In addition, this hypothesis will examine whether early reductions in internalizing or externalizing symptoms could account for subsequent improvements in mental health, which may potentially occur through a global mood-enhancing effect or a reduction in overall distress.

A second potential intervention mechanism is through the delay of early onset and escalation of alcohol use, both of which have been associated with "developmental harm" in adolescence (Lubman, Hides, Yucel, & Toumbourou, 2007). This includes an increased risk for mental health problems (Ferrari et al., 2014; McGue, Iacono, Legrand, Malone, & Elkins, 2001) and addiction in adulthood. Rates of adult alcohol dependence in individuals whose onset of alcohol use was below 14 years are estimated at 40% (Grant & Dawson, 1997). The harmful impact of early onset alcohol use may be explained by neurobiological processes, namely neurotoxic effects of ethanol on the adolescent brain (Lubman et al., 2007). Adult alcoholics have been shown to be impaired on cognitive tasks (Miller & Orr, 1980),

and these deficits have been replicated in adolescents with SUDs, though on a smaller scale (Brown, Tapert, Granholm, & Delis, 2000). Cognitive deficits have also been recognized in the nonproblematic, social drinking population (Parsons, 1998), with the suggestion that there is a continuum of deficits related to quantity of alcohol consumption (Squeglia, Spadoni, Infante, Myers, & Tapert, 2009). Studies on the mechanisms of long-term intervention effects of family focused universal prevention programs such "Guiding Good Choices" and the "Strengthening Families Program for Parents and Youth: 10–14" (Spoth, Trudeau, Guyll, Shin, & Redmond, 2009), as well as a combination of the Strengthening Families Program with the universal school-based Life Skills Training Program (Spoth, Trudeau, Redmond, & Shin, 2014) suggest that intervention effects on problematic substance use in young adulthood occurred indirectly through intervention effects on substance use initiation and growth in adolescence. This study's design would allow us to test whether a similar mechanism may operate during a 2-year period following participation in a personality-targeted intervention.

A third potential intervention mechanism for both substance misuse and other mental symptoms is through a decrease in common risk factors. Personality-targeted interventions target individuals with high levels of four personality traits, namely sensation seeking, impulsivity, anxiety sensitivity and hopelessness (Conrod et al., 2013). These personality profiles are correlates and risk factors of substance misuse and psychopathology in adolescence, and are associated with distinct motivational pathways (Castellanos-Ryan & Conrod, 2012). Anxiety sensitivity and hopelessness are risk factors for addiction through the use of substances to dampen fears of the physical sensations of anxiety, or to numb depressive symptoms, respectively. These internalizing traits are also risk factors for anxiety and depressive disorders, in turn (Woicik, Stewart, Pihl, & Conrod, 2009). Impulsivity is associated with a multitude of disinhibited behaviors, including conduct disorders (Urben, Suter, Pihet, Straccia, & Stephan, 2015) and polysubstance use (Conrod et al., 2000). Lastly, sensation seeking is associated with risk-taking behaviors for thrill-seeking or enhancement purposes, including binge drinking, but no other psychopathology (Castellanos-Ryan, O'Leary-Barrett, Sully, & Conrod, 2013). Evidence for common risk factors for addiction and psychopathology is supported by genome-wide linkage (Gizer et al., 2012) and factor analytic studies (Kotov et al., 2011). It is therefore possible that intervention effects on both substance misuse and other forms of psychopathology could be explained by decreases in the personality traits common to both problems. The potential for personality change across adolescence (and beyond) is supported by contemporary theories of personality and development (e.g., Roberts, Walton, & Viechtbauer, 2006). While no research to date has specifically tested whether personality risk factors for substance misuse are similarly subject to developmental influences, it is feasible to believe that they could be. Externalizing traits (e.g., sensations seeking and impulsivity) and alcohol use have been shown to mutually influence and exacerbate one another across adolescence and young adulthood (MacPherson, Magidson, Reynolds, Kahler, & Lejuez, 2010; Quinn, Stappenbeck, & Fromme, 2011). Anxiety sensitivity levels have also been found to decrease subsequent to a targeted intervention (Watt, Stewart, Lefaivre, & Uman, 2006). However, while personality-targeted interventions select individuals that exhibit high levels of personality risk factors, the goal of the intervention is not to change personality. The interventions target coping behaviors and risky motives for substance use that are specific to each personality profile. It is thus possible that intervention effects may be mediated by personality-specific changes in problematic coping as opposed to changes in personality itself (e.g., Conrod et al., 2011). However, no study to date has tested whether changes in personality risk factors themselves may account for subsequent intervention effects on problematic outcomes.

Please see Figure 1 for a visual illustration of the three complementary mechanism hypotheses (psychopathology reduction, developmental harm and common factors) to be tested. This study will examine the mechanisms of the personality-targeted intervention effects on measures of problematic alcohol misuse (binge drinking and alcohol-related problems), internalizing and externalizing symptoms over a 2-year period by examining each of the three hypotheses presented.

Method

Participants and Procedure

This cluster-randomized study randomly assigned 19 schools from nine randomly selected London boroughs to control ($n = 8$) or intervention ($n = 11$) conditions. All Year 9 students (mean age 13.7 years) were invited to participate. Students completed self-report questionnaires dur-

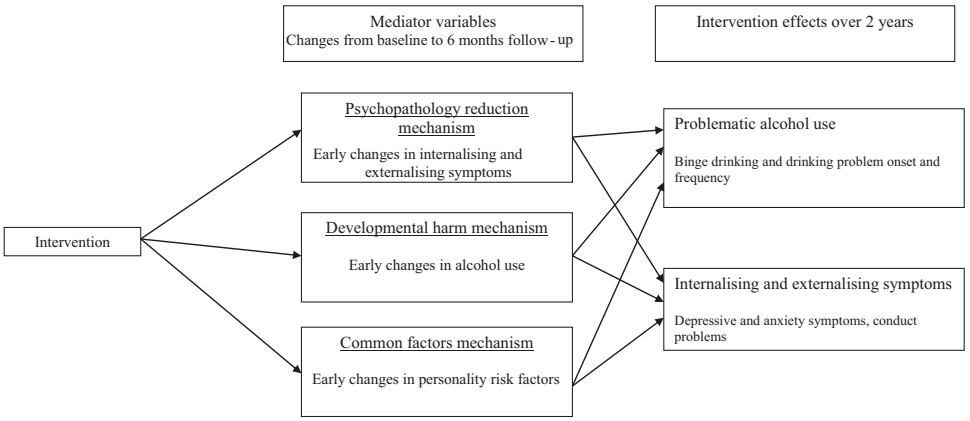

Figure 1. Three complementary mechanism hypotheses.

ing school hours at 6-month intervals for 2 years. Participation was informed by passive consent from parents and active assent from students, following approval from the King's College London Research Ethics Committee (CREC/06/07–192). High-risk students were defined as those scoring one standard deviation above the school mean on one of the four subscales of the Substance Use Risk Profile Scale (SURPS; Castellanos-Ryan et al., 2013). High-risk participants in intervention schools were invited to participate in personality-matched intervention sessions by trained school staff. If a student had elevated scores on more than one subscale, they were assigned to the personality group in which they showed the most statistical deviance according to z scores. Five hundred seventy-four (82.7%) high-risk participants received an intervention, but high-risk students were included in the intent-to-treat follow-up analysis regardless of whether or not they attended the sessions. The sample was ethnically diverse (42.6% White, 26.5% South Asian, 17.2% Black, 8.6% mixed origins and 5.1% other), and was 54% male. Follow-up assessments were conducted for all students who took part at baseline, including low-risk youth (N = 2,643), but this study reports on intervention mechanisms using only the high-risk sample. Please see Figure 2.

Measures

Demographic characteristics. Adolescents provided information on gender and ethnicity using a forced choice answering procedure following Conrod et al. (2006).

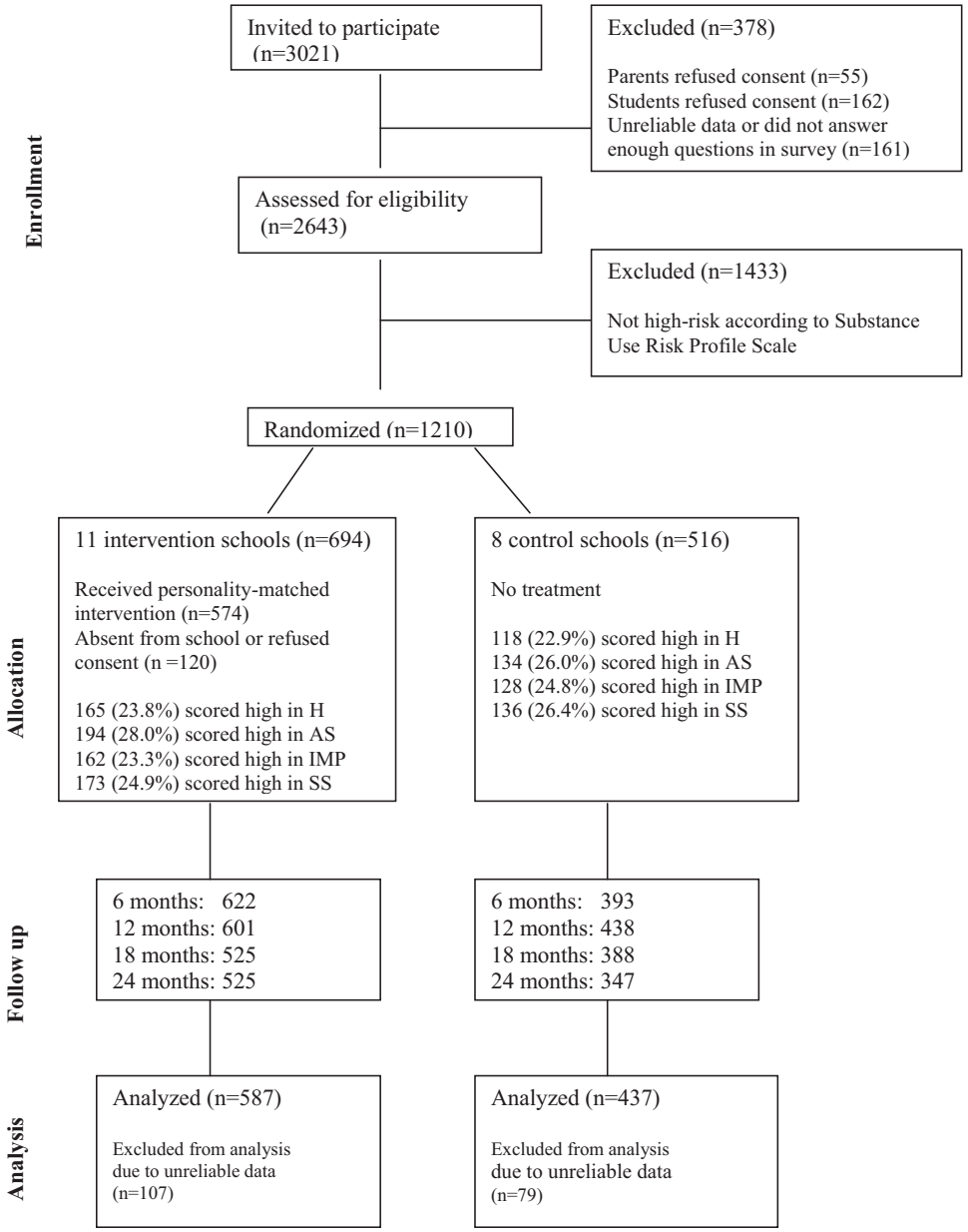

Figure 2. CONSORT diagram.

Personality risk. The SURPS was used to assess variation in personality risk for substance dependence along four dimensions: sensation seeking, impulsivity, anxiety sensitivity, and hopelessness. This scale has good concurrent, predictive and incremental validity (relative to other personality measures) with regards to differentiating individuals prone to reinforcement-specific patterns of substance-use in multiple samples (Conrod et al., 2010; Conrod, Castellanos, & Mackie, 2008; Krank et al., 2011; Woicik et al., 2009), including the sample described in the current study (Castellanos-Ryan et al., 2013). SURPS traits are concurrently and prospectively associated with substance misuse and nonsubstance-related externalizing behaviors and internalizing symptoms (Castellanos-Ryan et al., 2013). Each subscale had good internal reliability for short scales in the current study (Swailes & McIntyre-Bhatty, 2002), with Cronbach's alpha coefficients ranging from .67 to .82 ($\alpha = .67$ for sensation seeking [six items]; $\alpha = .67$ for anxiety sensitivity [five items], $\alpha = .68$ for impulsivity [five items]; $\alpha = .82$ for hopelessness [seven items]). Averaged interitem correlations for each subscale were as follows: sensation seeking, .24; impulsivity and anxiety sensitivity, .29; hopelessness, .41, which are considered acceptable (Clark et al., 1997). Personality subscales had good test–retest reliability over 2 years ($p < .001$ for each subscale).

Alcohol use. Participants self-reported their frequency and quantity of alcohol consumption in the past 6 months using two 6-point scales. Binge drinking was assessed by asking students the frequency at which they had consumed five or more alcoholic beverages (four or more for girls) on one occasion in the past 6 months. Frequency of alcohol problems in the past 6 months was assessed using an abbreviated version of the Rutgers Alcohol Problem Index (White & Labouvie, 1989), based on the eight most frequently endorsed items by 14- to 16-year-old adolescents living in London (Conrod et al., 2008) in a community sample with very similar demographic characteristics to the current study participants. Participants' self-report drinking behavior was reliable across the five 6-month assessments during 2 years (assessed using Cronbach's alpha), with respect to their reported age when they first tried alcohol ($\alpha = .95$) and age when they first consumed a full alcoholic drink ($\alpha = .92$).

Internalizing symptoms. Depression and anxiety symptom severity over the past 6 months were measured using the Depression and Anxiety subscales from the Brief Symptoms Inventory (Derogatis, 1993).

Externalizing symptoms. Conduct problems were assessed according to the conduct subscale of the Strengths and Difficulties Questionnaire (Goodman, 1997).

Calculating change scores. Change scores reflecting the differences in mediator variables between baseline and 6 months-follow up were calculated in order to test the three hypotheses of interest (see Figure 1). (a) The psychopathology reduction hypothesis was examined using change scores reflecting the difference in depressive and anxiety symptoms and conduct problems from baseline to 6 months-follow up as mediator variables. (b) The developmental harm hypothesis was tested using change scores reflecting the difference in quantity and frequency of alcohol consumption and alcohol-related problems from baseline to 6 months follow-up as mediator variables. As changes in the quantity and frequency of alcohol use were strongly correlated ($r = .79$), analyses including both variables used the residual drinking frequency scores in order to remove the covariance between the two variables. (c) The common factors hypothesis was tested using change scores reflecting differences in the four personality variables between baseline and 6 months-follow up as mediators.

Intervention

Personality-targeted interventions involved two 90-min group sessions led by a trained school-based facilitator and cofacilitator, with an average of six personality-matched adolescents per group. The interventions were manualized, and incorporated CBT, psychoeducational and motivational enhancement therapy (Carroll et al., 1998) components. Manuals included real life "scenarios" shared by London youth in specifically organized focus groups. In the first session, participants were guided in a goal-setting exercise designed to enhance motivation to change behavior. Psychoeducational strategies were used to teach participants about the target personality variable and associated problematic coping behaviors. Substance misuse was referred to as a problematic coping behavior across all groups, and the groups discussed personality-specific motives for use (e.g., to cope with feelings of sadness in the hopelessness-prone group). Other personality-specific maladaptive coping behaviors were discussed in each group, for example, avoidance (anxiety sensitivity and impulsivity groups), interpersonal dependence (hopelessness group), aggression (impulsivity groups) and risky behaviors (sensation seeking groups). Participants were then introduced to the CBT model and guided in breaking down personal experiences according to the physical, cognitive, and behavioral components of an emotional response. A novel component to this intervention approach is that all exercises discussed thoughts, emotions, and behaviors in a personality-specific way, for example, identifying situational triggers and cognitive distortions related to impulsivity specifically. In the second session, participants were encouraged to identify and challenge personality-specific cognitive distortions (e.g., negative, global, self-referent thinking for hopelessness) that can lead to problematic behaviors.

Training and supervision. Intervention facilitators and cofacilitators included school counselors, student support team members, teachers and special educational needs staff. As reported in the supplementary materials of O'Leary-Barrett, Mackie, Castellanos-Ryan, Al-Khudhairy, and Conrod (2010), all staff attended a 3-day training workshop, followed by a minimum of 4-hr supervision in running through a full, two-session intervention with the trial therapist. Supervised interventions were run with groups of Year 10 students who were not involved in the trial. An 18-point checklist was devised to measure whether facilitators demonstrated sufficient mastery of CBT, motivational enhancement therapy, and general counseling skills. Thirty-one staff members (84%) successfully qualified as facilitators of the intervention. Two individuals did not reach a sufficient standard of program delivery, so acted as cofacilitators of the intervention, but did not lead the group sessions.

Treatment integrity. One hundred eighty-two intervention sessions took place with high-risk youth over a 4-month period. Trained research staff observed 76 (41.7%) of these sessions to assess adherence to the treatment protocol (fidelity) and intervention quality, and each facilitator was observed running at least one intervention session.

Treatment fidelity. A scale was developed by the principal investigator (P. C.) and trial therapist to evaluate adherence to 12 core treatment components of the personality-targeted intervention program (e.g., goal setting, identifying and challenging automatic thoughts). Facilitators were evaluated as having "achieved," "partly achieved," or "not achieved" each component. Of the rated sessions, 88.2% were evaluated as having "achieved" or "partly achieved" these 12 core treatment components, and 64.5% of rated sessions were evaluated as having "achieved" most components. Facilitators were also rated on five core counseling skills (e.g., involving the entire group, being empathic) considered essential for successful program delivery. Of the sessions, 98.4% were rated as having "achieved" or "partly achieved" these core counseling skills, and 65.6% of sessions were rated as having "achieved" all core counseling skills (O'Leary-Barrett et al., 2010).

Treatment quality. Facilitators were evaluated using Young and Beck's Cognitive Therapy Scale (Young & Beck, 1980) on 11 key therapeutic skills, for example, interpersonal effectiveness or application of cognitive–behavioral techniques. Independent ratings by a clinical psychologist not involved in the study showed that 100% of rated sessions achieved a mean score of at least 3 (*satisfactory*). The mean rating in response to the question, "How would you rate the clinician in this session, as a cognitive therapist?" was 3.6 (between *satisfactory* and *good*). The mean rating in response to the question, "If you were conducting an outcome study in cognitive therapy, do you think you would select this therapist to participate at this time?" was 2.4 (between *uncertain/borderline* and *probably yes*). These scores suggest the intervention facilitators achieved many of the goals of a CBT intervention in practice but did not perform at a therapeutic level equivalent to a trained clinical psychologist. Comparisons of the efficacy of personality-targeted interventions as delivered by trained psychologists and school-based staff nevertheless revealed similar effect sizes across programs (O'Leary-Barrett et al., 2010). Control schools did not deliver the personality-targeted interventions to youth to trial participants, and received training in intervention delivery at the end of the trial, as an incentive for participation.

Attrition. Follow-up rates appear in Figure 2, and show significantly higher retention rates in intervention than control schools at 2 years postbaseline ($p = .02$) in the high-risk sample, due to one control school having insufficient resources to organize a systematic follow-up at the final follow-up point. Attrition at the end of the 2-year follow-up period was predicted by higher levels of conduct problems ($p = .01$) and hopelessness ($p = .05$). However, severe levels of conduct problems did not predict attrition, and there were no interactions between treatment condition and baseline levels of hopelessness or conduct problems on follow-up rates. Attrition was not predicted by gender, ethnicity, alcohol use, depression, anxiety, or personality traits other than hopelessness. Missing data was replaced using full information maximum likelihood estimation in SPSS, which enabled the use of all available data. As data was missing not at random, missing data were computed separately according to intervention condition and personality risk status (high vs. low), using demographic and outcome data from previous time-points as covariates. This procedure was considered adequate as the data estimation strategy was conceived according to the model for missingness, and attrition was not strongly associated with outcome measures (Schafer & Graham, 2002). This procedure is determined valid when less than 25% of a dataset is missing (Kenward & Carpenter, 2007).

Statistical Analyses

Intervention Effects Over 2 Years

Problematic alcohol use variables. Latent growth models in MPlus (Muthén & Muthén, 2010) were used to examine intervention effects on dichotomous drinking outcomes (onset of binge drinking and alcohol related problems). This allowed us to model data with a preponderance of zero observations, following Conrod et al. (2013), which reported primary study outcomes on the same sample. Additionally we ran latent growth models on the continuous drinking outcomes for the subsamples who had reported the onset of binge drinking or problem drinking at baseline, respectively. In our sample at baseline, 270 (22.3%) reported binge drinking and 201 (16.6%) reported having experienced problems relating to alcohol use in the preceding 6 months. These latent growth models allowed us to examine the effects of the intervention on the probability of engaging in a particular behavior (the dichotomous parts of the model, i.e., binge drinking and drinking problems onset) and its effects on frequency of the behavior when present (the continuous parts of the model, i.e., frequency of binge drinking and drinking problems). These models also allowed for the observation of main effects of the intervention across time (reflected in the intercept centered at 6 months) and time-dependent effects of the intervention (reflected in the slope from 6 to 24 months). All continuous outcome variables revealed interclass (cluster) correlations (ICCs) that were below .10, meaning that there was little variance at the school level across time. Some effects of cluster were observed for dichotomous outcomes (ICC = .10). The authors have previously reported having conducted additional analyses in the same sample using multilevel latent growth models while controlling for cluster in STATA, which did not impact the results (Conrod et al., 2013). Therefore, cluster was not accounted for in the latent growth models.

In order to attest to the real life impact of the interventions on problematic drinking outcomes, the binge drinking and drinking problem variables were dichotomized using cutoff points that were determined by considering the potential public health impact of these behaviors, following Spoth et al. (2009, 2014). Namely, participants who, at 2 years postintervention, reported binge drinking on a weekly basis, and those who reported having experienced one to two negative consequences of alcohol use over the past 6 months were considered as cases that would be more likely to be using alcohol at a level that could have public health consequences. Relative reduction rates (RRRs) were then computed based on the relative number of cases in each condition that reported experiencing this predefined negative outcome at 2 years postintervention. RRRs correspond to the proportion of control condition cases that would have been prevented had those individuals been in the experimental condition.

Internalizing and externalizing symptoms. Intervention effects on depression, anxiety and conduct problems were analyzed using linear generalized estimating equations (GEE), using an autoregressive correlation structure, following O'Leary-Barrett et al. (2013), which reported secondary study outcomes on the same sample. The models used outcomes from 6, 12, 18, and 24 months

follow-up, and accounted for correlations within outcomes across multiple time points. All GEE analyses were conducted using IBM SPSS Statistics 20 and significance levels were set at $p < .05$. ICCs indicated that 1–12% of the variance in outcomes was explained by school. Average design effects ranged from 0.6 to 8. According to recommendations by Muthén and Satorra (1995), school clusters were accounted for in all analyses and considered as the repeated measure in the GEE models. The distribution of depression and anxiety symptoms was highly positively skewed, so data were log transformed before analysis.

Intervention mechanisms. Linear regressions in STATA 13 (StataCorp, College Station, TX) examined whether treatment conditions predicted changes in mediator variables (change scores), accounting for gender, ethnicity and controlling for school cluster (a pathway; Baron & Kenny, 1986). Nonindependence observations were adjusted for using tests based on the Huber–White sandwich estimate of variance (White, 1980). This method provides standard errors that are robust within cluster correlations.

Relationships between the mediator variables (change scores) and alcohol use outcomes (*b* pathways; Baron & Kenny, 1986), were examined in latent growth models, accounting for gender and ethnicity. Latent growth models of the dichotomous problematic drinking outcomes (onset of binge drinking and alcohol-related problems) also controlled for baseline levels of the corresponding drinking variable. Relationships between mediator variables and internalizing and externalizing symptoms (*b* pathways) were examined using linear regressions in STATA. Analyses accounted for baseline measures of the outcome variables, as well as demographics and school cluster.

For all outcomes, the indirect effect of the intervention-mediator-dependent variable pathway was examined using MacKinnon's products of coefficients method (MacKinnon, Fritz, Williams, & Lockwood, 2007), using the prodclin program (Tofighi & MacKinnon, 2011). For outcomes for which intervention effects were present, mediation effects were examined; where no intervention effects were detected, indirect effects of the intervention were explored using the same procedure as described above.

Mediation of intervention effects on 2-year outcomes examined three complementary hypotheses, namely whether intervention effects were accounted for by early changes in personality (the common factors hypothesis), alcohol use (the developmental harm hypothesis) or internalizing and externalizing symptoms (the psychopathology reduction hypothesis) from baseline to 6 months follow-up. Changes in personality risk factors from baseline to 6 months follow-up were explored as mediators for the mental health symptoms to which they were theoretically relevant. For example, the change in levels of anxiety sensitivity was not explored as a potential mediator of intervention effects on conduct problems as there is no established relationship between these variables.

Results

See Table 1 for intervention effects on mediator variables (*a* pathways), accounting for gender, ethnicity and school cluster. Table 1 shows that there are statistically and trend-level significant a pathways relating to each of the three complementary hypotheses; developmental harm, psychopathology reduction, and common factors. Specifically, there were trend level intervention effects on drinking frequency and drinking problems over 6 months, significant decreases in depressive symptoms and trend-level decreases in anxiety symptoms and conduct problems, and significant decreases in anxiety sensitivity and impulsivity. Post hoc analyses were conducted to investigate intervention effects on relative rankings on personality traits using standardized scores (in addition to mean levels, as reported in Table 1). There were no changes in relative ranking on hopelessness, sensation seeking and anxiety sensitivity from baseline to 6 months follow-up. There was a relative increase in impulsivity ranking that was specific to the control condition. Impulsivity rankings in the intervention condition did not change over time. The relative stability in mean levels and ranking across most of the personality traits across adolescence is consistent with results from a meta-analysis on the development and stability of mean and rank-order personality traits across the lifetime (Caspi, Roberts, & Shiner, 2005)

Table 1
Intervention Effects on Mediator Variables From Baseline to 6 Months Follow-Up

Mechanism	Mediators[a]	*B* (*SE*)	β
Developmental harm mechanism	Drinking behaviors		
	Drinking quantity	−.12 (.08)	−.11
	Drinking frequency	−.17 (.10)[†]	−.15
	Drinking problems (total)	−.53 (.27)[†]	−.12
Psychopathology reduction mechanism	Mental health symptoms		
	Depression	−.85 (.39)[*]	.16
	Anxiety	−.54 (.29)[†]	.14
Common factors mechanism	Conduct problems	−.18 (.10)[†]	−.10
	Personality		
	Hopelessness	.07 (.20)	.02
	Anxiety sensitivity	−.31 (.15)[*]	−.11
	Impulsivity	−.52 (.20)[*]	−.18
	Sensation seeking	−.15 (.18)	−.04

Note. All models include demographic variables (gender and ethnicity), and account for school cluster.
[a] Mediator variables: change in score from baseline to 6 months follow-up.
[†] $p \leq .10$. [*] $p < .05$.

Mediation or indirect pathways for the three complementary hypotheses were examined only for mediator variables with significant or trend-level associations with the outcome variable (i.e., *b* pathways). Tables 2 and 3 reports indirect estimates for each mediator variable examined. The tables also report intervention effects on the outcome variables without mediators, and controlling for mediator variables with significant partial mediation or indirect pathways (*c* and *c′* pathways, respectively; Baron & Kenny, 1986).

Mechanisms of Intervention Effects on Measures of Problematic Drinking (Table 2)

Binge Drinking

Binge drinking onset (dichotomous model). The intervention was associated with reduced rates of binge drinking at 6 months follow-up (intercept), $p < .001$, but was not significantly associated with growth in binge drinking rates (slope) from 6 to 24 months. This is equivalent to a main intervention effect but no intervention by time interaction, with binge drinking in the intervention group being maintained at a lower rate than the control

Table 2
Mechanisms of Intervention Effects on Measures of Problematic Drinking

Outcome variables over 2 years; mediator variables[a] ($b^{\S}$)	Estimate (*SE*) [standardized estimate]	Indirect estimate (*SE*) [95% CI][b]
	Binge drinking onset (intercept) [D][i]	
Intervention effect without mediators ($c^{\S}$)	−.79 (.21)*** [−.15]	
Intervention effect with mediators ($c'^{\S}$)	−.49 (.20)* [−.10]	
Drinking quantity	.92 (.16)*** [.37]	**−.19 (.07) [−.349, −.062]**[c]
Drinking frequency	.66 (.13)*** [.28]	**−.13 (.06) [−.257, −.032]**
Drinking problems	.18 (.05)*** [.29]	**−.12 (.06) [−.255, −.016]**[c]
Hopelessness[a]	.09 (.03)** [.15]	−.002 (.03) [−.061, .055]
	Binge drinking onset (slope) [D][i]	
Intervention effect without mediators ($c^{\S}$)	.12 (.10) [.10]	
Intervention effect with mediators ($c'^{\S}$)	.04 (.10) [.04]	
Drinking quantity	−.19 (.07)** [−.31]	**.04 (.02) [.007, .083]**[c]
Drinking frequency	−.21 (.05)*** [−.37]	**.04 (.02) [.009, .085]**
Drinking problems	−.05 (.02)** [−.32]	**.03 (.02) [.003, .069]**
	Binge drinking frequency (intercept) [C][ii]	
Intervention effect without mediators ($c^{\S}$)	−.01 (.03) [−.04]	
Intervention effect with mediators ($c'^{\S}$)	−.01 (.02) [.05]	
Drinking quantity	.02 (.01)* [.14]	**−.003 (.002) [−.009, 0]**[c]
Drinking frequency	.04 (.01)*** [.27]	**−.01 (.003) [−.013, −.001]**
Depression	−.01 (.002)* [−.23]	**.005 (.003) [0, .013]**[c]
Anxiety	−.01 (.002)* [−.16]	.002 (.002) [−.002, .007]
	Binge drinking frequency (slope) [C][ii]	
Intervention effect without mediators ($c^{\S}$)	.001 (.01) [.01]	
Intervention effect with mediators ($c'^{\S}$)	.003 (.01) [.02]	
Drinking quantity	−.01 (.004)* [−.12]	**.001 (.001) [0, .004]**[c]
Drinking frequency	−.01 (.004)* [−.16]	**.002 (.001) [0, .004]**[c]
Depression	.003 (.001)** [.26]	**−.003 (.002) [−.007, 0]**[c]
Anxiety	.003 (.001)* [.20]	−.001 (.001) [−.004, .001]
	Drinking problems onset (intercept) [D][iii]	
Intervention effect without mediators ($c^{\S}$)	−.46 (.27)† [−.07]	
Intervention effect with mediators ($c'^{\S}$)	−.26 (.26) [−.04]	
Drinking quantity	.54 (.17)*** [.54]	**−.10 (.05) [−.206, −.016]**[c]
Drinking frequency	.64 (.14)*** [.22]	**−.10(.06) [−.222, −.008]**
Hopelessness	.09 (.04)** [.12]	0 (.03) [−.056, .057]
Impulsivity	−.04 (.03)† [−.08]	.02 (.02) [−.007, .059]
	Drinking problems onset (slope) [D][iii]	
Intervention effect without mediators ($c^{\S}$)	.004 (.14) [.002]	
Intervention effect with mediators ($c'^{\S}$)	−.05 (.14) [−.03]	
Drinking frequency	−.13 (.07)* [−.15]	.02 (.02) [−.002, .057]
Hopelessness	−.04 (.02)* [−.17]	0 (.01). [−.026, .025]
Impulsivity	.04 (.02)† [.13]	−.02 (.02) [−.055, .003]
Anxiety	−.03 (.02)† [−.16]	.01 (.02) [−.014, .047]
	Drinking problem frequency (intercept) [C][iv]	
Intervention effect without mediators ($c^{\S}$)	.001(.04) [.002]	
Intervention effect with mediators ($c'^{\S}$)	.03 (.04) [.05]	
Drinking quantity	.07 (.02)*** [.25]	**−.01 (.01) [−.025, −.002]**[c]
Drinking frequency	.05 (.02)** [.19]	**−.01 (.01) [−.019, −.001]**
	Drinking problem frequency (slope) [C][iv]	
Intervention effect without mediators ($c^{\S}$)	−.01 (.02) [−.14]	
Intervention effect with mediators ($c'^{\S}$)	−.02 (.02) [−.29]	
Drinking quantity	−.03 (.01)*** [−.81]	**.004 (.002) [.001, .009]**

Note. CI = confidence interval; [D] = Dichotomous model of the probability of engaging in a particular behavior (i.e., binge drinking and drinking problems onset); [C] = Continuous model of the frequency of binge drinking or drinking problems in the subsamples having reported binge drinking or drinking problems at baseline (n = 270 and n = 201, respectively). All models include gender and ethnicity as covariates. Dichotomous models also controlled for baseline levels of the corresponding drinking variable. Intercept of the outcome measure reflects the mean constant in frequency for any individual across time (6–24 months); slope of the outcome measure reflects any mean deviance from the intercept over time. Model fit: [i] Akaike information criterion (AIC) = 4,221.022, Bayesian information criterion (BIC) = 4,285.132, sample-size-adjusted BIC = 4,243.842. [ii] AIC = −476.989, BIC = −419.206, sample-size-adjusted BIC = −466.791. [iii] AIC = 2,947.468, BIC = 3,010.241, sample-size-adjusted BIC = 2,968.955. [iv] AIC = 1,032.197, BIC = 1,083.312, sample-size-adjusted BIC = 1,045.221.

[a] Mediator variables: Mediation/indirect effects were examined only when mediators had significant or trend-level b pathways ([§] Mediation pathway according to Baron & Kenny, 1986). [b] MacKinnon's products of coefficients method referring to the impact of each mediator individually (indirect estimates in **boldface**: significant indirect pathway according to MacKinnon's products of coefficient method). [c] Significant mediation pathways remain when taking others mediators into account.

† $p \leq .10$. * $p < .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 3
Mechanisms of Intervention Effects on Internalizing and Externalizing Symptoms

Outcome variables over 2 years; mediator variables[a] ($b^{\S}$)	*B* (*SE*) [β]	Indirect estimate (*SE*) [95% CI][b]
Depressive symptoms		
Intervention effect without mediators ($c^{\S}$)	−.02 (.01)* [−.09]	
Intervention effect with mediators ($c'^{\S}$)	−.01 (.01) [−.08]	
Drinking quantity	.01 (.005)† [.05]	−.001 (.001) [−.004, .001]
Drinking problems	.003 (.001)*** [.08]	**−.002 (.001) [−.004, 0]**[c]
Anxiety	.01 (.001)*** [.22]	−.006 (.003) [−.012, .002]
Hopelessness	.005 (.001)** [.09]	.0003 (.001) [−.002, .002]
Anxiety sensitivity	.003 (.002)† [.05]	**−.001 (.001) [−.003, 0]**[c]
Anxiety symptoms		
Intervention effect without mediators ($c^{\S}$)	−.02(.01) [−.12]**	
Intervention effect with mediators ($c'^{\S}$)	−.01 (.01)† [−.07]	
Drinking frequency	.01 (.003)* [.05]	**−.001 (.001) [−.004, 0]**[c]
Drinking quantity	.01 (.003)* [.05]	**−.001 (.001) [−.003, 0]**
Drinking problems	.003 (.001)* [.08]	**.002 (.001) [−.004, 0]**[c]
Depression	.01 (.001)*** [.27]	**−.007(.003) [−.013, −.001]**[c]
Anxiety sensitivity	.003 (.001)* [.06]	**−.001 (.001) [−.003, 0]**[c]
Conduct problems		
Intervention effect without mediators ($c^{\S}$)	−.19 (.06)** [−.10]	
Intervention effect with mediators ($c'^{\S}$)	−.16 (.06)** [−.09]	
Drinking quantity	.10 (.05)* [.05]	.012 (.011) [−.037, .005]
Drinking problems	.03 (.01)*** [.07]	**−.02 (.01) [−.038, 0]**
Depression	.02 (.01)* [.07]	**−.02 (.01) [−.047, −.001]**[c]
Hopelessness	.02 (.01)* [.05]	.002 (.005) [−.008, .012]
Sensation seeking	.02 (.01)† [.03]	−.003 (.004) [−.012, .004]
Impulsivity	.02 (.01)† [.04]	−.011 (.008) [−.029, .002]

Note. CI = confidence interval. Intervention effects reported in O'Leary-Barrett et al. (2013), without mediators in the model. All models include gender, ethnicity, and the corresponding baseline mental health symptom scores as covariates, and account for school cluster.
[a] Mediator variables: change in score from baseline to 6 months follow-up. Mediation or indirect pathways were examined only for mediator variables with significant or trend-level associations with the outcome variable (*b* pathways; § mediation pathway according to Baron & Kenny, 1986). [b] MacKinnon's products of coefficients method referring to the impact of each mediator individually when controlling for gender, ethnicity and corresponding baseline symptoms (indirect estimates in **boldface**: significant indirect pathway according to MacKinnon's products of coefficient method). [c] Significant mediation pathways remain when taking others mediators into account.
† $p \leq .10$. * $p < .05$. ** $p \leq .01$. *** $p \leq .001$.

group from 6 to 24 months. The intervention effect on the intercept of binge drinking rates was partially mediated through changes in drinking quantity, drinking frequency and drinking problems from baseline to 6 months postintervention, as reported in Table 2. When all mediators were entered into the model together (using the residual drinking frequency score due to the strong correlation between drinking quantity and frequency), the partial mediation effects through both drinking quantity and drinking problems remained significant, whereas the partial mediation through drinking frequency did not. The mediation pathway accounted for 56.8% of the variance in binge drinking onset over 2 years. 27.6% of the variance was accounted for by early changes in drinking behaviors.

There was an indirect effect on growth in binge drinking rates (slope) from 6 to 24 months follow-up through early postintervention changes in drinking quantity, drinking frequency and drinking problems. When all mediators were entered into the model (using the residual drinking frequency score), only the partial mediation effects through early changes in drinking quantity remained significant. The indirect pathway accounted for 16.5% of the variance in the growth of binge drinking rates from 6 to 24 months.

These findings provide support for the developmental harm hypothesis, as the maintenance of lower binge drinking rates over 2 years in the intervention group was accounted for by early changes in drinking behaviors, and not by changes in mental health symptoms or personality factors.

Binge drinking frequency (continuous model). There were no intervention effects on the intercept or slope of the continuous part of the binge drinking model in the subsample who had reported binge drinking at baseline ($n = 270$). There was an indirect effect on binge drinking frequency at 6 months follow-up (intercept) through early changes in drinking quantity, drinking frequency and depressive symptoms, as reported in Table 2. When all indirect effects were entered into the model (using the residual drinking frequency score), indirect effects through early changes in both drinking quantity and depressive symptoms remained significant. Together, the indirect pathway accounted for 16.7% of the variance in binge drinking frequency intercept at 6 months. 6.2%

of the variance was accounted for by early changes in drinking behaviors and 4.4% was accounted for by early changes in depressive symptoms.

There was an indirect effect on the binge drinking frequency slope from 6 to 24 months follow-up (intercept) through early changes in drinking quantity, frequency and depressive symptoms. All indirect effects remained significant when entered into the model together. The indirect pathway accounted for 15.9% of the variance in the growth in binge drinking frequency from 6 to 24 months (slope). 6.2% of the variance was accounted for by changes in drinking behaviors, and 1.3% by changes in depressive symptoms. These findings provide support for both the developmental harm and, to a lesser extent, the psychopathology reduction hypotheses in accounting for binge drinking frequency over 2 years in baseline binge drinkers.

Drinking Problems

Drinking problem onset (dichotomous model). There was a trend-level reduction in drinking problem onset at 6 months follow-up (intercept) in the intervention relative to the control condition, $p = .09$, but no intervention effects on the growth of onset of drinking problems (slope) from 6 to 24 months. This is equivalent to a trend-level main intervention effect but no intervention by time interaction on the intervention group's rate of drinking problem onset, with trend-level treatment gains being maintained from 6 to 24 months. There were indirect effects through early changes in drinking quantity and frequency from baseline to 6 months follow-up, as reported in Table 2. When both mediator variables were entered into the model together (using the residual drinking frequency score), only the indirect effect through drinking quantity remained significant. Together, the indirect pathway accounted for 46.2% of the variance in drinking problem onset over 2 years. 5.8% of the variance was accounted for by in early changes in drinking behaviors. These findings support the developmental harm hypothesis. Indirect effects on the growth in drinking problem rates from 6 to 24 months (slope) were not explained by early changes in drinking behaviors, mental health symptoms or personality risk factors.

Drinking problem frequency (continuous model). There were no intervention effects on the intercept or slope of the continuous part of the drinking problem frequency in the subsample who had reported experiencing drinking problems at baseline ($n = 201$). There were indirect effects on the frequency of drinking problems at 6 months (intercept) through early changes in drinking quantity and frequency. Only the indirect effect through drinking quantity remained significant when the change scores were entered into the model together. Similarly, indirect effects on the growth in drinking problem frequency from 6 to 24 months (slope) occurred through early changes in drinking quantity. The indirect pathway accounted for 12.4% of the variance in the drinking problem intercept over 2 years in participants who reported drinking problems at baseline. 5.3% of the variance was accounted for by changes in drinking quantity. These findings provide support for the developmental harm hypothesis in accounting for drinking problem frequency over 2 years in baseline problem drinkers.

Relative Reduction Rates

In order to assist in the interpretation of the real life impact of the interventions from a public health perspective, RRRs were calculated to approximate the percentage of those in an intervention school who could avoid a problematic drinking outcome that they would otherwise likely develop if they were a member of a control school. The RRR for weekly binge drinking 2 years postintervention was 19.9%, and the RRR for experiencing 1–2 weekly problems related to alcohol use in the previous 6 months was 15.4%.

Mechanisms of Intervention Effects on Internalizing and Externalizing Symptoms (Table 3)

Depressive symptoms. The intervention was associated with a significant reduction in depressive symptoms over 2 years ($p = .05$). Intervention effects were partially mediated by early changes in drinking problems and anxiety sensitivity from baseline to 6 months follow-up (as shown in Table 3). Both partial mediation effects remained significant when the two mediators were entered into the model together. The mediation pathway accounted for 33% of the variance in depressive symptoms over 2 years. 1% of the variance was accounted for by changes in drinking problems and anxiety sensitivity over the first 6 months postintervention. These findings lent support to both the developmental harm and common factors hypotheses, as long term intervention effects on depressive symptoms were partially mediated by early changes in both drinking-related behaviors and personality risk factors.

Anxiety symptoms. The intervention was associated with a significant reduction in anxiety symptoms over 2 years ($p = .01$). Intervention effects were partially mediated by changes in anxiety sensitivity, depression, and drinking frequency, quantity and alcohol-related problems from baseline to 6 months follow-up. When all mediators were entered into the model together (using the residual drinking frequency score), all remained significant except the partial mediation effect through early changes in drinking quantity. Together, the mediation pathway accounted for 33% of the variance in anxiety over 2 years, and 6% of the variance was accounted for by early changes in depressive symptoms. Changes in anxiety sensitivity, drinking frequency and drinking problems accounted for 1% of the variance each. These findings suggest that intervention effects on anxiety symptoms over 2 years were largely accounted for by global improvements in mood. In addition, these findings provided some support for the developmental harm and common factors hypotheses, although the variance accounted for by these mechanisms was small.

Conduct problems. The intervention was associated with a significant reduction in conduct problems over 2 years ($p = .001$). This intervention effect was partially mediated by early changes in depressive symptoms and drinking problems. When both mediators were entered into the model together, only the partial mediation effect through changes in depressive symptoms remained significant. Together, the mediation pathway accounted for 20% of the variance in conduct problems over 2 years. Less than 1% of the variance was accounted for by early changes in depressive symptoms. Similarly to above, these findings suggest that intervention effects on conduct problems over 2 years were accounted for by global improvements in mood, and not early changes in drinking

behaviors or personality risk factors. All analyses were rerun accounting for baseline levels of the mediator variable and using residual scores, and results did not differ.

Discussion

This study suggests that personality-targeted intervention effects on binge drinking onset over 2 years are partially mediated by early changes in drinking behaviors in the initial 6 months following the intervention. There were also indirect effects on the intercept and growth from 6 to 24 months (slope) in binge drinking frequency in the subsample reporting binge drinking at baseline through early changes in drinking behaviors. Similarly, there were significant indirect pathways on the onset of drinking problems over 2 years through early changes in alcohol use, and indirect effects on the intercept and growth from 6 to 24 months (slope) in the frequency of drinking problems through early changes in alcohol use in the subsample reporting having experienced problems relating to alcohol consumption at baseline. These findings are largely supportive of the developmental harm hypothesis, and suggest that early postintervention changes in alcohol use play an important role in accounting for longer term intervention effects on problematic drinking outcomes.

Two–year intervention effects on problematic drinking were largely not accounted for by changes in mental health symptoms (in contrast with the psychopathology reduction hypothesis). There was, however, an indirect effect on the frequency and growth of binge drinking over 2 years through early reductions in depressive symptoms in the subsample having reported binge drinking at baseline, suggesting that early improvements in mood may help to temper the escalation of binge drinking from 14 to 16 years, particularly in early onset binge drinkers. However, this indirect effect was relatively smaller than that through early changes in alcohol use. While there were reductions in mental health symptoms subsequent to the intervention, these changes largely did not appear to mediate long-term intervention effects on drinking. The minimal support for the psychopathology reduction mechanism with regards to intervention effects on alcohol misuse is consistent with some other studies in community samples (e.g., Adrian, McCarty, King, McCauley, & Stoep, 2014), which do not show a direct relationship between internalizing and externalizing symptoms and substance use in mentally healthy participants. Indeed, the associations between internalizing and externalizing symptoms with substance use are not consistently demonstrated in community adolescent samples (Colder et al., 2013; McCarty et al., 2013). The fact that early decreases in conduct problems did not mediate intervention effects on alcohol misuse in our study is consistent with studies showing that conduct problems are not causally linked to substance use behaviors, but rather that these behaviors are concurrently related as part of a spectrum of externalizing behaviors (Castellanos-Ryan & Conrod, 2011; Urben et al., 2015). The psychopathology reduction (or affect regulation) mechanism of substance use appears to be more established in individual experiencing harmful alcohol use, or problematic internalizing or externalizing symptoms (Edwards et al., 2014). This is supported by results from several indicated intervention approaches, demonstrating that targeting early depressive symptoms or conduct problems led to subsequent decreases in substance use (Rohde et al., 2012; Zonnevylle-Bender et al., 2007). In contrast, our study participants were not selected based on indicators of high-risk behaviors; most participants did not drink at baseline and did not report problematic internalizing or externalizing symptoms (see O'Leary-Barrett et al., 2013). However, our results show that early postintervention changes in depressive symptoms partially mediated longer term intervention effects on anxiety symptoms and conduct problems. Early changes in drinking accounted for a relatively smaller portion of the variance in mental health symptoms over 2 years. These findings suggest that early improvements in mood may lead to broader improvements in long term well-being, and support the psychopathology reduction mechanism with regards to long term intervention effects on mental health symptoms.

The current findings largely do not support the hypothesis that changes in personality account for long term intervention effects on mental health or alcohol misuse (the common factors hypothesis). Our findings revealed that there were reductions in some personality risk factors in the intervention condition (particularly those that have been shown to be less stable over time), and that reductions in anxiety sensitivity accounted for a small portion of the intervention effects on both depressive and anxiety symptoms over 2 years. The relationship between anxiety sensitivity and both depressive and anxiety symptoms is supported by other studies (Olthuis, Watt, & Stewart, 2014). However, 2-year intervention effects on drinking behaviors were not accounted for by changes in personality. As outlined in our hypotheses, this selective intervention model involves targeting problematic coping specific to each personality trait (e.g., avoidance in anxiety sensitive youth), but does not try to change youth's personalities. The interventions discuss how youth can maintain their sense of individuality without their personality leading to problems. Youth were taught personality-specific coping strategies to enable them to better cope in situations where they misuse alcohol or drugs (e.g., thinking before acting in the impulsivity group, and evaluating potential short and long-term negative consequences of using substances to cope with feelings of frustration). The findings that 6-month intervention effects on drinking behaviors mediated most of the longer term outcomes of the intervention support this interpretation.

The clinical implications of these findings are that it is of crucial importance to intervene on early onset alcohol use behaviors, as delaying onset and tempering the quantity of drinking when it begins in early adolescence accounts for reductions in subsequent problematic drinking. Early intervention effects on alcohol use behaviors (i.e., over the first 6 months) may in fact serve as a marker of longer-term intervention effects on both substance and nonsubstance related problems. While the current results are specific to the mechanisms of the personality-targeted approach, one could hypothesize that they may also apply more widely to other evidence-based intervention approaches in community samples. Indeed, studies examining mechanisms of universal family focused substance use prevention programs found that intervention effects on substance misuse in young adulthood occurred indirectly through substance use initiation and growth factors in adolescence (Spoth et al., 2009; Spoth et al., 2014). These results suggest that, despite notable differences in the format and delivery of personality-targeted interventions relative to universal family focused interventions, reductions in early onset substance use behaviors may be key to longer term intervention efficacy on prob-

lematic alcohol use (either directly or indirectly) across various programs. We are currently investigating whether delays in early onset alcohol use result in benefits in cognitive domains through protecting the developing brain from the neurotoxic effects of ethanol (Lubman et al., 2007). However, until we have a more detailed understanding of intermediate processes, the proximal mechanisms by which early changes in alcohol use account for later intervention effects on substance use remains unclear.

In addition to reductions in substance use, personality-targeted interventions also result in global improvements in mood, anxiety and conduct problems across all personality groups (in addition to some personality-specific intervention effects on more severe levels of mental health symptoms; O'Leary-Barrett et al., 2013), which partially mediate longer term intervention effects on both internalizing and externalizing symptoms that are often comorbid with SUDs in clinical populations. The process through which the intervention effects came about in each personality group was not examined in the current study. It is possible, for example, that individuals learned personality-specific coping skills that enabled them to better manage their personality traits. Tentative support for this idea is provided by research demonstrating that personality-targeted interventions reduce coping motives for substance use (Conrod et al., 2011). Personality-specific intervention effects and mechanisms were, however, beyond the scope of the current study, and will be further investigated in subsequent studies in our lab and others (e.g., Olthuis, Watt, Mackinnon, & Stewart, 2015).

This study suggests that personality-targeted interventions impact alcohol misuse and psychopathology through two relatively independent processes. Specifically, 2-year intervention effects on problematic alcohol use appear to operate through the "developmental harm" mechanism (i.e., early reductions in drinking behaviors), whereas intervention effects on mental health symptoms appear to operate through reductions in psychopathology (specifically, depressive symptoms) and, to a certain extent, reductions in personality risk factors (the common factors hypothesis), with short term reductions in anxiety sensitivity partially mediating intervention effects on internalizing symptoms. This has implications for both mental health and substance use prevention. Namely, the current results suggest that, in a preventive context at least, intervention effects on alcohol misuse may not be dependent on improvements in mental health symptoms, and vice versa. These findings also inform models of substance use and psychiatric comorbidity in that common risk factors (i.e., high risk personality profiles) may confer risk to different sets of problems that might not be causally related in youth. As discussed above, the causal relationship between substance misuse and mental health symptoms may become more evident when levels of substance use and psychopathology are greater than in the current sample (as suggested by several studies in clinical samples, e.g., Edwards et al., 2014).

The strengths of this study include its cluster-randomized design, large sample size and methodological rigor. The examination of mechanisms of effective interventions is crucially important in guiding treatment strategies, and targeting risk factors for addiction and comorbid problems is an innovative approach that is much needed due to the difficulties faced treating substance use comorbidity in clinical populations.

One limitation of these results is that the mediators examined accounted for only a small portion of the variance in intervention effects on internalizing and externalizing symptoms. This suggests that the mechanism of intervention effects on mental health symptoms is largely not captured by the variables examined. The variance in problematic drinking accounted for by the current models is larger (up to 57% for binge drinking rates), but there is still a significant portion of variance in intervention effects that is not explained by the variables examined. One reason for this may be that the study was designed to provide insights into the mechanisms of long-term intervention effects, but not to test the process through which these changes are achieved (which may explain more of the variance). A second limitation is that we did not include additional measures of personality risk factors with which to supplement our investigation of the common factors hypothesis, such as cognitive measures of disinhibition or behavioral measures of personality traits. A subsequent trial in our lab is investigating cognitive measures associated with each personality risk factor and will be able to shed further light on this question. Third, while the current findings largely contrast with the psychopathology reduction hypothesis, they do not necessarily disprove the hypothesis as the sample in question is relatively healthy. A recent study suggests that, although there may not be a direct psychopathology reduction, or affect regulation, pathway to substance use in adolescence, the internalizing pathway to adolescent substance use may be mediated by individual's rumination style (Adrian et al., 2014). This suggests that more proximal mechanisms of intervention effects such as emotional and cognitive processing would provide greater insight into the relationship between substance use and internalizing and externalizing symptoms, and an even richer understanding of the process through which participants responded to the intervention. Intervention process is being examined in a subsequent study. Lastly, personality-targeted interventions were compared with drug education and psychological services as usual in control schools, as opposed to an active comparison intervention, thus control participants had less contact with school-based intervention facilitators. However, there was no difference in the amount of contact with research project staff across treatment conditions, as the interventions were delivered by school-based professionals only. Two previous studies have demonstrated that personality-matched interventions are significantly more effective in reducing substance-related outcomes than personality-mismatched or motivational control interventions (Conrod, et al., 2000), or nonspecific treatments controlling for effects of group and therapist exposure (Watt, Stewart, Birch, & Bernier, 2006). This suggests that personality matching is key to intervention efficacy and reduces the likelihood that the reported intervention results are due to a placebo effect. In addition, the use of intent-to-treat analyses was a conservative data analysis procedure, as 120 (17.3%) of high-risk participants did not receive an intervention. The true impact of the intervention may therefore be stronger than what is reported here.

In conclusion, these findings suggest that long term personality-targeted intervention effects on problematic drinking in youth are largely accounted for by early changes in drinking behaviors, and not by changes in mental health symptoms or personality risk factors. Intervention effects on internalizing and externalizing symptoms are largely accounted for by reductions in depressive symptoms and reductions in anxiety-sensitivity (in the case of internalizing symptoms). Thus, targeting personality risk factors leads to intervention effects on substance- and nonsubstance-

related behaviors that appear to operate through distinct mechanisms.

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Bridging statement to Study 4

Comments on Study 3

The results from Study 3 suggest that 2-year intervention effects on binge drinking and alcohol-related problems are partially mediated by early changes in drinking behaviours in the 6 months post-intervention. In addition, global improvements in mood in the 6 months post-intervention were found to partially mediate intervention effects on both internalising and externalising symptoms over 2 years. These results emphasise the clinical significance of targeting early-onset drinking behaviours, which can then account for longer term intervention effects on substance misuse. The mediating role of short term intervention effects on alcohol use is also supported by long-term investigations of family-focused universal prevention programs (Spoth, Trudeau, Guyll, Shin, & Redmond, 2009; Spoth, Trudeau, Redmond, & Shin, 2014). The results also suggest that early reductions in the growth in alcohol consumption or mental health symptoms may represent proximal markers of longer term intervention efficacy. However, we have not yet investigated the more proximal processes through which this personality-targeted intervention program has its effects.

Introduction to Study 4

Study 4 uses a mixed mixed methods design including both quantitative and qualitative data in order to elucidate candidate process variables that account for positive behavioural changes subsequent to personality-targeted interventions. This study proposes to test the extent to which personality-targeted interventions impacts on core elements of the cognitive behavioural therapy model of change in psychopathology, namely reducing cognitive distortions, increasing adaptive coping (and decreasing maladaptive coping), and increasing self-efficacy. The study will use a combination of investigator-driven hypotheses and youth-generated feedback to elucidate key intervention features associated with early indicators of treatment efficacy over a 12-

month period. Following Study 3 (O'Leary-Barrett, Castellanos-Ryan, Pihl, & Conrod, revised manuscript under consideration), early reductions or reduced growth in alcohol use and mental health symptoms will be considered as proximal indicators of longer-term intervention efficacy. Data was collected as part of the Co-Venture cluster randomised controlled trial, which is a five-year trial of the Preventure personality-targeted intervention program currently being carried out in 31 high schools in Montreal, Canada. As recommended, intervention processes are being explored before presenting outcome data in order to avoid interpretation biases (Oakley et al., 2006). Nevertheless, results from previous randomised controlled trials suggest that intervention outcomes on both substance misuse and mental health symptoms will be favourable (Conrod et al., 2011; Conrod et al., 2010; Conrod et al., 2013; Conrod et al., 2006; O'Leary-Barrett et al., 2013).

Study 4

Process variables predicting changes in alcohol consumption and mental health symptoms following personality-targeted interventions: an exploratory study.

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(manuscript under review, *Psychotherapy Research*)

Abstract

Objective: This study aims to identify key process variables that predict changes in alcohol consumption and mental health symptoms over 12 months following personality-targeted interventions in youth.

Method: 154 high-risk youth (aged 12-13 years) in 7 Montreal high schools were identified using the Substance Use Risk Profile Scale and participated in personality-matched interventions. Preliminary process variables were identified using a combination of investigator-driven hypotheses and youth-generated (qualitative) feedback immediately post-intervention.

Results: Learning, skill development and having a positive group experience were key to positive behavioural change. Youth-generated feedback independently accounted for 12-25% of the variance in the change in alcohol use and mental health symptoms over 12 months. Investigator-driven hypotheses relating to hypothesised mechanisms of action in a CBT intervention accounted for somewhat less of the variance in alcohol use (0-9%), but a moderate-to-large portion of the variance in changes in mental health symptoms (up to 44%).

Conclusions: The study findings highlight candidate process variables relevant to future implementations of this program that might inform change processes relevant to brief interventions with youth more generally. This study suggests that youth experiences can indicate proximal measures of program efficacy, and has implications for the dissemination of this brief intervention program.

Clinical Trial registered on www.ClinicalTrials.gov, "Does Delaying Adolescent Substance Use Lead to Improved Cognitive Function and Reduce Risk for Addiction", study NCT01655615.

Keywords

Prevention, alcohol misuse, mental health symptoms, cognitive-behavioural therapy, process, youth feedback

Introduction

Understanding the mechanisms of effective interventions is a vital step in allowing us to understand how therapeutic change occurs. Isolating active ingredients of treatment, and focusing on those components of therapy that drive change is fundamental in order to maximise treatment efficacy and minimise iatrogenic elements across clinical practice (Shirk & Karver, 2006). Psychotherapy process research is a necessary complement to efficacy studies (Elliott, 2010), and provides insight into the maintaining factors and etiology of psychological problems. Treatment processes are currently understudied, particularly within youth populations (Weersing & Weisz, 2002), and interventions conducted in a group format (Webb, Auerbach, & Derubeis, 2012; Webb & Sheeran, 2006).

A selective personality-targeted intervention program known as Preventure has been shown to delay the onset and growth of alcohol and drug misuse in youth, as well as to reduce internalising and externalising symptoms up to 2 years post-intervention in 4 separate school-based randomised controlled trials (Conrod, Castellanos-Ryan, & Mackie, 2011; Conrod, Castellanos-Ryan, & Strang, 2010; Conrod et al., 2013; Conrod, Stewart, Comeau, & Maclean, 2006; Lammers et al., 2015; O'Leary-Barrett et al., 2013). This manuscript aims to identify key process variables that predict changes in alcohol consumption and mental health symptoms over 12 months in a sub-sample of youth who have participated in the Preventure program. In order to do so, we will first describe theoretical underpinnings of the Preventure model and the potential mechanisms of action, which will inform the hypotheses examined in this study.

Preventure is based on empirically supported treatments for alcohol misuse, namely cognitive behavioural therapy (CBT; Waldron & Turner, 2008) and motivational interviewing (Jensen et al., 2011). Additionally, Preventure integrates intervention characteristics associated with heightened program efficacy in school settings, namely targeting high-risk youth in a preventive format and having groups led in an interactive manner with peer contributions (Gottfredson & Wilson, 2003).

CBT for substance misuse is based on the premise that problematic alcohol and drug use reflect a lack of adaptive coping skills, and a lack of self-efficacy in the face of negative or distressing situations (Marlatt, 1985; Witkiewitz & Marlatt, 2004). Conrod and Stewart (2005) have expanded the relapse prevention model to describe how concurrent mental health and addictive behaviours can be treated using CBT, with a particular focus on personality-specific cognitive distortions and alcohol expectancies, and personality-specific coping strategies, forming the theoretical model for Preventure. Despite CBT's strong theoretical foundation and solid evidence base, the evidence regarding the notion that changes in cognitions and improvements in coping and self-efficacy are the mechanisms through which problematic behaviours decrease is mixed, both in treatments for substance use (Morgenstern & Longabaugh, 2000) and other disorders (Garratt, Ingram, Rand, & Sawalani, 2007; Longmore & Worrell, 2007). This study proposes to test the extent to which the Preventure program impacts on core elements of the CBT model of change, namely coping skills, self-efficacy and cognitive distortions.

A second key feature of Preventure is the integration of the motivational interviewing (MI) "spirit" (Miller & Rollnick, 2002) within a CBT framework. MI is deemed particularly effective in targeting problematic behaviours where individuals experience ambivalence around change, such as substance use. Brief MI interventions are effective for a range of behaviours in youth and adult populations, although effect sizes are known to be variable (Foxcroft, Coombes, Wood, Allen, & Almeida Santimano, 2014; Hinshaw, 2002). A novel features of the Preventure approach is that MI strategies are directed towards promoting prosocial behaviours in the absence of problems; interventions orient youth to focusing on their personal motives for change in relation to their valued life goals. Research on change processes in MI is in its infancy, but a recent study suggests that certain MI exercises, such as decisional balancing and goal setting, are associated with larger effect sizes in brief interventions for adolescents (Tanner-Smith & Lipsey, 2015). Litt et al (2003) demonstrated that higher levels of readiness to change enhanced the use of adaptive coping skills following interventions for alcohol dependence. The current study will provide an opportunity to examine whether participants' motivation or readiness to change are associated with positive treatment response.

In addition, it has long been discussed that many treatments include common or "non-specific" factors, such as the establishment of a therapeutic alliance and the use of empathy, which are associated with therapeutic outcome (Wampold, 2001; Weinberger, 2014). There is a continuing debate in the field of psychotherapy as to whether common factors may lead to similar processes of therapeutic change across treatment modalities (Heimberg & Ritter, 2008; Messer & Wampold, 2002). To corroborate this suggestion, several authors cite evidence suggesting that there is no significant difference in effectiveness between treatments (*e.g.,* Wampold, 2001), including alcohol interventions (Klimas et al., 2014), delivered in either group or individual formats (Sobell, Sobell, & Agrawal, 2009; Tanner-Smith & Lipsey, 2015). It is thus important to consider the role of common or non-specific therapeutic factors when investigating intervention process. In Preventure, it is thought that grouping youth with peers with similar personality profiles may be particularly helpful with regards to normalising personality-specific difficulties (*e.g.,* feelings of worthlessness in youth prone to hopelessness) and facilitating introspection through identification with similar peers. Normalising difficulties and reducing stigma may improve self-esteem, which in turn may facilitate change (Budman et al., 1989; Foxcroft & Tsertsvadze, 2011; Vigna-Taglianti et al., 2014). Other studies of group psychotherapy highlight that social support among group members is one of the strongest predictors of treatment response (Burlingame, Fuhriman, & Johnson, 2004), and perceptions of group climate have also been shown to influence participants' benefit from psychotherapy groups (Ogrodniczuk & Piper, 2003).

In addition to theory-based, or researcher-driven hypotheses, assessing patients' perspectives is particularly important in process research, as studies suggest that patients' perceptions of group factors may be more strongly associated with outcomes than ratings by observers or therapists (Harel, Shechtman, & Cutrona, 2011; Piper, Ogrodniczuk, Lamarche, Hilscher, & Joyce, 2005). Indeed, integrating stakeholders (in this case, youth participants) into the research process is expected to enhance the relevance and implementation of an intervention approach (Graham & Tetroe, 2009; Henderson et al., 2012). Many component studies investigating CBT process to date have focused on exploring intervention mechanisms from an investigator-driven perspective based on the

theorised intervention model (*e.g.,* changes in cognitions and coping), with mixed results as discussed above. Qualitative data representing participants' perspectives can be used to assess whether participants' experiences match the intended therapeutic model. Indeed mixed methods approaches are recommended in investigating intervention process (Oakley et al., 2006; Stiles, Hill, & Elliott, 2014). More importantly, it is necessary to link these perspectives to actual behavioural change, which is not often done in such research.

The current study aims to identify key process variables predicting changes in alcohol consumption and internalising and externalising symptoms over 12-months in a sub-sample of youth who have completed personality-targeted post-intervention in an ongoing randomised controlled trial. Investigating changes during the first 12 months post-intervention is of particular interest as a recent Preventure study suggests that early intervention effects on alcohol consumption and mood are key in accounting for longer-term intervention effects (O'Leary-Barrett, Castellanos-Ryan, Pihl, & Conrod, under review). It is expected that levels of alcohol consumption will increase during the 12 months post-intervention, as it is normative for youth to take up and experiment with alcohol use from 12 years of age (Traoré et al., 2014). Similarly, internalising and externalising symptoms are known to increase across childhood and adolescence (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003). A reduced growth in alcohol consumption or mental health symptoms over the first 12 months post-intervention may therefore represent a proximal marker of longer term intervention efficacy. This study will use a mixed methods design including both quantitative and qualitative data in order to investigate several questions of interest. Firstly, investigator-driven hypotheses will be examined pertaining to the relationship between potential mechanisms of change relating to CBT (coping, cognitive distortions, self-efficacy), MI (motivation to change) and general therapeutic processes (self-esteem) that are hypothesised to reflect multiple components of process leading to a positive treatment responses. Secondly, youth-generated qualitative (open-ended) data will be used to supplement and (possibly) confirm investigator-driven hypotheses.

Method

Participants and procedure

The current study is being conducted using data from the Co-Venture project, an ongoing cluster randomised controlled trial evaluating the effectiveness of school-based personality-targeted interventions on substance use over 5 years trial in Montreal (Quebec), Canada. The trial is being conducted in 31 high schools, with all consenting adolescents enrolled in grade 7 (12-13 years) at baseline (N=3670). In the first year of the trial, intervention schools were trained and assisted by clinical research staff in the delivery of interventions to a selected group of high-risk students (42.6%), defined as those meeting criteria for personality risk according to the Substance Use Risk Profile Scale (SURPS; Woicik, Stewart, Pihl, & Conrod, 2009) . Participation for both survey and intervention phases was informed by passive consent from parents and active assent from students, following approval from the CHU Sainte-Justine Research Ethics Committee (#3427). Data collection occurred during regular class times using a web-based platform (Psytools software; Delosis Ltd, London, UK). Additionally, high-risk youth in 7 intervention schools who completed their intervention sessions from November 2013 onwards completed a self-report Group Experience Questionnaire directly following the final intervention session.

Whilst the primary outcomes of the trial are intervention effects on the development of substance use and related problems over 5 years, the current study will present 12 month follow-up data from a subsample of high-risk intervention youth who were administered the primary measure of interest for this study, namely the Group Experience Questionnaire (n=154). Intervention outcomes will be reported at a later date. Please see Figure 1 for the trial design.

Measures

Personality

The Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009) is a 23-item questionnaire assessing variation in personality risk for addiction along 4 dimensions:

sensation seeking, impulsivity, anxiety sensitivity and hopelessness. Students who score more than one standard deviation above the school mean on any of the four personality risk subscales are considered as high risk (approximately 40-45% of the sample). The SURPS has good concurrent, predictive and incremental validity with regards to differentiating individuals prone to reinforcement-specific patterns of substance use (Castellanos-Ryan, O'Leary-Barrett, Sully, & Conrod, 2013; Krank et al., 2011; Woicik et al., 2009). SURPS traits are concurrently and prospectively associated with substance misuse and non substance-related externalising behaviours and internalising symptoms (Castellanos-Ryan et al., 2013). A French translation of the SURPS has been validated in a sample of Quebec youth (Castonguay-Jolin et al., 2013). Each subscale had good internal reliability for short scales in the current study (Swailes & McIntyre-Bhatty, 2002), with Cronbach alpha coefficients ranging from .63-.84 [α=.63 for sensation seeking (6 items); α=.64 for anxiety sensitivity (5 items), α=.69 for impulsivity (5 items); α=.84 for hopelessness (7 items)]. Inter-item correlations for each subscale were as follows: sensation seeking: .22, anxiety sensitivity: .26, impulsivity: .31, hopelessness: .42, which are considered acceptable or measures of broad personality characteristics (Clark et al., 1997). Personality subscales had good test-retest reliability over 12 months ($p<.001$ for each subscale).

Outcome variables

Alcohol use

Self-report alcohol use was assessed using a modified version of the "Detection of alcohol and drug problems in adolescents" questionnaire (DEP-ADO; Germain et al., 2005). Youth were asked to report on the frequency of their lifetime alcohol use and the quantity of their alcohol use during drinking episodes in the past 12 months. This tool has demonstrated good construct validity, internal consistency and test-retest reliability in Quebec youth, and reliably identifies youth with alcohol and drug use disorders (Landry, Tremblay, Guyon, Bergeron, & Brunelle, 2004).

Mental disorder symptoms

Depression and anxiety symptom severity over the past 12 months were measured using the Depression and Anxiety subscales from the Brief Symptoms Inventory (Derogatis, 1993). Conduct problems over the past 12 months were assessed according to the conduct subscale of the Strengths and Difficulties Questionnaire (Goodman, 1997).

Investigator-driven hypotheses: theorised mediator variables

Self-esteem

Self-esteem was measured using the Rosenberg Self-Esteem Scale (Rosenberg, 1965), a 10-item questionnaire which asks participants to respond to a list of statements regarding general feelings about themselves. This scale has been extensively validated in adolescent samples as a measure of global self-worth (Gray-Little, Williams, & Hancock, 1997).

Coping

Participants completed the 28-item Brief COPE questionnaire (Carver, 1997), which assesses a broad range of coping behaviours using 14 subscales of 2 items each. 8 scales measure adaptive coping strategies (*e.g.,* active coping, using emotional support, planning) and 6 focus on maladaptive coping strategies (*e.g.,* substance use, behavioural disengagement, denial), associated with desirable and undesirable outcomes, respectively (*e.g.,* Carver et al., 1993). The full scale COPE questionnaire (Carver, Scheier, & Weintraub, 1989) has been validated in adolescent populations (Phelps & Jarvis, 1994), and the brief COPE has been used with adolescents (Stratta et al., 2014) in both English and French (Muller & Spitz, 2003). Composite adaptive and maladaptive coping scores were created following previous studies (Carver et al., 1993; Meyer, 2001) and used in subsequent analyses.

Cognitive distortions (automatic thoughts)

Automatic thoughts were assessed using the personal failure and hostility subscales of the Children's Automatic Thought Scale (Schniering & Rapee, 2002), which examines participants' experiences of negative self-statements. These two subscales were selected

as some of the statements were related to cognitions targeted during the Preventure program.

Intervention process variables

Participants' intervention experiences

The Group Experience Questionnaire (GEQ) is a mixed-methods questionnaire that was designed for the purpose of this study in order to measure participants' intervention experiences. It includes both qualitative and quantitative data. It was administered to 156 high-risk participants from 7 intervention schools directly following the completion of their final intervention session as a self-report measure. This sub-sample corresponded to those completing the interventions post-November 2013, which is when the questionnaire was finalised by the research team. In order to protect respondents' confidentiality, questionnaires were identified using unique identifier codes, and participants placed their questionnaires directly into an envelope following completion, which was then sealed and not shown to the group facilitator. Participants responded to questions relating to their level of motivation and self-efficacy to make a personal change using a 7-point Likert scale (0=not at all motivated/confident, 7=extremely motivated/confident). Participants were also asked to respond to 4 open-ended questions in free format namely "Something that you liked about the group", "Something that you didn't like the group", "What is the most important thing you have learned from this workshop?" and "What is the change that you are considering?" (subsequent to being asked "How motivated are you to make a change following this workshop?")

Coding of qualitative data

Content analysis of the four open-ended questions was conducted following Braun & Clarke (2006). The coding was conducted in three stages, as follows. 1) Data entry and reading responses to become familiar with the data. 2) Generating initial themes emerging from the dataset. 3) Reviewing themes and refining final list of themes coded according to the theoretical model being examined, namely cognitive-behavioural therapy and motivational interviewing, in order to ensure that themes coded could be used to

answer specific questions about the salience and influence of various therapeutic features, following Boyatzis (1998). 4) Coding data according to the list of themes. Three raters coded the data independently and then met to resolve inconsistencies in their responses after each stage. If participants provided more than one response to a question (which was the cases in 28.2% of respondents), the response was given multiple codes to reflect each theme represented therein.

Interventions

Personality-targeted interventions involved two 90-minute group sessions led by a trained facilitator and co-facilitator. Groups were run with personality-matched adolescents. The mean group size was 6 (standard deviation: 2.64). Interventions were manualised, and incorporated cognitive-behavioural therapy (CBT), psycho-educational and motivational interviewing (MI) components. Manuals were adapted from previous trials (Conrod et al., 2013) and included real life "scenarios" shared by Montreal youth in specifically-organised focus groups. In the first session, participants were guided in a goal-setting exercise designed to enhance motivation to change behaviour. Psychoeducational strategies were used to teach participants about the target personality variable and associated problematic coping behaviours. Substance misuse was referred to as a problematic coping behaviour across all groups, and the groups discussed personality-specific motives for substance use (*e.g.,* to cope with feelings of sadness in the hopelessness-prone group). Other personality-specific maladaptive coping behaviours were discussed in each group, *e.g.,* interpersonal dependence (hopelessness groups) and risky behaviours (sensation seeking groups). A decisional balancing exercise was used to explore short and long term consequences of maladaptive coping behaviours. Participants were then introduced to the CBT model and guided in breaking down personal experiences according to the physical, cognitive, and behavioural components of an emotional response. All exercises discussed thoughts, emotions, and behaviours in a personality-specific way, *e.g.,* identifying situational triggers and cognitive distortions related to impulsivity specifically. In the second session, participants were encouraged to identify and challenge personality-specific cognitive distortions (*e.g.,* negative, global, self-referent thinking for hopelessness) that can lead to problematic behaviours.

Training and supervision

Training in the delivery of personality-targeted interventions was offered to up to 5 staff-members per school. Trainees included teachers, school counsellors, and special educational needs staff. Facilitators attended a 3-day workshop reviewing principles of CBT, MI and general counselling involving didactic instruction and role-play exercises. Following the 3-day workshop, the trainees received a minimum of 4 hours of supervision and feedback from the clinical team in conducting a full intervention with groups of grade 8-10 students who were not involved in the formal trial. A scale was developed by the principal investigator (P.C.) to evaluate adherence to 12 core treatment components of the personality-targeted intervention program (*e.g.,* goal setting, identifying and challenging automatic thoughts- described in (O'Leary-Barrett et al., under review). The Cognitive Therapy Scale-Revised (Blackburn, James, Milne, & Reichelt, 2001) and the Motivational Interviewing Treatment Integrity 3.0 (Moyers, Martin, Manual, Miller, & Ernst, 2007) were used to assess the quality of CBT and MI skills demonstrated, respectively. These questionnaires were used during supervision in order to provide trainees with feedback and ensure that they reached sufficient levels of program delivery before running personality-targeted interventions with trial participants. A total of 76 intervention groups were run, 35 (46%) of which were conducted by school staff, and 41 (54%) were conducted by the clinical team. Previous research conducted in our laboratory suggests that the efficacy of personality-targeted interventions delivered by trained school staff is similar to that when delivered by skilled psychotherapists (O'Leary-Barrett, Mackie, Castellanos-Ryan, Al-Khudhairy, & Conrod, 2010).

Treatment integrity

The clinical research team observed and evaluated the quality and fidelity of 46 intervention sessions (at least one for each school-based facilitator) using the same scales as used during supervision. Each facilitator was observed running at least one intervention session. An independent rater from the Motivational Interviewing Network of Trainers (MINT) evaluated 6 sessions in order to provide independent verification with regards to quality of motivational interviewing skills demonstrated by facilitators. Ratings provided by the independent rater did not differ from the clinical team's.

Statistical Analyses

Investigator-driven hypotheses

Theorised mediator variables

Linear regression analyses were conducted in MPlus (Muthén & Muthén, 2010) in order to examine whether changes in theorised mediator variables (coping, cognitive distortions and self-esteem), predicted changes in alcohol consumption or mental health symptoms over the 12 months following the interventions. R^2 was used to indicate how much of the variance in changes in outcomes over 12 months were accounted for by the theorised mediator variables.

Intervention process variables

Linear regression analyses examined whether levels of motivation and self-efficacy predicted changes in alcohol consumption or mental health symptoms over the 12 months following the interventions.

Youth-generated information

Identification of salient themes of intervention

Descriptive statistics were conducted using IBM SPSS Statistics 21 on the 154 high-risk intervention participants that had completed the Group Experience Questionnaire immediately following the final personality-matched intervention session. Frequency analyses were used to describe the most salient features of the interventions as reported by participants in free format responses.

Participants' intervention experiences: qualitative data

Linear regressions in MPlus were used to examine whether participants' intervention experiences predicted changes in alcohol use over 12 months. All group experience questions were explored as predictor variables, with the exception of intervention features that participants did not like, as this question was considered less relevant to change

processes. Linear regression were then used to examine whether the intervention features identified in the preceding analyses as predicting changes in alcohol use also predicted changes in mental health symptoms.

Residual scores were created for each outcome and theorised mediator or process variable at 12 months follow-up in order to remove the variance accounted for by the corresponding variable at baseline. These scores were used in all analyses. Gender and personality scores were included in all regression models as covariates. Multiple comparisons for all regression models were adjusted for using the Benjamini-Yekutieli false discovery rate method (Benjamini & Yekutieli, 2001; Narum, 2006).

Results

Baseline characteristics of the high-risk sample

Chi-squared tests and paired samples t-tests within the full Co-Venture sample (including low and high risk participants from both control and intervention schools, N=3670) revealed that participants with high levels of any of the four personality risk factors measured by the Substance Use Risk Profile Scale (Woicik et al., 2009) reported higher levels of the outcome variables of interest, namely rates of alcohol consumption (28.6% vs. 17.4%), quantity and frequency of alcohol consumption, depressive, anxiety and conduct problem symptoms ($p \leq .006$ for each). High-risk participants also reported differences in the theorised mediator variables relative to low-risk youth at baseline, namely higher levels of cognitive distortions (personal failure thoughts and hostile interpretations), more frequent use of of adaptive and maladaptive coping strategies, and lower self-esteem ($p < .001$ for each).

Sub-sample characteristics relative to other high-risk intervention participants

This study reports on data from a sub-sample of high-risk participants in intervention schools who completed the Group Experience Questionnaire (GEQ). The GEQ was administered to 156 high-risk participants from 7 intervention schools, namely 25% of the total sample of high-risk intervention participants. This sub-sample contains a higher percentage of females than high-risk intervention participants who were not administered

the GEQ (64.3% vs. 46.8%, $\chi^2(1)=14.59$, $p<.001$). There were higher levels of depressive in the sub-sample analysed [$t(194.78)=-3.33$, $p=.001$]. There were no differences in the reported quantity of alcohol consumption in the past year, conduct problems, anxiety or levels of each of the four SURPS personality traits in the sub-sample analysed relative to other high-risk participants in intervention schools (when Bonferroni corrections accounted for multiple testing).

Normative changes in alcohol consumption, internalising and externalising symptoms and theorised mediator variables

Paired samples t-tests within the high-risk subsample analysed indicated that the quantity, frequency and rates of alcohol consumption increased from baseline to 12 months follow-up ($p\leq.01$), as expected given the normative uptake and experimentation with alcohol use in adolescence. There were decreases in the use of adaptive coping strategies during the 12-month period ($p<.001$), and a trend-level increase in hostile automatic thoughts ($p=.06$). There were no changes in personal failure thoughts, self-esteem, use of maladaptive coping strategies, depressive or anxiety symptoms, or conduct problems.

Investigator-driven hypotheses

Association between theorised mediator variables and changes in alcohol consumption

Changes in coping, self-esteem and automatic thoughts were not associated with changes in alcohol consumption over the 12 months post intervention. R^2 (shown in Table 1) indicated that regression models including the theorised mediators accounted for up to 25% of changes in alcohol use behaviours 12 months. Coping, automatic thoughts and self-esteem independently accounted for 0-9% of the variance in the changes in alcohol consumption over 12 months-post intervention, when taking into account gender and personality, but adding these variables to the regression models did not significantly increase the proportion of variance in alcohol consumption accounted for beyond gender and personality.

Association between theorised mediator variables and changes in mental health symptoms

Coping

Changes in adaptive coping were negatively associated with changes in depressive symptoms ($p<.01$), but were not associated with changes in anxiety symptoms or conduct problems. Changes in maladaptive coping were positively associated with changes in depressive and anxiety symptoms ($p<.001$ for both), but not associated with changes in conduct problems. R^2 (shown in Table 1) indicated that changes in coping accounted for up to 13% of the variance in internalising symptoms and 1% of the variance in conduct problems, but adding coping variables to the regression models did not significantly increase the proportion of variance accounted for by the models beyond gender and personality.

Automatic thoughts

Changes in personal failure thoughts were positively associated with changes in depressive and anxiety symptoms ($p<.001$ for both), but not associated with changes in conduct problems. Changes in personal failure thoughts independently accounted for the largest portion of variance in outcomes relative to other mediators (up to 44% of the variance in internalising symptoms), and adding this variable to regression models significantly increased the proportion of variance in internalising symptoms accounted for by the models. Changes in hostile thoughts were not associated with changes in internalising or externalising symptoms over 12 months. Changes in hostile thoughts independently accounted for 4-11% of the variance in mental health symptoms over 12 months, and significantly increased the variance in depressive symptoms accounted for when added to the regression models (but did not increase the variance in anxiety or conduct problems symptoms accounted for).

Self-esteem

Changes in self-esteem were negatively associated with changes in both internalising and externalising symptoms over 12 months post-intervention ($p\leq.001$ for each). Changes in

self-esteem accounted for up to 35% of the variance in internalising symptoms and 14% of the variance in conduct problems, and adding this variable each of the three mental health symptom models significantly increased the proportion of variance accounted for by each of the models.

Motivation and self-efficacy

As rated on Likert scales (1=not at all, 7=extremely), participants reported being motivated to make a change following the workshop (m=5.08±1.48), and confident that they could do so (m=5.17±1.44). However, motivation and self-efficacy were not associated with changes in alcohol consumption or mental health symptoms over 12 months.

Youth-generated information

Salient intervention features according to participants

Please see Table 2 for the list of youth-generated themes in response to the four questions posed and example responses.

Association between youth-generated responses and changes in alcohol use over 12 months (please see Table 3 for regression coefficients).

"Something I liked about the intervention."

Participants who endorsed liking learning during the intervention reported no increase in the quantity of alcohol consumed during drinking episodes or the frequency of alcohol consumption over 12 months post-intervention relative to intervention participants who did not express liking learning, who reported an increase in the quantity ($p=.05$) and frequency ($p<.001$) of alcohol consumption over 12 months. Liking the intervention ambiance was also associated with reporting no change in the alcohol quantity of alcohol consumption over 12 months relative to participants who did not endorse this theme, who reported an increase in the quantity of alcohol consumed over time ($p=.003$). Liking other intervention features (sharing, material reasons) was not associated with changes in alcohol consumption.

"What is the most important thing you have learned from this workshop?"

Participants who expressed that the most important thing they learned from the workshop was coping, goal setting, psychoeducation and managing or challenging thoughts reported no increases in alcohol use onset over 12 months, in contrast with an increase in alcohol use rates for those participants who did not endorse these themes ($p<.05$ for each). Participants who endorsed learning about coping, goal setting and thoughts also reported smaller increases in the frequency of alcohol use over 12 months (for those who expressed that the most important thing they learned from the workshop was goals, there was no change in the frequency of alcohol consumption over 12 months).

"What is the change that you are considering?"

Contrary to expectations, participants who expressed that they were considering changing their thought patterns subsequently reported a larger increase in their frequency of alcohol consumption over 12 months. However, considering changing one's thought patterns did not predict differences in alcohol consumption over the 12 months follow-up, nor did considering changing feelings or behaviours.

<u>Association between youth-generated responses and mental health symptoms</u>

"Something I liked about the intervention."

Liking learning or the intervention ambiance did not predict differential changes in mental health symptoms 12 months post-intervention relative to participants who did not report liking these particular intervention features.

"What is the most important thing you have learned from this workshop?"

Participants who expressed that the most important thing they learned from the workshop was coping reported decreases in depressive symptoms ($B=-1.36$, $S.E.=.41$, $\beta=-.59$, $p<.015$), anxiety symptoms ($B=-1.38$, $S.E.=.46$. $\beta=-.56$, $p<.015$) and conduct problems ($B=-1.10$, $S.E.=.46$. $\beta=-.47$, $p=.015$) over the 12 months post-intervention relative to those who did not express having learned about coping, who reported no changes in mental health symptoms over 12 months. Participants who reported that goal setting was the most important feature of the intervention for them also reported decreases in

depressive symptoms over the 12 months post-intervention (B=-1.13, S.E.=.40, β=-.33, p<.015). Participants who expressed that managing/ challenging thoughts or psychoeducation were the most important intervention features to them did report any differential changes in mental health symptoms over the 12 months post-intervention.

"What is the change that you are considering?"

Participants who considered changing their thought patterns did not report any differences in in mental health symptoms over 12 months relative to those who did not endorse this response. Given the unexpected association between considering changing thoughts and an increase in the frequency of alcohol consumption, post-hoc analyses examined whether endorsing this intervention features was associated with changes in the theorised mediator variables. Participants who expressed that they were considering changing their way of thinking reported having experienced an increase in personal failure thoughts over 12 months (B=1.53, S.E.=.58, β=.57, p<.015) relative to those that did endorse this response, who experienced no significant change in personal failure thoughts over time. Endorsing this response did not predict changes in coping, self-esteem or experiences of hostile thoughts.

Discussion

This study uses a combination of investigator-driven hypotheses and youth-generated feedback to explore key variables predicting changes in alcohol consumption and mental health symptoms over 12 months following participation in personality-targeted interventions. These findings underline the potential for using youth feedback as an early indicator of treatment efficacy, and provide valuable information regarding key intervention features associated with positive behavioural change. This conclusion is supported by others who suggest that integrating participants into the research process should improve the relevance and implementation of an intervention approach (Graham & Tetroe, 2009; Henderson et al., 2012). These findings may support the dissemination and evaluation of personality-targeted interventions in school settings where it is likely not be feasible to conduct long-term outcome evaluations.

This study suggests that participants' (qualitatively reported) experiences during group personality-targeted intervention sessions can influence the development of their alcohol consumption (and, in some case, in mental health symptoms) over the following 12 months. Participants' group experiences independently accounted for up to 25% of the variance in changes in alcohol use and 12% of the variance in mental health symptoms over 12 months. Results suggest that learning and skill development, in particular, are key to positive behavioural change. Youth who benefit the most from the intervention appear to be those for whom the cognitive-behavioural skills taught (*e.g.,* coping and cognitive restructuring) and goal-setting exercises are the most salient. Participants who reported learning about coping strategies, goal setting, managing thoughts and psychoeducation, and participants who reported liking learning and liking the group ambiance reported decreases or no change in their alcohol consumption over 12 months. In contrast, participants who did not endorse these responses reported increases in alcohol use behaviours over time. Learning about coping and goal setting was also associated with decreases in mental health symptoms over 12 months. This suggests that providing an engaging learning environment and a positive group atmosphere may contribute to the Preventure's intervention effects. These results contrast with other studies suggesting that knowledge doesn't typically translate to change in substance-related treatment programs (Tobler et al., 2000). However, engaging youth with a personally relevant intervention message by targeting specific personality risk profiles may provide a means to better interest and engage youth in the intervention process and the development of key skills.

By contrast, the theorised mediator variables defined according to investigator-driven hypotheses based on the theoretical framework underlying the CBT and general group process models (coping, cognitive distortions and self-esteem) were not associated with changes in alcohol consumption. Nevertheless, regression models revealed that these variables accounted for a small portion of the variance in alcohol use over 12 months (0-9%), which suggests that changes in alcohol use are not independent of changes in the coping, self-esteem and cognitive distortions. In addition, increases in self-esteem and reductions in personal failure thoughts predicted reductions in internalising and externalising symptoms over 12 months, and improvements in coping (reductions in

maladaptive coping or increases in adaptive coping) predicted reductions in internalising symptoms. The theorised mediator variables independently accounted for a sizeable portion of the variance in mental health symptoms (up to 44%). This suggests that changes in mental health symptoms are relatively closely associated with changes in self-esteem and automatic thoughts. The fact that the theorised mediator variables predicted changes in mental health symptoms but not alcohol use may be related to the fact that levels of alcohol consumption in this sample were relatively low in early adolescence. Rates of alcohol consumption were around 20%, whereas there was more variability in mental health symptoms. It may be worth re-examining these relationships at a later point in the study when youth are older and rates of alcohol consumption will likely be greater.
There was an increase in the levels of alcohol consumption in the 12 months post-intervention in our sample, as expected given the normative uptake and experimentation with alcohol use in adolescence (Traoré et al., 2014). Whilst it was not possible to compare this sample's alcohol consumption to their control counterparts, previous Preventure studies suggest that the anticipated growth in alcohol use would be greater in the control group (*e.g.,* Castellanos-Ryan et al, 2013; Conrod et al, 2011, 2013). Mean levels of internalising and externalising symptoms did not change over 12 months in our sample, in contrast to the expected increase in symptoms based on longitudinal developmental studies (Costello et al., 2003). It is not possible at this point to evaluate the trajectories of mental health symptoms in the control group, or comment on possible treatment effects. However, we considered a reduced growth in alcohol consumption of mental health symptoms to be clinically relevant indicators of likely enhanced intervention efficacy. This interpretation is supported by previous studies of both the Preventure program (O'Leary-Barrett et al., under review) and family-focused approaches (Spoth, Trudeau, Guyll, Shin, & Redmond, 2009; Spoth, Trudeau, Redmond, & Shin, 2014), which suggest that reductions in symptomatology in the 12 months post-intervention may be proximal markers of longer term intervention effects.

A number of findings were unexpected. Firstly, participants' levels of motivation and self-efficacy were not associated with changes in alcohol consumption and mental health symptoms over 12 months. It is not possible to conclude in this study whether

participants' reported levels of motivation and self-efficacy (which were relatively high) reflect the successful delivery of the intervention, or whether they may instead reflect pre-treatment individual features. Secondly, the changes that participants self-reported considering making were largely not associated with changes in alcohol consumption over 12 months. In fact, participants who reported considering changing their cognitions (22%) subsequently reported a greater increase in the frequency of alcohol consumption than those who did not consider making a cognitive change. It is possible that this response may reflect higher levels of distress, as post-hoc analyses revealed that these participants also experienced an increase in personal failure thoughts over 12 months. Thus, endorsing this response may flag participants who could benefit from additional interventions. A second possibility is that this response may point to participants who are not motivated to make a behavioural change, as they refer only to reconsidering their thought patterns, which could be considered more of a reflective, as opposed to an active process. Nevertheless, cognitive restructuring is considered to be a key component of CBT, with the assumption that challenging cognitive distortions can, in turn, promote behavioural changes. These hypotheses would need to be further examined in future studies that can relate intervention participants' experience to intervention efficacy.

This study has several strengths, namely that it employs a mixed methods approach within a complex intervention trial, providing a preliminary investigation of the process underlying an evidence-based intervention model, and addressing a gap in the literature (Oakley et al., 2006; Stiles et al., 2014). The inclusion of both qualitative and quantitative data allows us to test both hypothesised intervention mediators according to existing literature, as well as collecting open-ended information from participants on the most salient features of the intervention according to them that may not have been captured in previous studies. This was considered advisable given the mixed support for the theoretical explanatory model underling CBT, with studies suggesting that CBT interventions' efficacy may occur through pathways other than changes in coping and cognitive processes (*e.g.,* Litt et al., 2003; Longmore & Worrell, 2007).

The study also has several limitations. Firstly, despite the acknowledged rationale for investigating intervention process before outcome (Oakley et al., 2006), the importance of the various intervention features discussed remains preliminary in the absence of data on intervention outcomes. Longer-term follow-up within this study will also us to examine whether early changes in alcohol use over 12 months account for intervention effects, as anticipated, and whether the candidate process variables may mediate intervention effects. Nevertheless, this study highlights the features of the intervention which may contribute to enhanced intervention efficacy. Secondly, due to a delay in implementing the Group Experience Questionnaire on the part of the research team, the sub-sample who completed this questionnaire had some differences at baseline relative to other high-risk intervention participants. However, these baseline differences were accounted for in all analyses. Thirdly, whilst the study examined the most prominent proposed mediators underlying the therapeutic tools employed (*e.g.,* coping, cognitive distortions), changes in behaviours theoretically associated with the motivational components of the intervention were not explored in this study, such as changes in motivation, change talk and therapist behaviours (Apodaca & Longabaugh, 2009; D'Amico et al., 2015). Coping self-efficacy (often discussed in the CBT literature as a potential treatment mediator; *e.g.,* Marlatt, 1985) was also not specifically assessed. Whilst participants were asked to indicate their level of confidence relating to the change they considered making following the intervention, this is not equivalent to asking specifically about self-efficacy in relation to CBT tools. However, this study is not meant to review all potential treatment processes, but instead represents a first step in exploring potential active ingredients during the interventions from both youth and researcher-driven perspectives. Fourth, data on treatment integrity was not presented in this study- it is thus possible that intervention delivery may not have corresponded with the intended model. However, process data can be used to support treatment integrity (Rychetnik, Frommer, Hawe, & Shiell, 2002), and the data presented suggest that the intended cognitive behavioural and motivational intervention features were effectively communicated to participants. Lastly, there may be personality differences in intervention process, which could not be reliably examined in this study due to sample size limitations. These would be worth exploring in future analyses with a large sample.

However, personality scores were accounted for as covariates in all analyses in the current study.

In summary, certain aspects of the participants' experience during the group sessions were associated with proximal indicators of early intervention efficacy. These features largely reflected learning and skill development, and experiencing a positive group environment. These variables could potentially be used as post-intervention indices treatment response. The study findings highlight candidate process variables of the Preventure model relevant to future implementations of this program and might inform change processes relevant to brief interventions with youth more generally. One major limitation to maintaining evidence-based prevention programs in the community is the lack of resources to continually evaluate their impact on behavioural outcomes. This study provides some evidence to support using youth experiences as proximal measures of program efficacy.

Figure 1: CONSORT diagram

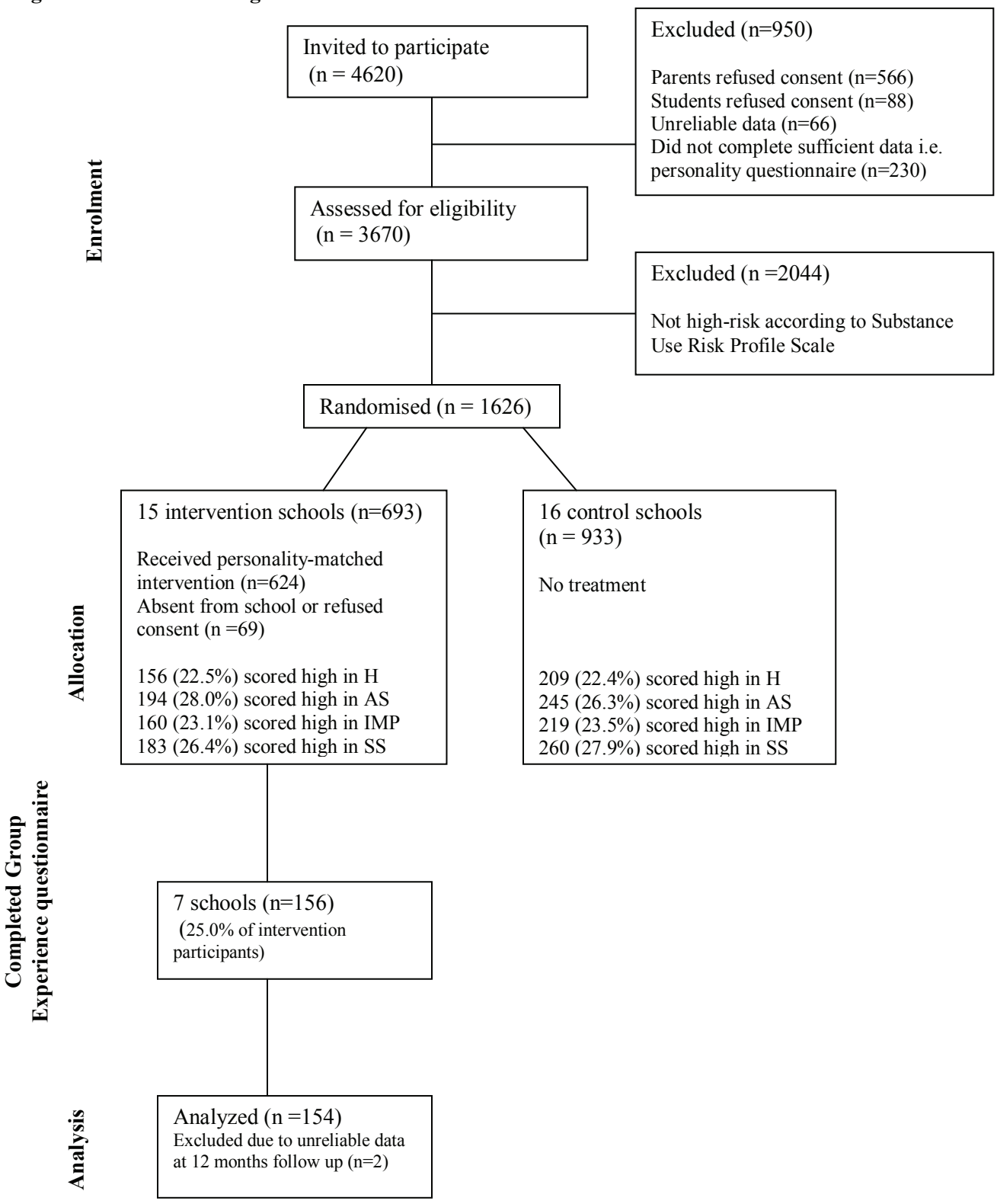

Table 1: Proportion of variance of alcohol use outcomes 12 months post-intervention accounted for by theorised mediator variables

	Model R^2 for outcome variables over 12 months post-intervention^					
	Alcohol use onset	Alcohol use quantity	Alcohol use frequency	Depressive symptoms	Anxiety symptoms	Conduct problems
Models accounting for gender and personality	.15*	.16**	.23***	.15*	.14*	.16*
Separate models with theorised mediators						
Coping^						
Adaptive	.15*	.16**	.23***	.15*	.16*	.17*
Maladaptive	.15*	.17**	.24***	.23*	.27**	.16*
Automatic thoughts^						
Personal failure thoughts	.15*	.18**	.25***	**.53*****	**.58*****	.20**
Hostile thoughts	.18*	.17**	.25***	**.26***	.23	.20*
Self esteem^	.16*	.25**	.25***	**.48*****	**.49*****	**.30*****

Note.

^Models accounting for mediator variables separately, with gender and personality as covariates.

* Significance of model R^2-: *p<.05, **p<.01, ***p≤.001

Coefficients in bold: significant increase in model R^2 when theorised mediator is added.

Table 2: Salient intervention features as reported by participants in open-ended questions

Group Experience Questionnaire: Questions and themes	Example responses	% participant endorsement^
Something that you liked about the group.		
Sharing	I liked sharing my stories and hearing about other people's experiences.	50.0%
	Knowing that we had common goals. Knowing that there are other people like me and feeling understood.	
	Sharing and not being judged by others. Knowing that everything was confidential.	
Ambiance	The atmosphere, the facilitators.	22.7%
	The group was fun.	
	The facilitators were nice and understanding. The friendliness.	
	I liked how comfortable I felt.	
Material reasons	The food and drink.	16.2%
	Missing class.	
Learning	Learning about impulsivity- I didn't know anything about it before.	15.6%
	Learning about how to find other solutions in difficult situations.	
	Talking about how to solve problems.	
	Learning about anxiety and ways to deal with it.	

Something that you didn't like about the group.		
Nothing	Nothing. I liked everything.	51.9%
Intervention content or structure	It was boring. There were some things that I didn't relate to. It was repetitive. That we had to do written exercises.	16.2%
Group atmosphere	Some people didn't want to share their experiences. Everyone was uncomfortable/shy. Sometimes everyone was speaking at once.	12.3%
Sharing	I don't like talking about my feelings. I didn't trust everyone in the group, even though we shared a confidentiality agreement.	6.5%
What is the most important thing you have learned from this workshop?		
Coping	I learned that I should always speak to people when I'm feeling down. That it's OKAY to express how you feel. How to control myself.	31.2%
Managing/challenging thoughts	Not to jump to conclusions. To think before I do my actions. (sic)	26.6%
Psychoeducation	There are people who feel the same as me. I think that this workshop really helped me to understand my anger.	24.7%

Goals	Set goals and reach for them.	10.4%
	To concentrate on your goal at all times.	
What is the change that you are considering?		
Behaviour	To stop doing things I'm not allowed to do.	31.8%
	To try to speak to my friends when they are feeling down.	
	To take any challenges that come my way.	
	Breath when I'm stressed and nervous.	
	Not be so mean.	
Feelings	To learn to calm down and properly control my anxiety.	31.8%
	Coping with my sensation seeking.	
	To be less nervous and to live freely.	
Thoughts	To think before making a decision, or an action.	22.1%
	Now I will challenge myself and look at the positives.	
	Being more positive towards myself in awkward situations or difficult situations.	

^Some participants provide more than one response to the questions. Each response was coded, thus total percentages surpass 100%.

Table 3: Linear regressions: youth-generated qualitative data predicting alcohol use outcomes 12 months post-intervention

Intervention features°	Outcome variables at 12 months post-intervention^		
	Alcohol use onset	Alcohol use quantity	Alcohol use frequency
		B (S.E.), [β]	
Something that you liked about the group.			
Learning	-.13 (.34), [-.05]	-.94 (.37), [-.39]*	-.76 (.29), [-.26]*
Sharing	-.18 (.25), [-.10]	-.70 (.29), [-.40]	-.54 (.23), [-.25]
Ambiance	-.16 (.26), [-.07]	-1.03 (.32), [-.49]*	-.63 (.27), [-.25]
Material reasons	.08 (.24), [.03]	.21 (.27), [.09]	-.12 (.22), [-.04]
What is the most important thing you have learned from this workshop?			
Coping	-1.16 (.30), [-.56]*	-1.14 (.50), [-.60]	-.90 (.35), [-.40]*
Goals	-1.05 (.30), [-.34]*	-.94 (.45), [-.33]	-1.39 (.33), [-.41]*
Psychoeducation	-1.44 (.41), [-.66]*	-.91 (.67), [-.45]	-.90 (.47), [-.38]
Managing/challenging thoughts	-.79 (.24), [-.37]*	-.75 (.45), [-.38]	-.83 (.29), [-.36]*

What is the change that you are considering?

Thoughts	.24 (.29), [.11]	.83 (.37), [.41]	.72 (.29), [.29]*
Feelings	.18 (.27), [.09]	.40 (.23), [.22]	.28 (.31), [.12]
Behaviour	.18 (.26), [.09]	.27 (.20), [.15]	.62 (.29), [.27]

Note.

^Outcome variables represented the residual scores of the alcohol use variable at 12 months post-intervention. All analyses accounted for baseline personality scores and gender as covariates;

° Participant-reported salient intervention features: open-ended response format;

B: Unstandardised coefficient, S.E.: standard error, β : Standardised beta; *p<.015 (significance level adjusted for multiple comparisons using the Benjamini-Yekutieli false discovery rate method)

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GENERAL DISCUSSION

This dissertation supports conclusions concerning the promising efficacy of a personality-targeted approach to the prevention of substance misuse and mental health problems in youth, and supports the utility of using a mechanism-informed approach to understanding and optimising an evidence-based prevention program.

Clinical significance of results following personality-targeted interventions

Study 3 demonstrates that brief, personality-targeted interventions can have clinically significant effects on levels of problematic alcohol use in youth associated with harmful consequences (Kuntsche et al., 2013) and likely to have a public health impact (following Spoth, Trudeau, Guyll, Shin, & Redmond, 2009; Spoth, Trudeau, Redmond, & Shin, 2014). Namely, relative reduction rates 2 years post-intervention for youth binge drinking on a weekly basis were 20%, and relative reduction rates for youth experiencing 1-2 negative consequences of alcohol use over the past 6 months were 15%. The health benefits associated with effective early substance misuse interventions are substantial: a 1-year delay in alcohol-use onset can decrease the risk for future alcohol dependence by almost 10% over 12 years (Grant, Stinson, & Harford, 2001). The potency of the Preventure interventions is comparable to effective universal family-focused programs such as the Iowa Strengthening Families Program (now referred to as the "Strengthening Families Program"; relative reduction rates 19-23%) and compares favourably to effect sizes from the Preparing for the Drug Free Years (now referred to as the "Guiding Good Choices" program, relative reduction rates 9-11%) (Spoth et al., 2009). This is impressive given the brevity of the personality-targeted intervention program (two 90-minute sessions), in contrast to substantially more intensive family-focused intervention programs that require 10-13 hours of intervention. A more recent study demonstrated that both the Strengthening Families Program and the school-based Life Skills Training program resulted in relative reduction rates of 13% for drunkenness (the most comparable outcome) for high-risk youth who had initiated substance use at baseline. However, relative reduction rates were much lower (2-4%) for youth who had not yet initiated substance use (Spoth et al., 2014). This suggests that a personality-targeted approach may

be more impactful than the Life Skills Training or Strengthening Families Program in baseline non-substance users, which are largely the youth targeted in preventive programs. Indeed, 60-70% of high-risk youth targeted in the interventions described in Studies 1, 3 and 4 had not consumed alcohol at baseline. A previous study (O'Leary-Barrett, Mackie, Castellanos-Ryan, Al-Khudhairy, & Conrod, 2010) suggests that personality-targeted interventions demonstrate stronger efficacy than many other universal school-based alcohol prevention programs, whose impact has been described as limited by several systematic reviews (Faggiano, Minozzi, Versino, & Buscemi, 2014; Foxcroft & Tsertsvadze, 2011; Tobler et al., 2000), with some programs even showing iatrogenic effects (Sloboda et al., 2009; Werch & Owen, 2002).

Study 1 demonstrates that personality-targeted interventions can have clinically significant intervention effects on internalising and externalising symptoms in high-risk youth, with a 21-26% reduction in the odds of experiencing severe depressive and anxious symptoms and severe conduct problem relative to control participants over 2 years (O'Leary-Barrett et al., 2013). Study 1 also demonstrates some personality-specific intervention effects in youth most at risk for a particular problem. Notably, the odds of reporting symptoms of severe conduct problems in youth with high levels of impulsivity were reduced by 36%, the odds of reporting severe anxiety symptoms were reduced by 33% in youth with high levels of anxiety sensitivity, and the odds of reporting severe depressive symptoms in youth with high levels of hopelessness were reduced by 23% (although this reduction was statistically non-significant). The prevention of mental illness in adolescence is particularly meaningful, as mental disorders in childhood and adolescence are associated with a significantly increased risk of experiencing chronic and recurrent mental health problems in later life, including major depressive disorder (Musci et al., 2015), severely negative life events (Champion, Goodall, & Rutter, 1995) and substance use disorders (Pihl et al., 2014).

Although initially designed as an alcohol and drug prevention program, this dissertation demonstrates that personality-targeted interventions can have positive effects on a variety of problematic symptoms or behaviours beyond substance misuse. The Preventure

program appears to reduce various pre-cursors to substance dependence, including delaying or reducing early alcohol and drug use (Conrod, Castellanos-Ryan, & Mackie, 2011; Conrod, Castellanos-Ryan, & Strang, 2010; Conrod, Castellanos, & Mackie, 2008; Conrod et al., 2013) and mental health symptoms, as shown in Study 1 (O'Leary-Barrett et al., 2013). Both early substance use (Grant & Dawson, 1997, 1998; Kuntsche et al., 2013) and mental health symptoms (Cooper, Frone, Russell, & Mudar, 1995; Lazareck et al., 2012; Mushquash et al., 2013) are associated with an increased risk for future substance dependence, suggesting that this early intervention may have a longer term impact on addiction outcomes. It could also be hypothesised that the intervention may impact on additional behaviours associated with early substance use that are not measured in this dissertation. Namely, early onset substance use is associated with multiple health risk behaviours (DuRant, Smith, Kreiter, & Krowchuk, 1999; Seth, Wingood, DiClemente, & Robinson, 2011), including delinquency, risky sexual behaviours and risky behaviours relating to car use (*e.g.,* not using a seat belt, riding with a driver who has been drinking). A delayed onset of substance use following personality-targeted interventions could therefore also be associated with reductions in other health risk behaviours. Preliminary unpublished findings suggest that the Preventure program is associated with reduced tobacco use, for example. In addition, delays in early alcohol onset may protect the developing adolescent brain against the potential damage on cognitive functioning (Zeigler et al., 2005). Studies in alcohol-dependent teenagers and college students have revealed impairments in mental performance relative to their non-drinking peers (Brown, Tapert, Granholm, & Delis, 2000), particularly in relation to verbal and non-verbal memory, attention, executive and visuospatial performance (Sher, Martin, Wood, & Rutledge, 1997; Tapert et al., 2001; Tapert & Brown, 2000). Poorer performance in specific cognitive domains have also been noted in social drinking populations (Parsons, 1998), including heavy alcohol or marijuana users in adolescence (Lisdahl & Price, 2012; Winward, Hanson, Tapert, & Brown, 2014). It can thus be hypothesised that a delay in the onset and growth in substance use following participation in personality-targeted interventions will be associated with improved cognitive functioning relative to no-intervention peers. Similarly, early onset depression has been

associated with brain alterations (Schmaal et al., 2015), which suggests that reductions in depressive symptoms in adolescence may protect against such brain effects. This hypothesis will be examined in the Co-Venture project, which includes longitudinal assessments of cognitive measures, and within a neuroimaging add-on project (Neuroventure), which will explore longitudinal neuroimaging data for Preventure program participants. Abnormalities in various cognitive processes have also been found to be implicated in the underlying vulnerability to substance misuse and externalising problems (Castellanos-Ryan et al., 2014), and to mediate the relationship between externalising personality profiles (impulsivity and sensation seeking) and personality-specific problematic outcomes (conduct problems and binge drinking, respectively; Castellanos-Ryan, Rubia, & Conrod, 2011). This suggests that potential improvements in cognitive functioning following the personality-targeted interventions could be indirectly associated with reduced externalising problems and substance misuse. Specifically, short-term delays in the growth of alcohol consumption, improvements in mood and reductions in anxiety sensitivity over the first 6 months following participating in personality-targeted interventions (from Study 3) are hypothesised to translate into longer-term term intervention effects through the protective effects exerted on the developing brain. Namely, a later onset and delayed escalation of alcohol use in adolescence as well as a reduction in the incidence of early mood disorders, and the ensuing promotion of cognitive functioning and psychological well-being are hypothesised to account for longer-term reductions in more problematic substance misuse and mental health symptoms and disorders (reported in Studies 1, 3 and previous publications, *e.g.,* Conrod et al., 2011; Conrod et al., 2010; Conrod et al., 2013; Mahu, Doucet, O'Leary-Barrett, & Conrod, 2015). See Figure 1 for a theoretical model of the mechanisms accounting for long-term intervention effects of the Preventure program, based on the results of this dissertation and the existing literature.

Higher cognitive functioning and a more positive mood are also associated with a reduced likelihood in susceptibility to negative peer influence in early adolescence (Mrug, Madan, & Windle, 2012), which in turn may reduce the subsequent risk of delinquency and substance use in intervention participants (Monahan, Steinberg, &

Cauffman, 2009; Selfhout, Branje, & Meeus, 2008; Wills & Cleary, 1999). A previous publication has noted that selective personality-targeted interventions appear to have a beneficial universal or "herd" effect on low-risk youth who did not participate in the interventions, which is reflected in lower levels of alcohol misuse in low risk youth in intervention schools (Conrod et al., 2013). Preliminary unpublished data from our lab suggest that an intervention that is successful in reducing alcohol use in high-risk adolescents has the potential to have a wider school-level impact by changing the way adolescents who use alcohol interact within their friendship groups. Alcohol use in grade 7 students has also been associated with increased rates of school suspension and school skipping in later high school (Hemphill et al., 2014). Additionally, increased alcohol use and/or skipping school have been associated with reductions in educational aspirations over time (Barry, Chaney, & Chaney, 2011). Reductions in alcohol use following participation in Preventure may therefore also be associated with improved educational outcomes. An earlier study of Preventure demonstrated, for instance, that intervention participants reported lower levels of school skipping over 6 months (Castellanos & Conrod, 2006). Longer-term follow-up in the Co-Venture project will allow a formal assessment of the impact of the personality-targeted interventions on academic achievement and school drop-out.

The use of mechanisms research

This dissertation also focuses on the mechanisms of personality-targeted interventions. Insights gained from exploring intervention process can be used to optimise and further refine the Preventure intervention strategy and may be applied more widely to other intervention approaches. Several conclusions were generated from the studies reported.

Firstly, Study 3 suggests that 2-year personality-targeted intervention effects on problematic drinking in youth are largely accounted for by changes in drinking behaviours in the first 6 months post-intervention, and are not mediated by changes in mental health symptoms or personality risk factors. This suggests that short-term intervention effects on the quantity and frequency of alcohol consumption may serve as proximal markers of longer term efficacy. This also suggests that the delay and reduction in alcohol misuse resulting from the Preventure program largely do not occur through an

improvement in negative affect. In contrast, the affect regulation mechanism of substance use disorder treatment has gleaned substantial support in clinical samples, both adult (Lazareck et al., 2012; Riper et al., 2014) and adolescent (Rohde, Stice, Gau, & Marti, 2012; Zonnevylle-Bender, Matthys, van de Wiel, & Lochman, 2007), where improvements in negative affect have been found to drive subsequent reductions in substance misuse. Study 3 highlights, therefore, that the mechanisms of treatment action in a preventive context may be different to those when psychopathology is already established. Study 3 also suggests that 2-year intervention effects on mental health symptoms are largely accounted for by early reductions in depressive symptoms and reductions in anxiety-sensitivity (in the case of internalising symptoms). This suggests that the intervention effects on alcohol consumption and mental health symptoms may occur through both common and specific processes, likely reflecting a combination of mental health and early-onset drinking on adolescent mental health trajectories. On a practical level, schools that choose to implement personality-targeted interventions without the continued input from the research team may be able to obtain an indicator of likely long-term efficacy of the intervention by assessing changes in their students' behaviours over the 6 month period following the intervention.

Secondly, Study 4 sheds light on more proximal process variables that may represent potential active ingredients of the interventions, and highlights the potential for youth feedback as a proximal indicator of treatment efficacy. Specifically, this study suggests that learning and skills development in the context of a positive group environment are key in accounting for delays and reduced growth in alcohol consumption and reductions in mental health symptoms in the 12 months following the intervention. By extension, results also suggest that facilitators can use a post-session questionnaire to assess the likely efficacy of the intervention delivered. This could be used as a measure of ongoing treatment quality evaluation that school facilitators could self-administer. It could also highlight which youth may not have benefitted from the intervention and indicate the need for additional follow-up.

Thirdly, the results of study 4 appear to suggest that personality-targeted interventions are most effective when youth engage in the process of considering how to better manage their personality styles and behaviours in order to achieve longer term goals. It is hypothesised that the personalised intervention material may enable youth to personally engage with the intervention content, and allow group participants to develop a broader perspective on their current behaviours. In guiding youth on reflecting as to whether their current decisions are in line with their longer term goals and providing them with a framework for understanding their personality-specific responses, they may be provided with valuable insight into their reactions, and strategies for managing unhelpful thoughts and improving their coping strategies. Youth experiences may therefore act as moderators of intervention efficacy, as the active intervention ingredients may lead to a positive outcome only in youth who have a positive group experience and engage with the cognitive behavioural skills provided (see Figure 2).

The importance of personalised interventions has also been found in the field of medicine (Harvey et al., 2012), and is recommended as a method of enhancing behaviour change in improving sleep habits (Cassoff, Knauper, Michaelsen, & Gruber, 2013), nutrition (Celis-Morales, Lara, & Mathers, 2015) and the treatment of comorbid depression and complex medical problems (Alexopoulos et al., 2013) and bulimia nervosa (Schmidt et al., 2006).

Overall, it is hypothesised that the personal relevance of the targeted materials is central to stimulating behaviour change, but that interventions include both personality-specific and common components that may contribute to specific and general intervention effects. Intervention youth were found to report personality-specific reductions in mental health symptoms to which they are most prone, in addition to global reductions in internalising and externalising symptoms (Study 1; O'Leary-Barrett et al., 2013) and substance use (Conrod et al., 2013) across all personality groups. This may occur through a combination of personality-specific and common intervention components. For instance, the teaching of personality-specific coping strategies or cognitive restructuring relating to hostility may contribute to stronger intervention effects on externalising problems in youth with high levels of impulsivity (as shown in Study 1). However, the positive group

effects of sharing common experiences with youth with similar personality profiles and the normalisation and acceptance of personality-specific issues may contribute to positive intervention effects on mood and self-esteem (and by extension, reductions in distress) across all groups. On the other hand, global intervention effects on substance use may occur through personality-specific pathways that are associated with personality-specific motivations for substance use. For instance, improved coping with negative mood and improvements in affect may contribute to decreased substance use in youth with high levels of hopelessness, whereas improved decision making and reductions in impulsivity may contribute to decreased substance use in youth with high levels of impulsivity. This hypothesis is supported by studies suggesting that personality profiles targeted in the Preventure program indirectly predict alcohol consumption and related problems through specific drinking motives in both adolescent (Woicik, Stewart, Pihl, & Conrod, 2009) and college (Mackinnon, Kehayes, Clark, Sherry, & Stewart, 2014) samples. A testing of this personality-specific intervention meditational model would enhance our understanding of common and personality-specific intervention features accounting for intervention effects within and across the targeted personality groups.

Lastly, this dissertation highlights ways in which the personality-targeted intervention model could be improved and refined. Study 1 suggests that youth with high levels of internalising traits and severe internalising symptoms (particularly severe depressive symptoms or panic attacks) may require more intensive intervention than provided by this brief program. This is to be expected given that the current program is designed as a preventive approach. Additional behavioural activation components (McCauley, Schloredt, Gudmundsen, & Martell, 2011), interpersonal skills training (Horowitz & Garber, 2006), exposure exercises (Mattick, Andrews, Hadzi-Pavlovic, & Christensen, 1990) or booster sessions might further benefit these more vulnerable youth. Study 2 suggests that, contrary to our initial hypothesis, attentional biases to emotional faces do not mediate the relationship between personality risk profiles and symptoms of mental disorders. By extension, this suggests that the addition of cognitive bias modification tasks would not be appropriate in this preventive context. This result contrasts with studies demonstrating the promise of cognitive bias modification tasks as a stand-alone or

adjunct treatment for a range of conditions (Beard, Sawyer, & Hofmann, 2012; Macleod, 2012), including anxiety (Clarke, Notebaert, & MacLeod, 2014), addiction-related behaviours (Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013) and depression (Williams, Blackwell, Mackenzie, Holmes, & Andrews, 2013). However, whilst bias modification tasks may be appropriate in a treatment context, attentional biases to emotional faces do not appear to indicate prospective risk for mental disorders in a community sample. Instead, Study 2 provides further validation for the use of the four personality risk profiles measured by the Substance Use Risk Profile as indicators of prospective risk for mental disorders in youth and appropriate targets for selective interventions (following Castellanos-Ryan, O'Leary-Barrett, Sully, & Conrod, 2013; Krank et al., 2011; Woicik et al., 2009).

Practical implications

Importantly, personality-targeted interventions can be successfully delivered by school-based professionals, suggesting that this intervention model may be amenable to wider dissemination. It also suggests that intervention facilitators can include a wide range of school-based professionals that can be trained and supervised in-house, and need not be restricted to trained clinical psychologists. Having facilitators based in schools has the added benefit of allowing a greater potential for follow-up and booster sessions beyond the proposed 2 session intervention model with the most vulnerable youth (*e.g.,* youth with high levels of hopelessness discussed in Study 1). The dissemination of an evidence-based intervention approach in schools is significant given the recognised difficulties in having vulnerable youth engage with and access psychological services (Merikangas et al., 2011; Ringel & Sturm, 2001). School-based programs provide a platform to implement prevention programs that many youth would otherwise likely not attend (Masia Warner & Fox, 2012; Ryan & Masia Warner, 2012). Schools are also one of the primary contexts in which children and youth are impaired (Ginsburg, Becker, Newman Kingery, & Nichols, 2008), and are increasingly recognised as representing an ideal setting for the implementation of alcohol and drug prevention programs (Benningfield, Riggs, & Stephan, 2015; Gresham, 2004). In addition, providing psychological

treatments in naturalistic settings such as schools is thought to have the capacity to reduce the stigma associated with mental health treatments (Storch & Crisp, 2004).

Previous studies have noted significant challenges in the uptake of intervention programs by schools (Faggiano et al., 2008; Stephens et al., 2009). Several factors have been found to influence school counsellors' availability and willingness to deliver evidence-based intervention programs. Time limitations have been identified as the greatest challenge to providing mental health services in schools (Beidas, Edmunds, Marcus, & Kendall, 2012), given students' and staffs' heavy workloads and the competing demands on their schedules. The brevity of the Preventure program is thus advantageous in this regard. The buy-in of school administrators is known to be critical in promoting the implementation of school-based programs. School psychologists have been found to be less willing to implement mental health interventions when they perceive lower organisational and administrative support (Forman, Fagley, Chu, & Walkup, 2012), and a supportive school administration can facilitate the scheduling of sessions, which addresses one important barrier to implementation. In addition, school clinicians' favourable attitudes towards evidence-based treatments have been associated with an increased willingness to deliver programs, and greater adherence to treatment protocols (Beidas et al., 2012; Forman et al., 2012). It may thus be useful to place greater emphasis on the value of evidence-based treatments when developing partnerships with schools, as well as during the graduate-level training of school psychologists and counsellors (Baker, McFall, & Shoham, 2009). Importantly, results of this dissertation can inform schools about proximal measures of long-term efficacy that can be easily assessed, namely youth feedback on their intervention experience and short-term changes in levels of alcohol consumption and mood. These findings may support the wider dissemination of the Preventure program in allowing schools to self-monitor intervention efficacy.

In addition, it is possible that the long-term sustainability of an evidence-based school mental health services may require providing an incentive to school administrators, either through a financial commitment (*e.g.*, release time for staff, hiring other personnel to prepare class schedules or materials), or in establishing how the proposed interventions

have a positive impact on school-related outcomes that are prioritised by school administrators. The Mental Health Strategy for Canada report, for instance, recognises the link between mental health and academic performance and recommends increasing "comprehensive school health and post-secondary mental health initiatives that promote mental health for all students and include targeted prevention for those at risk" (Mental Health Commission of Canada, 2012, recommendation 1.2.3). It may therefore be helpful for research teams to establish valued outcomes that are shared between themselves and school administrators that can be evaluated and reported to schools throughout the research project, in order to increase schools' interest in and adherence to prevention programs.

With regards to the randomised controlled trials discussed in this dissertation, school recruitment and retention for the Adventure trial (Studies 1 and 3), conducted in London, U.K, was facilitated by highlighting how the provision of a personality-targeted intervention program designed to prevent substance misuse, risky behaviours and mental health problems coincided with the U.K. government Education Committee's requirements that each school's Personal, Social, Health and Economic Education curriculum should include education on mental health and substance misuse. In addition, U.K. schools are required to follow guidelines of a policy referred to as "Every Child Matters", which includes targeting vulnerable students or individuals with challenging behaviours, and to complete a yearly Self Evaluation Form for submission to the Office for Standards in Education, Children's Service and Skills (Ofsted). As part of the recruitment package for the Adventure trial, schools were provided with an example Self Evaluation Form detailing how the Preventure program met various Ofsted requirements. For both the Adventure and Co-Venture trials (Study 4), previous efficacy data was provided to school administrators during the recruitment phase in order to highlight the anticipated effect of the interventions in their schools. School administrators were also provided with de-identified summary reports of their students' behaviours following each phase of data collection throughout the studies that allowed them to have an overview of their students' mental health and risky behaviours over time. Both intervention and control school staff were offered training and supervision in implementing the Preventure

program as an incentive for participation, either at the beginning of the mid-point of the trial, respectively. In addition, although not focused on in this dissertation, data was collected on teacher-reported classroom behaviours and academic achievement in order to assess whether the intervention improved school-related outcomes that were of particular interest to school administrators.

Long-term training needs

The personality-targeted interventions described in this dissertation were successfully delivered by a variety of school-based professionals, the great majority of which did not have specialised mental health training. Observations and ratings of interventions suggested that the intervention facilitators achieved many of the goals of a cognitive behavioural therapy intervention in practice but did not perform at a therapeutic level equivalent to trained clinical psychologists (as reported in Study 3). It is suggested that "there is a clear need to develop training models that strike a balance between effectiveness and feasibility" (Masia Warner & Fox, 2012). Thus, even though the therapeutic quality of interventions delivered by school-based professionals may be slightly inferior to clinical psychologists, the advantages of having facilitators based in-house, and the potential for longer term follow-up of the neediest individuals may outweigh the slight compromise in terms of quality. Comparisons of the efficacy of personality-targeted interventions in a previous study nevertheless suggested that the effect sizes were similar when delivered by trained psychologists and school-based staff over a 6-month period (O'Leary-Barrett et al., 2010), and the 2-year intervention effects reported in this dissertation (Studies 1 and 3; O'Leary-Barrett, Castellanos-Ryan, Pihl, & Conrod, under review; O'Leary-Barrett et al., 2013) and others (Conrod et al., 2013; Mahu et al., 2015) suggest that the training model results in clinically significant intervention effects over 2 years.

However, the sustained efficacy of any school-based prevention program over multiple years without the continued input of the research team needs to be evaluated in a systematic trial, as adherence to treatment protocols is known to vary over time (Dusenbury, Brannigan, Falco, & Hansen, 2003; Ringwalt et al., 2010). Existing training

models suggest that ongoing supervision should be provided by experienced clinicians during treatment implementation in order to promote skill acquisition and maintenance (Beidas et al., 2012; Miller, Yahne, Moyers, Martinez, & Pirritano, 2004; Sholomskas et al., 2005). During the Adventure and Co-Venture trials, intensive supervision was provided during practice interventions with youth not involved in the research studies, as the goal was to ensure that facilitators reached an adequate level of program delivery to implement interventions with trial participants. However, supervision was implemented more informally throughout the formal trials, on a needs basis. We have not yet evaluated what form of ongoing training and supervision should be provided, if any, in order to ensure the maintenance of high quality program delivery in the longer term. The "gold-standard" of weekly supervision by experienced clinicians implemented for trainees in clinical settings would be costly and impractical for school-based professionals (Rakovshik & McManus, 2010). Alternative options include "pyramid training" (*e.g.,* Demchak & Browder, 1990), where one school-based professional could be intensively trained to deliver the Preventure program and then supervise other colleagues. A second option would be the use of internet or software-based learning (*e.g.,* virtual conferencing platforms; Beidas et al., 2012; Vismara, Young, Stahmer, Griffith, & Rogers, 2009) to train facilitators from a distance or provide booster training sessions. However, there is some concern that these training models may results in a decreased efficacy of supervision and subsequent reductions in the effect sizes of the intervention. These approaches would need to be systematically evaluated with school-based professionals implementing the Preventure program.

Limitations

This dissertation has a number of limitations. Firstly, personality-targeted interventions were compared with drug education and psychological services as usual in control schools, as opposed to an active comparison intervention, which may limit the interpretability of the efficacy data presented. The difficulties in designing appropriate comparison treatment conditions in randomised controlled trials are acknowledged in the literature, and placebo conditions have been associated with therapeutic improvement in a non-negligible portion of patients (Beecher, 1955). However, this effect is particularly

evident in small samples (Hróbjartsson & Gøtzsche, 2001), whereas the samples used in this dissertation were relatively large. The authors were also keenly aware of the possible iatrogenic effects of an untested comparison intervention (Dynarski et al., 2004; Sloboda et al., 2009; Weiss et al., 2005). In addition, a recent study also suggested that personality-targeted interventions can indirectly impact the behaviour of peers of high-risk youth who attended intervention sessions (Conrod et al., 2013), suggesting the possibility of a contagion effect of selective interventions across schools. This emphasises the importance of ensuring that planned control interventions are not harmful, as a contagion effect could theoretically also occur in the context of an iatrogenic control intervention. The majority of schools are thought to implement universal alcohol and drug prevention programs (Faggiano et al., 2014; Foxcroft & Tsertsvadze, 2011; Gottfredson et al., 2000), which suggests that many students across both control and intervention conditions may have received a universal prevention program as their treatment-as-usual. However, this was not systematically measured in the 2 randomised controlled trials described in this dissertation, which precludes making any conclusions on the comparison of selective and universal prevention approaches. Based on the results of Study 4, it would also be informative to design a variety of comparison conditions involving personalised feedback, personality matching, cognitive behavioural and motivational tools that would allow the measurement of the relative contribution of these therapeutic ingredients to intervention efficacy. Two previous studies have demonstrated that personality-matched interventions are significantly more effective in reducing substance-related outcomes than personality-mismatched or motivational control interventions (Conrod, Pihl, Stewart, & Dongier, 2000), or non-specific treatments controlling for effects of group and therapist exposure (Watt, Stewart, Birch, & Bernier, 2006). This suggests that personality matching is key to intervention efficacy and reduces the likelihood that the reported intervention results are due to a placebo effect. In addition, the use of intent-to-treat analysis in Studies 1 and 3 was a conservative data analysis procedure, as 120 (17.3%) of high-risk intervention participants did not receive an intervention, which suggests that the true impact of the interventions may be underestimated.

A second limitation is that the measures reported in this dissertation in Studies 1, 3 and 4 were largely based on adolescent self-report data, which may be subject to recall bias or be influenced by social desirability effects. (Study 2, on the other hand, included cognitive data, and parent and clinician-rated behaviours.) Although the gold standard of measurement would include additional sources of measurement such as observational data or behaviour reported by parents or teachers, this was not feasible in a systematic manner given the large sample sizes involved in the study. More objective measures of alcohol consumption such as blood alcohol calculators were also not appropriate given that the young age of the participants and our interest in assessing alcohol use behaviours retrospectively. Similarly, other biological measures such as urine, saliva and hair samples would permit an objective measure of other drug use, but were not considered appropriate given the young age of the sample, and would have been impractical and expensive to administer given the large sample size. Nevertheless, teacher-reported data were used to corroborate self-report internalising and externalising symptoms in a sub-sample of youth in Study 1, and these external reports supported the validity of the self-report mental health items used. A number of studies have found that adolescent self-report data has excellent discriminant (Crowley, Mikulich, Ehlers, Whitmore, & MacDonald, 2001) and predictive validity (Crowley, Mikulich, MacDonald, Young, & Zerbe, 1998). The 2 randomised controlled trials described used a number of procedures to maximise the reliability of the self-report data, including having data collected by research assistants, as opposed to teachers, and ensuring the confidentiality of the data by using unique identifier codes, either on paper (in the Adventure trial, Studies 1 and 3), or using the Psytools computer software (in the Co-Venture trial, Study 4). Stringent data and reliability checks were also carried out including a sham drug item and participants with unreliable data patterns were excluded from analyses (*e.g.,* those who endorsed only the highest symptoms levels across scales indiscriminately). The consistency of participants' self-reported alcohol use onset was assessed across multiple longitudinal assessments, and revealed high levels of Cronbach's alpha over 2 years (reported in Study 3). Nevertheless, it may have been informative to supplement the self-report measures with additional cognitive and behavioural measures. These could include

cognitive measures of disinhibition or reward sensitivity to corroborate self-reported levels of impulsivity or sensation seeking, for instance. It would also be interesting to measure whether attentional biases could be detected in youth with high levels of personality risk factors according to the Substance Use Risk Profile Scale following emotional primes, or under conditions of stress (for example following physical arousal in youth with high levels of anxiety sensitivity), as discussed in Study 2.

A third limitation is that we were unable to blind schools, youth or research staff to school randomisation during the Adventure and Co-Venture trials. However, the fact that interventions were largely conducted by school-based professionals meant that the research team were not aware of which participants had attended interventions when carrying out school-based data collections. Only trained facilitators were informed as to the personality risk status of students, and this information was treated as confidential. In Co-Venture, although approximately half of interventions were conducted by members of the research team, these team members did not participate in data collection. The fact that both high and low risk youth were followed up in intervention and control schools also meant that research staff could not easily identify intervention participants. Although youth in intervention schools were aware that they had participated in interventions, they were not aware of the primary study outcomes. The interventions' focus on personality-specific coping, as opposed to alcohol consumption per se, may also have helped to conceal this from participants. As noted in Studies 3 and 4, the fact that high-risk intervention participants reported an increase in alcohol consumption over time (albeit less than control participants) also suggests that intervention participants' responses were not influenced by social desirability, as does the fact that the interventions were not found to have positive effects indiscriminately across all outcomes examined (Study 1).

A fourth limitation is that potential personality-specific mechanisms of intervention effects were largely not examined in this dissertation. Study 1 suggests that intervention effects on mental health symptoms may operate through both personality-specific and general mechanisms, and Study 3 suggests that intervention effects on alcohol consumption and mental health symptoms may occur through both common and specific

processes. There may also be personality differences in the process variables highlighted in Study 4. A more in-depth exploration of potential personality differences in the mechanisms of intervention effects would therefore be of interest in further refining the intervention approach. Previous studies have highlighted, for instance, that the relationship between certain personality risk factors and substance misuse or psychopathology are mediated by distinct motivational (Woicik et al., 2009) or neurocognitive profiles (Castellanos-Ryan & Conrod, 2012; Castellanos-Ryan et al., 2011). Intervention mechanisms may therefore vary according to youths' personality profiles. It is possible, for instance, that identification with peers with similar personality profiles and normalisation of personality-specific difficulties may be particularly important intervention features for youth with internalising personality profiles who may be more likely to conceal their distress. Conversely, motivational factors may be key to positive behaviour change for youth with high levels of sensation seeking, who may experience fewer negative consequences of this personality profile in adolescence. Youth with high levels of sensation seeking may thus consider making a change following the intervention only if the motivational exercises used result in youth feeling intrinsically motivated to adapt their current behaviours to better align with their longer term goals. Whilst these research questions were beyond the scope of the current dissertation, the results described suggest that the exploration of personality-specific intervention mechanisms would be worthy of further study.

Summary

In summary, this dissertation contributes to the literature in support of a selective personality-targeted approach to the prevention of substance misuse and associated psychopathology and demonstrates the utility of research into intervention mechanisms in informing and optimising the intervention approach. This dissertation demonstrates that personality-targeted interventions can have clinically significant intervention effects on alcohol misuse, internalising and externalising symptoms over a 2-year period when delivered by educational professionals, suggesting that this selective prevention model may be feasibly implemented in school settings by trained professionals. The examination of intervention mechanisms suggests that long term intervention efficacy can

be monitored in the short term using proximal markers during the first 6 months post-intervention. This dissertation identifies candidate process variables relating to participants' experiences during the intervention sessions that are associated with positive behavioural change. These findings underline the potential for using youth feedback as an early indicator of treatment efficacy. This has implications for the potential dissemination and continued evaluation of personality-targeted intervention in school settings. Findings discussed in this dissertation might also inform change processes relevant to brief interventions with youth more generally.

Figure 1: Theoretical model of the mechanisms accounting for long-term intervention effects of the Preventure program.

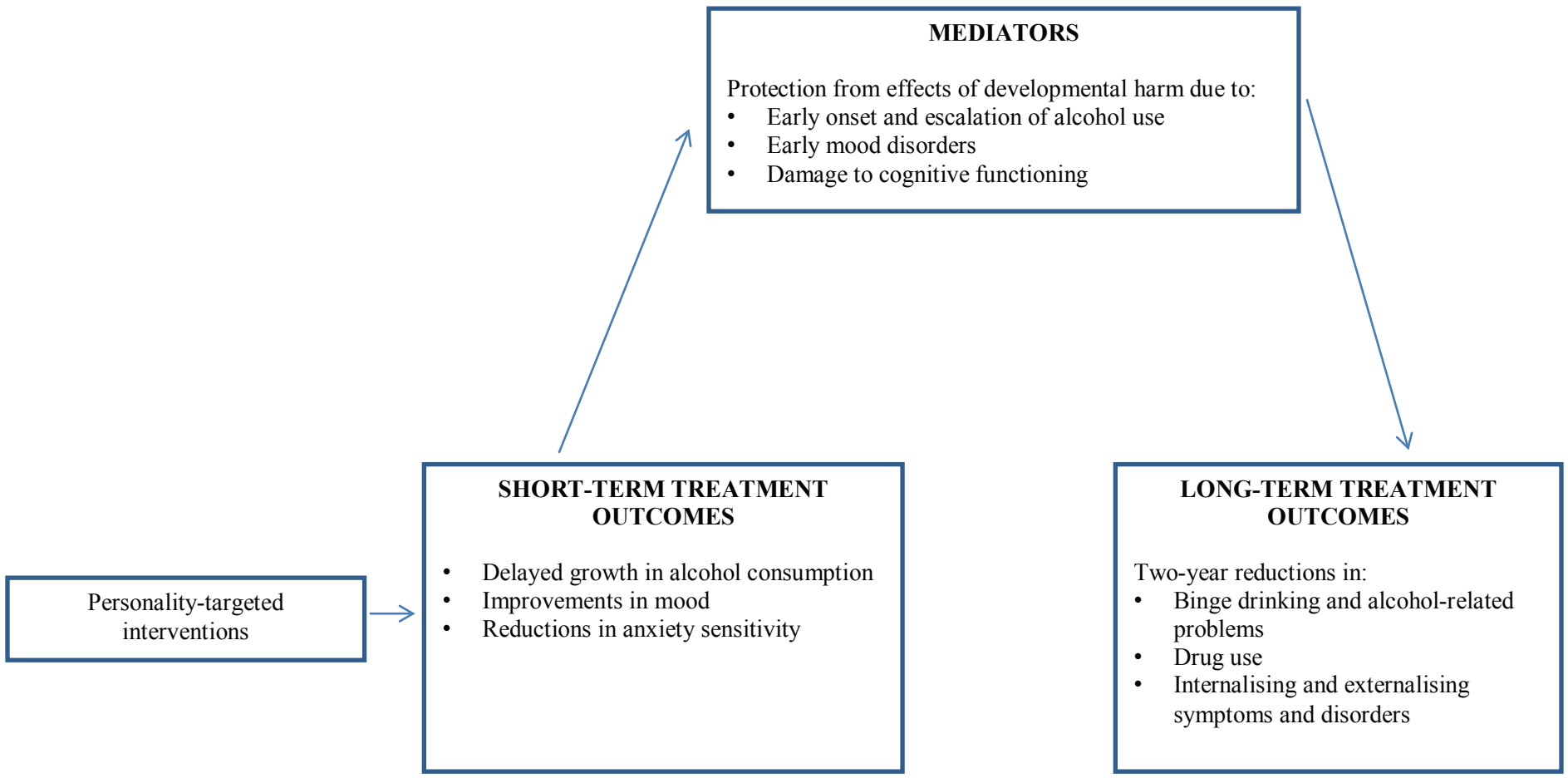
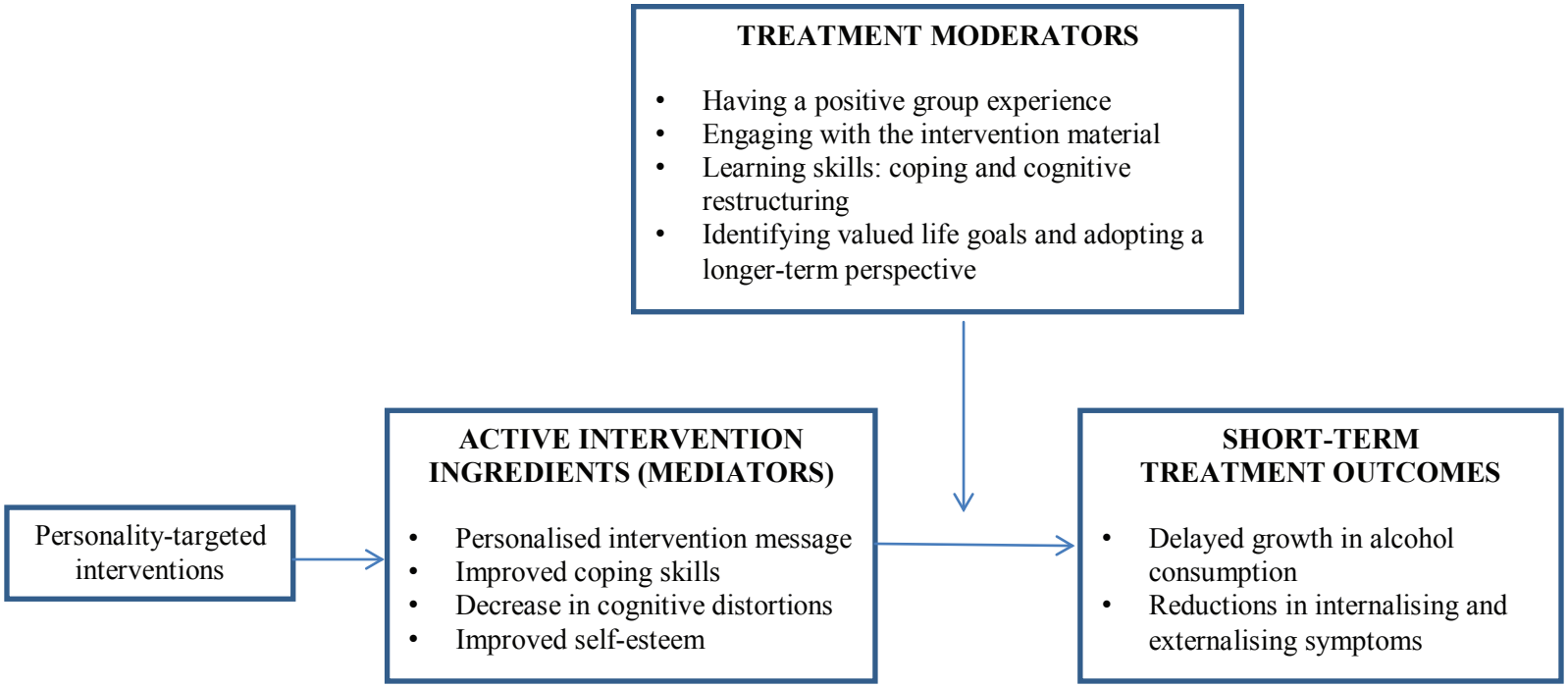


Figure 2: Theoretical model of the Preventure intervention process.



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