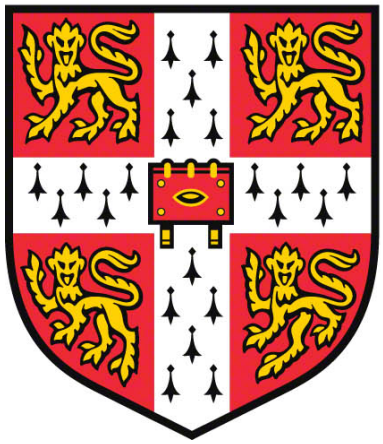

The development and feasibility testing of a digital health intervention for reducing Estonian adolescent and young adult alcohol and tobacco consumption

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This dissertation is submitted for the degree of Doctor of Philosophy.

Preface

This dissertation is the result of my own work and includes nothing, which is the outcome of work done in collaboration except as declared in the Preface and specified in the text.

It is not substantially the same as any that I have submitted, or, is being concurrently submitted for a degree or diploma or other qualification at the University of Cambridge or any other University or similar institution except as declared in the Preface and specified in the text. I further state that no substantial part of my dissertation has already been submitted, or, is being concurrently submitted for any such degree, diploma or other qualification at the University of Cambridge or any other University of similar institution except as declared in the Preface and specified in the text.

It does not exceed the prescribed 60,000-word limit for the Clinical Medicine and Clinical Veterinary Medicine Degree Committee.

Abstract

This project aimed to develop a digital web and mobile phone intervention for reducing Estonian adolescent and young adult alcohol and tobacco consumption. A systematic review was conducted, including a meta-analysis based on 32 randomised controlled trials, to investigate the associations with effectiveness of digital interventions in reducing adolescent and young adult alcohol and tobacco consumption. Digital interventions reduced adolescent and young adult weekly drinking (mean difference = -0.55, 95% CI (-1.04, -0.05), I^2=93%) and monthly binge drinking (mean difference = -0.30, 95% CI (-0.55, -0.05), I^2 = 75%). Digital interventions increased smoking cessation (risk ratio = 1.70, 95% CI (1.37, 2.11), I^2= 35%). A qualitative focus group study with Estonian adolescents and young adults (N=22) indicated a lack of knowledge regarding effects of alcohol and tobacco consumption early in life and a recognition of the difficulty to change alcohol and tobacco consumption. A web and mobile phone based intervention programme was appealing to the focus group participants. The development of the first individually tailored web and mobile phone intervention targeting Estonian adolescent and young adult alcohol and tobacco consumption was undertaken. The content of this intervention was informed by the systematic review and meta-analysis, focus group study, psychological theory, and participatory design. The intervention, called MyOwnMe, is a tailored web program linked to a daily mobile phone text-messaging program. A pilot study with Estonian adolescents and young adults (N=22) indicated feasibility of implementation in Estonia and acceptability of intervention content. No difference was found between the intervention and control group in alcohol (mean difference = -0.2 95% CI (-0.9, 0.6), p = 0.62) or tobacco consumption (30-day abstinence from cigarette smoking RR = 1.25, 95% CI (0.81, 1.94)) after the 8-week study period. Results of this pilot study will be used for recommendations in this thesis on the development of individually tailored web and mobile phone interventions for Estonian adolescents and young adults.

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Dissemination of this research

This research has been presented at the following academic conferences:

Date	Conference title	Type of presentation	Presentation title
2013 September	Division of Health Psychology Annual Conference, Brighton, UK	Poster	Are digital interventions effective at influencing alcohol and tobacco consumption behaviours in adolescents and young adults?
2014 March	e-Minds conference, Birmingham, UK	Oral	Developing a web and mobile phone intervention for adolescent and young adult alcohol use and smoking behaviours.
2014 August	European Health Psychology Society Annual conference, Innsbruck, Austria	Oral	Digital interventions targeting alcohol and tobacco use in adolescents and young adults: A systematic review.
2015 August	European Health Psychology Society Annual conference, Limassol, Cyprus	Poster	'My inner voice says yes, but I say no so…maybe' Insights into Estonian adolescent and young adult alcohol and tobacco consumption.
2016 January	Young Researchers Association, Tallinn, Estonia	Oral	An e-health program for Estonian youth: self-development and addiction prevention.
2016 September	Political Economy of Public Health Conference, Cambridge, UK	Oral	Adding insights from history to public health intervention design – a case study from Estonia.

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CHAPTER 1
INTRODUCTION

The problem of adolescent and young adult alcohol and tobacco consumption

All major disease groups affecting the world today are influenced by behavioural risk factors (World Health Organization/WHO, 2014[1]). Alcohol and tobacco consumption are two such risk behaviours. Tobacco consumption has been found to cause pulmonary functioning decline in the short-term and cardiovascular disease and cancer in the long-term (Gold et al., 1996). Tobacco consumption has a direct relationship with negative health effects, where increased consumption leads to increasingly negative health effects (Groenbaek, 2009). Tobacco kills up to half of its users (WHO, 2016[1]). Tobacco consumption is a cause of nicotine dependence, with inhalation through tobacco smoking being the most reinforcing and dependence-producing administration of nicotine (Henningfield & Keenan, 1993). Individual variability in nicotine metabolism plays an important role in the development of nicotine dependence and is influenced by both genetic factors and demographic characteristics such as age and gender (Benowitz et al., 2009). Nicotine is metabolised primarily by the liver enzymes CYP2A6, UDP-glucuronosyltransfease (UGT) and flavin-containing monooxygenase (FMO) (Benowitz et al., 2009). Nicotine has been shown to be cleared from the human body when there is increased blood flow to the liver, such as during meals, is faster in adults than children or the elderly and in women than men (Benowitz et al., 2009). Nicotine has also been found to produce less withdrawal effects in young people than adults (Kota et al., 2007).

Alcohol consumption has been found to increase the risk of alcohol dependence, liver cirrhosis, violent behavior, impaired judgment and loss of inhibition, which can then lead to sexually transmitted diseases, drinking and driving and alcohol related violence (WHO, 2015[1]; Gill, 2002). In 2012, 5.9% of all deaths worldwide were attributable to alcohol consumption (WHO, 2014[2]). The evidence on the health effects of alcohol consumption has indicated a more complex influence than is the case with smoking (Groenbaek, 2009). In small doses, alcohol can have a positive effect on some health outcomes, whereas in larger doses it also becomes detrimental to health (Groenbaek, 2009). The negative health effects of alcohol consumption have a biological basis (Myers, 1978). Alcohol is an organic solvent, which directly and indirectly harms different organs when consumed in high doses, and which increases the risk for alcohol dependence when consumed over a long period of time (Groenbaek, 2009). The potential beneficial effects of

alcohol consumption might also differ by age and gender, where older individuals might benefit from a decrease in the risk of cardiovascular disease when consuming alcohol, whereas younger individuals do not (Rimm et al., 1999). Genetic factors also influence the effects of alcohol consumption on the individual (Crabbe et al., 2011).

Alcohol and tobacco consumption is especially concerning among adolescents and young adults. In Europe, 12% of 15-year-olds smoke cigarettes and 13% consume alcohol at least once a week (WHO, 2016[2]). Early initiation of both behaviours predicts lifetime usage, which increases the risk for the negative health effects of consumption in the long term (Hayatbakhsh et al., 2013; Bornstein, 1989). Alcohol consumption initiation in adolescence and young adulthood can also lead to many short-term consequences such as reckless driving, unsafe sex and violence (WHO, 2013). Tobacco consumption in adolescence and young adulthood is associated with reduced lung growth and addiction to nicotine (U.S. Department of Health and Human Services, 1994). Uptake of tobacco consumption is influenced by factors such as parental and sibling smoking (Leonardi-Bee et al., 2011), use of other substances, friends' smoking and approval and family conflict (Flay et al., 1998). The risk of alcohol consumption initiation is increased by factors such as smoking, adults drinking at home, peer drinking and positive attitudes towards alcohol (Fisher et al., 2007). The uptake of both alcohol and tobacco consumption is therefore influenced by parental and peer consumption, as well as the consumption of other substances. Targeting of common factors influencing the uptake of both substances in prevention and intervention efforts might be effective beneficial in reducing long term harm from the use of either substance (Jackson, 1997).

Tobacco and alcohol consumption have both been shown to potentially having a bigger risk of negative health effects in young people compared to adults, with clearance of nicotine from the human body taking longer in young people, the presence of less nicotine withdrawal symptoms in young people and the potentially protective health effects of moderate alcohol consumption only being present in older individuals (Benowitz et al., 2009; Rimm et al., 1999). Both alcohol and nicotine influence the human brain's dopaminergic pathways, which is also involved in the perception of rewards (Nestler, 2005). Due to the dopaminergic as well as other neurocircuitry still developing in the adolescent brain, nicotine and alcohol consumption in adolescents

involves an increased risk of dependence (Chambers et al., 2003; Crews et al., 2000). However, the brain has also been shown to be capable of recovering from the damage alcohol and tobacco consumption cause during adolescents once consumption is ceased (Crews et al., 2005; Lledo et al., 2006). Despite this potential for the brain to heal, prevention or early intervention of alcohol and tobacco consumption has been suggested as the best way to avoid long-term harm, meaning that consumption should be reduced or ceased early in life (Sawyer et al., 2012).

Developmental specificities during adolescence and young adulthood

Adolescence and young adulthood is a critical period for cortical development when the brain is especially vulnerable to addictive substances (Crews et al., 2007; Bornstein, 1989). Alcohol and nicotine both have negative effects on the development of the prefrontal cortex (Feldstein et al., 2014; Abernathy et al., 2010; Goriounova & Mansvelder, 2012). The consumption of alcohol in adolescence and young adulthood may increase the toxic effects of alcohol on the developing brain and result in the learning of heavy drinking behaviours (Crews et al., 2007). Tobacco consumption, on the other hand, is associated with impaired cognitive functioning in the short-term and increased risk of addiction disorders, academic problems, panic disorders and other mental and behavioural issues in the long-term (Goriounova & Mansvelder, 2012). The prefrontal cortex does not mature until the mid-twenties (Steinberg, 2008; Crews & Hodge, 2007; Lenroot et al., 2007). The evidence on the late maturation of the prefrontal cortex has extended the traditional definition of adolescence to include individuals in the young adult age category (Sawyer et al., 2012). Although the age of 18 legally still signifies the end of adolescence and the beginning of adulthood in Europe, this is becoming increasingly meaningless in the context of young people's daily life experiences (Sawyer et al., 2012).

Adolescence and young adulthood is also characterised by changes in the nature of peer and family relationships (Siegel, 2013). As an individual enters adolescence, peer relationships start to become the main context for socialising, especially if their parents take an authoritarian approach and do not respect adolescents' autonomy (Fuligni & Eccles, 1993). The root of these changing relationships is the drive towards developing autonomy and an independent identity, a natural part of the development undertaken by adolescents and young adults (Siegel, 2013). As

an individual enters late adolescence and young adulthood, their developing identity is increasingly autonomous but still linked to their family identity, if their parents exhibit support for their changing identities (Grotevant & Cooper, 1985). For adolescents to develop to fulfil their potential as autonomous adults, the support of the social environment within which they are developing is critical, specifically having a balance between support matching maturity level and sufficient challenge for further development (Eccles et al., 1993). Adolescence is a time of honing relationship skills through the balancing of attachment relationships with family and establishing autonomy with peers (Noom et al., 1999).

These peer and family relationships have also been seen as the source of adolescent and young adult risk taking behaviours such as alcohol and tobacco consumption (Albert & Steinberg, 2011). Adolescent and young adult risk taking behaviour has traditionally been seen as a compromised decision making process due to hormonal changes during this developmental period (Smith et al., 2013). More modern views on adolescent and young adult risk taking behaviour are framing it in the context of the more recent evidence on brain development of which risk taking is a symptom (Albert & Steinberg, 2011).

Alcohol and tobacco consumption co-occurrence

Alcohol and tobacco consumption often co-occur (Falk et al., 2006; Kahler et al., 2008; Daw & Boardman, 2014; Johnson et al., 2000), which results in greater negative health effects than either substance would have on its own (National Institute on Alcohol Abuse and Alcoholism, 2007). The co-occurrence of alcohol and tobacco consumption is most likely in older adolescents and young adults (Weitzman & Chen, 2005). Adolescents who consume alcohol are more likely to also consume tobacco than those who do not consume alcohol, and those who consume tobacco are more likely to also be alcohol consumers (Reed et al., 2007; Chen & Kandel, 1995; Kandel & Yamaguchi, 1993). Adolescents and young adults are the age groups most susceptible to developing both alcohol dependence and nicotine addiction, so emphasis on common aspects such as withdrawal symptoms might be useful to consider in interventions targeting both behaviours (Winters & Lee, 2008; Christensen et al., 2014; Guo et al., 2001).

Alcohol and tobacco consumption are likely to have linked determinants (Dusseldorp et al., 2014; Ma et al., 2000; Room, 2004). Whereas alcohol acts as a depressant, nicotine acts as a stimulant and as such, consuming them together facilitates increased amounts and longer consumption times (Marlatt & Gordon, 1985). This means that the consumer will take longer to notice the effects of alcohol if the nicotine is providing an opposing effect and vice versa and consumption will be less self-regulated (Marlatt & Gordon, 1985). Nicotine consumption might also reduce the intoxicating effects of alcohol, allowing alcohol to be consumed for longer (Chen et al., 2001). Features of the social context might also cue alcohol and tobacco consumption (Johnson & Jennison, 1992). For example, although legislative efforts to curb smoking in Europe have decreased tobacco consumption considerably, it is still viewed as socially acceptable in the context of environments where alcohol consumption is also present (Nichter et al., 2010). Aside from continuing public health efforts to prevent adolescent and young adult alcohol and tobacco consumption, interventions that target their co-use might be beneficial (Bobo & Husten, 2000).

Determinants of adolescent and young adult alcohol and tobacco consumption

Identifying psychological determinants of health behaviour is an important first step in developing interventions aimed at changing behaviour at the individual level (Hardeman et al., 2005). The determinants of adolescent and young adult alcohol and tobacco consumption have been widely studied. In this section, I will summarise five groups of psychological determinants. The determinants were chosen because they have been shown to be predictive of alcohol and tobacco consumption behaviour in adolescents and young adults (Urban, 2010; Vilenne & Quertemont, 2015; Connor et al., 2011; Kear 2002; Lewis & Neighbors, 2006; Tyas & Pederson, 1998; Williams et al., 2000; Johan et al., 2012; Yeager et al., 2014) and to be modifiable with individual level interventions (Bersamin et al., 2007; Simmons et al., 2013; Voogt et al., 2014; Lotrean et al., 2010; LaBrie et al., 2013; Buller et al., 2008; Hagger et al., 2012; Williams et al., 2006; Yeager et al., 2011).

Determinant type 1: Outcome expectancies

Adolescents and young adults commonly hold positive outcome expectancies for the effects of alcohol and tobacco consumption. Positive alcohol expectancies predict future alcohol consumption levels in adolescents (Vilenne & Quertemont, 2015), and alcohol expectancies change over the course of adolescence and young adulthood (Nicolai et al., 2012). This means that an individual who starts their adolescence with positive alcohol expectancies might hold negative expectancies by the time they reach adulthood and vice versa. Similarly to alcohol, tobacco consumption decisions are also influenced by outcome expectancies (Urban, 2010; Shadel & Mermelstein, 1993). For example, adolescents and young adults frequently consume tobacco to counteract negative mood states (Kassel et al., 2007).

Outcome expectancies have been shown to mediate the relationship between adolescent risk taking and tobacco consumption behaviour and to predict current and future alcohol consumption (Urban, 2010; Scott-Sheldon et al., 2012). Considering the importance of risk taking as a developmental task in adolescence (Albert & Steinberg, 2011), outcome expectancies are important determinants of alcohol and tobacco consumption behaviour to address during adolescence and young adulthood to prevent future consumption habits (Scott-Sheldon et al., 2012). In both alcohol and tobacco consumption, outcome expectancies predict not just consumption patterns, but also quitting or reduction attempts, thus having implications for intervention development (e.g. Engels et al., 1998; Hasking et al., 2011). Interventions targeting outcome expectancies are associated with reduced alcohol use and reduced tobacco consumption (Scott-Sheldon et al., 2012; Wetter et al., 2004).

Determinant type 2: Refusal self-efficacy

Self-efficacy is defined as a set of perceptions or beliefs about one's efficacy in dealing with one's environment (Bandura, 1982). Self-efficacy beliefs are associated with the emotional reactions, thought and behaviour patterns that individuals experience and exhibit and are important beliefs to consider in changing adolescent and young adult alcohol consumption.

Several different types of self-efficacy have been identified (Bandura, 1982), but refusal self-efficacy has received specific attention in the context of adolescent and young adult alcohol and tobacco consumption behaviours. Refusal self-efficacy has been defined as 'the belief in one's ability to resist drinking in certain, usually high-risk, situations' (Oei et al., 1997, p. 704). Low levels of drinking refusal self-efficacy predict adolescent and young adult alcohol consumption (Young et al., 2006) and smoking refusal self-efficacy predicts adolescent and young adult cigarette smoking (Hiemstra et al., 2011; Menati et al., 2014).

Refusal self-efficacy beliefs are also associated with the skillset of saying 'no' to alcohol and tobacco. As a part of natural psychosocial development, refusal self-efficacy skills increase with age from early adolescence through to young adulthood (Sumter et al., 2009). Interventions focusing on increasing refusal self-efficacy in adolescents and young adults aim to catalyse the development of refusal self-efficacy skills to reduce alcohol and tobacco consumption.

Determinant type 3: Perception of social norms

Social norms are beliefs and perceptions that influence our thoughts and behaviours based on the behaviours of those around us (Berkowitz, 2005; Perkins, 2003). Adolescents become more susceptible to social norms in young adulthood and are more eager to gain peer approval than before or after this developmental phase (Steinberg, 2008; Frech, 2012; Klimes-Dougan & Zeman, 2007). Health risk behaviours such as alcohol and tobacco consumption tend to cluster within social groups where the group environment gives behavioural cues for which norms to follow, also known as descriptive norms (Christakis & Fowler, 2008; Smith & Christakis, 2008; Mead et al., 2014; Mollen et al., 2013). If these norms are followed, peer approval will be given, also known as injunctive norms, which alongside peer consumption predicts adolescent and young adult alcohol and tobacco consumption (D'Amico & McCarthy, 2006; Kelly et al., 2012; Trucco et al., 2011; de Vries et al., 1995; Chen et al., 2006; Harakeh & Vollebergh, 2012; Mollen et al., 2013).

The more the importance of peer relationships increases in adolescence and young adulthood, the more individuals become motivated to comply with the social norms of their peer groups (Stacy et al., 1992). However, adolescent and young adults misperceive the norms of the alcohol and tobacco consumption surrounding them, in other words they perceive their peers to either consume more or less than they actually consume (Prentice & Miller, 1993). Interventions that aim to correct these misperceptions can effectively reduce adolescent and young adult alcohol and tobacco consumption (Neighbors et al., 2004; Litt & Stock, 2011; Zehe et al., 2013; Chen et al., 2006; Harakeh & Vollebergh, 2012; McAlaney et al., 2011).

To correct misperceptions of social norms in adolescents and young adults, two different intervention approaches can be taken. The first involves giving personalised normative feedback to each intervention user that highlights the differences between the user's own consumption level and the consumption level of their peers (Lewis & Neighbors, 2006). The second method is the social marketing approach, which engages in mass media campaigns for example on university campuses and attempts to correct misperceptions of peer consumption in this way (DeJong et al., 2006). Social norms approaches are associated with effectiveness especially when delivered over the web or a computer (Moreira et al., 2009). However, social norms marketing approaches are not associated with effectiveness and are therefore not recommended as an intervention delivery mechanism and personalised normative feedback approaches are recommended instead (Moreira et al., 2009).

Determinant type 4: Autonomy and autonomous motivation

Autonomy can be defined as a state of being independent or self-governing (Spear & Kulbok, 2004). Adolescence is the developmental period when autonomy starts to be negotiated and decisions independent of the family context start to be made (Neel et al., 1985). Risk-taking behaviours such as alcohol and tobacco consumption are examples of attempts to achieve autonomy and an independent identity by adolescents (Curtis, 1992). It is important for health behaviour interventions aiming to change behaviours in adolescent and young adult populations to take the process of autonomy development in these age groups into account (Spear & Kulbok,

2004). Adolescents and young adults can have defensive reactions to information about the risk of different health behaviours, and it has been shown that highlighting their autonomy might reduce defensiveness and increase autonomous motivation to reduce alcohol consumption and cigarette smoking (Pavey & Sparks, 2012; Williams et al., 1999).

Autonomy has also been associated with several determinants of adolescent and young adult alcohol and tobacco consumption such as resistance to peer pressure and higher self-esteem (Ryan & Lynch, 1989; Allen et al., 1994). This is only the case, however, if autonomy is reached in late adolescence or young adulthood rather than in early adolescence (Pavlova et al., 2011). If an adolescent becomes autonomous too early, this can have the opposite effect of increasing the likelihood of problem behaviour and substance use (Dishion et al., 2004). Positive alcohol expectancies and cigarette consumption are also reduced in individuals with higher levels of autonomy (Neighbors et al., 2003; Williams et al., 2000). Lastly, autonomy might be a precursor for motivation to change health behaviour, which is an important determinant of successful change (Deci & Ryan, 2000; Deci & Ryan, 1985; Borsari & Carey, 2000).

Determinant type 5: Overcoming social adversity

The determinants of adolescent and young adult alcohol and tobacco consumption, which I have discussed thus far, are considered risk factors that increase the risk of alcohol and tobacco consumption (Hawkins et al., 1992). There are also determinants, which can be considered protective factors, that reduce the risk of adolescent and young adult alcohol and tobacco consumption (Hawkins et al., 1992). Interventions targeting both risk and protective factors might be most likely to reduce multiple risk behaviours such as alcohol and tobacco consumption in adolescents and young adults (Jackson et al., 2012).

One of the protective factors that may prevent and reduce adolescent and young adult alcohol and tobacco consumption is the ability to overcome social adversity or peer conflict (Walton & Cohen, 2011). The skill to overcome social adversity is predictive of adolescent and young adult alcohol and tobacco consumption (Schinke et al., 2009; Webb & Baer, 1995; Vidrine et al., 2013). Adolescence and young adulthood represent a developmental period of many physical,

emotional, social and cognitive changes (Sawyer et al., 2012). Inevitably, conflict with peers may arise during this time, especially given the importance of peer approval and quality of peer interactions (Prince & Carey, 2010; Leung et al., 2014). It is important for adolescents and young adults to have a sense of social belonging and the inability to overcome social adversity may threaten this, producing feelings of exclusion and rejection instead (Bynner, 2001; Masten et al., 2009).

Implicit self-theories might moderate adolescent ability to overcome social adversity (Markovic et al., 2013). Implicit self-theories posit that individuals hold either an incremental or an entity belief about their characteristics (Dweck, 2012). Individuals who believe that their skills and talent are innate and cannot be changed are said to hold an entity belief. Individuals who believe that their skills and talent are a result of effort and practice and therefore can be changed are said to hold an incremental belief (Dweck et al., 2009). Interventions aiming to change entity beliefs into incremental beliefs reduce adolescent negative reactions in the face of social adversity and self-regulation (Yeager et al., 2013; Yeager et al., 2014; Burnette et al., 2013). Targeting implicit self-theories in health behaviour change interventions is also associated with increases in adolescent physical activity (Biddle et al., 2003; Cury et al., 2002). Implicit self-theories have not yet been operationalised in an intervention targeting adolescent and young adult alcohol and tobacco consumption, but given the association between inability to overcome social adversity and adolescent and young adult alcohol and tobacco consumption (Urberg et al., 2003; Campbell et al., 2008), it is deemed an appropriate protective factor to target in the current research project.

Reducing adolescent and young adult alcohol and tobacco consumption

The most common approach to reducing adolescent alcohol and tobacco consumption has been school-based education (Steinberg, 2015). This entails both information on alcohol and tobacco consumption included in the general school curriculum and programs delivered in addition to the curriculum (Steinberg, 2015). Although this is by far the most common approach to addressing adolescent alcohol and tobacco consumption, few school-based programs have been associated with a change in alcohol and tobacco consumption behaviour (Langford et al., 2015). Some school-based interventions seem to be effective in some contexts but the mechanism of change is

unclear (Wiehe et al., 2005; Foxcroft & Tsertsvadze, 2011; Galanti et al., 2014; Wolfenden et al., 2014; Carney et al., 2014; Langford et al., 2015). The school-based interventions that have been associated with changes in behaviour have been theory-based, addressed social influences, cognitive-behavioural skills, and trained facilitators and included multiple components (Peters et al., 2009). Additional research into effective interventions in adolescents is required (Steinberg, 2015).

In young adults, the main intervention approach has been to deliver intervention content directly to the individual, especially in university student populations (White et al., 2006; Hustad et al., 2010; Carson et al., 2011). This often entails single session personalised feedback on the social norms of alcohol and tobacco consumption relevant to each individual user (Carey et al., 2007; Dotson et al., 2015). Only a few interventions targeting young adults include educational components; most deliver one-time online assessments and individualised feedback (Bhochhibhoya et al., 2015). Such individually targeted approaches have been associated with modest changes in young adult alcohol and tobacco consumption behaviours, but mostly in the short-term (Walters et al., 2007; Riley et al., 2008; Abroms et al., 2008; Pardavila-Belio et al., 2015; Samson & Tanner-Smith, 2015). The individual approach has started to gain traction in adolescent populations as well, and several interventions have been associated with reductions in adolescent alcohol and tobacco consumption (Schwinn et al., 2009; Chen & Yeh, 2006; Tait & Christensen, 2010).

A criticism of the current intervention approaches for reducing adolescent and young adult alcohol and tobacco consumption is that they are based too much on developing interventions *for* them, rather than *with* them (Steinberg, 2015; Mandel & Qazilbash, 2005). Due to the changing nature of adolescent and young adult relationships to peers and authority figures, this top-down approach to delivering health information might not be appealing to them, and a more egalitarian approach might be needed (Eysenbach, 2008; Neuhauser & Kreps, 2010). Critiques of the school-based interventions directed at adolescents have included the lack of insight they reflect into the daily-lived experience of adolescents, lack of credibility and taking a patronising tone (de Visser et al., 2015; Harrison et al., 2011; Fry, 2011). The predominantly social norms-based interventions for young adults are somewhat effective when delivered via digital technology

mechanisms, but only in the short-term (Moreira et al., 2009). Behaviour change interventions in general have also been critiqued for lacking insight into the context within which the users exist (Michie et al., 2011). There is promise to improve the understanding of the context of adolescent and young adult alcohol and tobacco consumption and find the right communication methods to develop interventions that might lead to more exposure of intervention content than digital health interventions have thus far achieved (Crutzen et al., 2011).

In addition to increasing contextual insights in interventions, using an autonomy-supportive communication style might be more appealing to adolescents and young adults, than the often-instructional communication style of interventions developed *for* rather than *with* them (Miller et al., 2007; Steinberg, 2015; Mandel & Qazilbash, 2005). Instructional communication involves the use of controlling language that attempts to persuade the receiver to abide by it, explicitly giving instructions of what the receiver should do (Miller et al., 2007). Instructional communication is likely to use words such as 'should' and 'must' (Miller et al., 2007). Autonomy-supportive communication, on the other hand is less explicit and emphasises the choice of the receiver to act or not to act on the information delivered to them (Miller et al., 2007). Autonomy supportive communication is more likely to use words such as 'perhaps' and 'maybe', thus leaving the interpretation slightly more ambiguous, but also more choice for the receiver (Miller et al., 2007). Adolescents' and young adults' drive towards finding their independent identities might mean that autonomy supportive intervention content would be more appealing to them and the lack of such a communication style in existing interventions might provide an explanation for the low level of effectiveness (Steinberg, 2015; Mandel & Qazilbash, 2005; Siegel, 2013).

Reducing co-occurring alcohol and tobacco consumption in adolescents and young adults

The likelihood of co-occurring alcohol and tobacco consumption should be considered in intervention development efforts (Falk, 2004). Co-occurring alcohol and tobacco consumption has negative implications on the cumulative health effects of the consumption of both substances and causes increased costs for the healthcare system compared to the consequences of

consuming only one of these substances (Edington et al., 1997). Commonalities exist across alcohol and tobacco consumption, which suggests that targeting these with interventions might provide for effective intervention programs in adolescents and young adults (Peters et al., 2009). Several interventions have effectively changed multiple health behaviours in adolescents and young adults (Palinkas et al., 1996; An et al., 2013; Werch et al., 2007; Cameron et al., 2015; Werch et al., 2011; Evers et al., 2012; Grossbard et al., 2010). Systematic reviews of multiple behaviour change interventions have found associations with adolescent and young adult alcohol and tobacco consumption reduction, especially in the long-term (Hale et al., 2014). Systematic reviews also suggest that there are commonalities across tobacco and alcohol consumption behaviours in adolescents and young adults, which could be targeted in the same intervention (Busch et al., 2013; Hale et al., 2014).

Multiple behaviour change theory

Using behaviour change theory is likely to increase intervention effectiveness (Glanz & Bishop, 2010). The theoretical basis for multiple behaviour change interventions can be approached in one of three ways: (1) behaviour change principles approach, (2), global health/behavioral category approach or (3) multiple behavioural approach (Noar et al., 2008). The behaviour change principles approach posits that as all the existing behaviour change theories, for example the social cognitive theory (Bandura, 1982), can be applied across different single health behaviours, then a set of common determinants to multiple health behaviours could also be derived (Noar et al., 2008). The global health category approach suggests the use of general attitudes that could underlie the initiation of different health behaviours (Noar et al., 2008). The multiple behavioural approach focuses on the relationship between different health behaviour constructs and how change itself occurs, for example whether it is sequential or simultaneous in the case of multiple behaviours (Noar et al., 2008). This thesis will take the first approach of behaviour change principles, which has been shown to be useful in the development of multiple behaviour change interventions (Godin & Kok, 1996; Prochaska et al., 1994). Understanding commonalities between different health behaviours can then be used for intervention development in adolescents and young adults.

The potential of digital interventions

In recent years, interventions targeting individual adolescents and young adults have been increasingly delivered via digital channels, such as computer programs, the Internet, mobile phone text messaging and mobile phone applications; also labeled as eHealth, mHealth, or digital health (Eysenbach, 2001; Serbanati et al., 2011). Due to its dynamic and ever-changing nature, digital health has been difficult to define, but a possible definition might be:

'e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies' (Eysenbach, 2001)

Well-designed digital health programs can increase access to health information and facilitate informed health decision-making (Devine et al., 2016). Digital interventions might engage adolescents and young adults more than the traditional approaches. Health is also one of the most common topics searched for online in these age groups, so receiving digital health interventions might be a familiar way to engage with such topics (Bernhardt & Hubley, 2001; Skinner et al., 2003; Shahab et al., 2014; Eysenbach, 2008. Young adults prefer to investigate their health via the Internet before they turn to a medical professional and are keen to not just investigate, but also assert opinions and connect with others who are experiencing similar issues (Neuhauser & Kreps, 2010). Digital interventions can also be a cost-effective intervention delivery mechanism in adolescents, especially when targeted to specific subgroups (Drost et al., 2016). The current generation of adolescents and young adults might be especially suited to receiving health information via digital delivery channels as they grew up using the Internet and 95% of them are daily users of online content (Roberts & Foehr, 2008; Lenhart, 2015; Pew Internet & American Life Project, 2012; 2013). Various digital interventions have been associated with reductions in adolescent and young adult alcohol and tobacco consumption, targeting determinants of alcohol and tobacco consumption behaviour such as outcome expectancies, social norms and refusal self-efficacy (Strohman et al., 2016; Simmons et al., 2013; Ridout & Campbell, 2014; Buller et al., 2008; Voogt et al., 2014).

Challenges of delivering digital interventions to adolescents and young adults

Digital interventions that reduce risk behaviours such as alcohol and tobacco consumption have the potential to reduce or prevent such risk factors, but to date this potential remains relatively poorly realised (Neuhauser & Kreps, 2010). Even though adolescents and young adults often search for health information online, their exposure to evidence-based health behaviour change programs remains low (Crutzen et al., 2011). Even if adolescents and young adults start using a digital intervention, they are likely to not complete it (Eysenbach, 2005; Bennett & Glasgow, 2009). This means that the potential efficacy of the intervention is reduced, as the participants are not receiving the full intervention and only a reduced amount of behaviour change content (Crutzen et al., 2011).

There are several ways in which adolescent and young adult engagement with and exposure to digital interventions could be increased, such as strengthening the theoretical foundation of interventions, using context-driven and persuasive health communication or increasing interactive components in interventions (Neuhauser & Kreps, 2010; Cuijpers, 2002; Crutzen et al., 2011). Customising content to user type, easy access, self-monitoring, simulation and easily understandable content might be other strategies to increase exposure to digital interventions (Crutzen et al., 2011; Eysenbach, 2005; Norman & Skinner, 2007; Wodarski et al., 2012; Hallet et al., 2009; Lehto & Oinas-Kukkonen, 2011; Crutzen et al., 2011). Digital interventions also allow anonymity and real-time feedback on behaviour change goals, which are intervention features associated with changes in behaviour in adolescent and young adult age groups (Griffiths et al., 2006). Additional research into the effectiveness of different exposure strategies and engaging intervention content is required to realise the potential of digital interventions in adolescent and young adult age groups (Crutzen et al., 2011).

Increasing digital intervention effectiveness

The science of behaviour change

It is not yet clear which types or components of digital behaviour change interventions are most effective due to often having multiple components, differences in intervention content, small

sample sizes in evaluations, lack of control groups and inconsistent outcome measures (Brown, 2013). The synthesis of evidence allows for the systematic identification of effective intervention components and designs (Craig et al., 2008). Efforts are therefore needed to systematise the science of behaviour change in order to provide cumulative evidence on the effective ingredients and design of digital health interventions (Michie & Johnston, 2012). A cumulative science of behaviour change requires the systematic reporting of intervention components, behaviour change techniques and the underlying theoretical constructs of interventions (Michie & Johnston, 2012; Michie et al., 2009). In the case of digital behaviour change interventions, specialised guidelines might be necessary in order to encompass the varied digital delivery mechanisms of interventions as well as combinations of multiple intervention components (Eysenbach, 2011).

Another element of a cumulative science of behaviour change is the process of evaluating interventions (Michie & Johnston, 2012). Several approaches exist for evaluating digital intervention effectiveness (Murray et al., 2016). These include methods such as N-of-1 studies, sequential A-B testing, concurrent A-B testing, uncontrolled quantitative evaluation, factorial experiments, fractioned factorial experiments, non-randomised comparisons, SMART designs, trials of intervention principles, cost-impact evaluations, randomised controlled trials and the multiphase optimisation approach (West & Michie, 2016). Although study design by itself is an inadequate marker for evaluating interventions (Rychetnik et al., 2006), including it in the evaluation process is important for enabling the synthesis of evidence through systematic reviews and meta-analyses (Craig et al., 2008).

Most of the designs listed above have not yet been used to evaluate digital behaviour change interventions. In the case of smartphone-based behaviour change interventions, most such programs available on the iTunes and Google Play Stores have not been evaluated at all (Bender et al., 2013). The majority of existing intervention evaluations employ the randomised controlled trial design, which has also been the focus of systematic reviews of digital behaviour change interventions thus far (e.g. Free et al., 2013; Bender et al., 2013). Exceptions to this include the use of a few cohort studies for intervention evaluation (Brown, 2013). It is not yet clear which types or components of digital behaviour change interventions are most effective due to often having multiple components, differences in intervention content, small sample sizes in

evaluations, lack of control groups and inconsistent outcome measures (Brown, 2013). The continued synthesis of evidence and evaluations of digital behaviour change interventions is necessary to provide clarity to key questions in the science of behaviour change (Craig et al., 2008).

Persuasive health communication for adolescents and young adults

Communication is at the heart of health behaviour change interventions as it is the way in which information is exchanged between intervention developers and users (Rimal & Lapinski, 2009). The overarching aim of health communication is to enhance the relevance of the information delivered to the reader or intervention user (Kreuter & Wray, 2003). Personally relevant information has been found to be more persuasive than impersonal information (Kreuter & Wray, 2003). Receiving personally irrelevant health information can lead to disengaging from the information, which might then also influence whether health behaviour is changed or not (Crutzen et al., 2011). Digital interventions aimed at adolescents and young adults must therefore ensure personal relevance of the information transferred and provide a credible health information resource (Gray et al., 2005).

To make health information more personally relevant to the user, tailoring methods can be used (Hawkins et al., 2008). Tailoring of health information is a series of communication methods aiming to accurately reflect the preferences and experiences of the intervention user (Hawkins et al., 2008). Tailoring is a form of data based communication and can only be done if enough information about each individual user of the intervention is collected in an assessment style format (Kreuter & Way, 2003). It is thought to enhance the intervention user's motivation to process the health information delivered to them in four ways: by matching the content of the intervention to the individual's interest, by framing the content in a context that is meaningful to the individual, by using design elements that hold the individual's attention and by providing information in the amount, type and through channels that the individual prefers (Rimer & Kreuter, 2006). It also allows the users of an intervention to be segmented into different user profiles, which can then be further customised to individually-tailored messages, thus enhancing the personal relevance of intervention content even further (Hawkins et al., 2008).

In addition to personal relevance, health information should also be persuasive to be associated with changes in behaviour (Simons, 1976; Smith, 1982). Elements of persuasion include information that is easily remembered and considered trustworthy or credible (Pease et al., 2006). The Elaboration Likelihood Model (ELM) of persuasion suggests (Petty & Cacioppo, 1986) two types of persuasion in health communication, one of which results from considerations of the credibility of the information presented and the other of which results from a simple cue in the persuasion context that induces change without the credibility of the information presented coming under scrutiny (Petty & Cacioppo, 1986). The ELM also suggests that people want to hold 'correct' attitudes. As a child matures into adolescence and adulthood, their desire to hold correct attitudes increases their ability to scrutinise the credibility of information compared to children (Petty & Cacioppo, 1986). Adolescents and young adults report finding it difficult to find information on health-related topics online, which might be linked to their health literacy levels but also to the lack of personal relevance and persuasiveness in the information they do find (Gray et al., 2005).

Persuasive health communication in digital interventions

Digital intervention development has also been critiqued for focusing too much on technological innovation and not enough on the thoughtful communication of health information (Kreps & Neuhauser, 2010). In the context of multiple health behaviour interventions, it is possible to tailor intervention content to user characteristics across behaviours as well as within behaviours (Maibach et al., 1996). This might result in a clearer understanding of the intervention users' general motivations for carrying out different health behaviours and add to the persuasiveness of the communication they receive (Maibach et al., 1996). Multiple health behaviour interventions in adolescents and young adults might also be especially suited to digital intervention delivery channels. Digital interventions make it feasible to provide the tailored information that has been identified as a key component in effective interventions targeting alcohol and tobacco consumption separately in adolescents and young adults (Velicer et al., 2006; Riper et al., 2009).

The credibility of health information delivered to adolescents and young adults via digital channels is of concern, but young people are also increasingly critical of information found on the Internet for example and aware of the risk of receiving unreliable information (Murray et al., 2003). Information credibility is judged by looking for a reliable source, a professional design, scientific language and ease of use (Eysenbach & Köhler, 2002). Adolescents and young adults might benefit the most from Internet-delivered interventions, as the health issues they are likely to be interested in are of a sensitive nature, such as sexuality, drug use or mental health issues (Eysenbach, 2008). However, many mistrust information coming from authority figures such as the government or teachers (Eysenbach, 2008). Recognising health information that is personally relevant is especially important now that much of health information is delivered via digital channels (Dutta-Bergman, 2004). People are often unaware whether the health information they are receiving/searching for in digital channels is relevant to their cultural context or not (Eysenbach & Diepken, 1998).

Providing context-driven health information might be one way of increasing the persuasiveness of health information and the effectiveness of digital interventions in adolescents and young adults (Neuhauser & Kreps, 2010; Cuijpers, 2002; Crutzen et al., 2011). This would involve creating intervention content that reflects the environmental and social contexts of the intervention users' everyday lives (Monk & Heim, 2013; Connor et al., 2014). This includes contexts such as social situations where individuals are most likely to drink such as parties, pubs or bars (Monk & Heim, 2013). Or, for tobacco consumption, the context could involve investigating the density of tobacco outlets in the area an individual lives in, which might increase their risk of tobacco consumption (Lipperman-Kreda et al., 2012).

Creating context-driven and persuasive health communication involves tailoring methods, which create personally relevant messages for each individual user of a programme, and this personal relevance can lead to actions based on this information (Kreuter, 2012). For health communication tailored to context to be interpreted by the receivers as intended, the creators of the communication must relay messages that reflect the experiences of the receivers (Neuhauser & Kreps, 2010). However, in this model of communication where the creator and receiver are different individuals, there is always a chance of misinterpretation and having the creators of the

communication be representatives of the receivers of it might lead to less interpretation errors (Hodge & Kress (1988, 45). Involving the receivers of the communication in the development process of tailored content might be a way to prevent this kind of misinterpretation (Neuhauser & Kreps, 2010).

Analysis of context is a key component of knowledge transfer models, where considerations of the context of readers impacts the communication delivered to them (Ward et al., 2009). Health behaviours are a part of everyday life and interventions should reflect this in order to increase users' perceived self-efficacy and sense of control to actually carry out changes (Neuhauser & Kreps, 2003). The rooting of intervention content in the socio-cultural context of the intervention users is critical for reflecting their health behaviour in their everyday life context (Kreps & Neuhauser, 2010). The general offering of health information on the Internet has a context-deficit, meaning that the source of the information, the receivers it is intended for and the credibility of the information are unclear (Eysenbach, 2008).

Mixed methods in intervention development

To increase adolescent and young adult engagement with digital interventions, a mixed methods approach to intervention development might be used to improve understanding of the context within which alcohol and tobacco consumption occurs (de Visser et al., 2015; Shaw et al., 2014). Combining qualitative and quantitative methods is important for gaining an accurate representation of the social, cultural and historical context of potential intervention participants (Shaw et al., 2014; de Visser et al., 2015). Qualitative research advances understanding of what is meaningful and engaging to potential intervention users thus guiding user centred intervention development, which impacts on user engagement (Lerner & Tolan, 2016; Clemensen et al., 2007). Qualitative methods have a gap to fill to implement interventions effectively, where qualitative data can aid interpretation of whether interventions are effective or not and how could they be implemented more effectively (Shaw et al., 2014). Qualitative methods also shed light on the in-depth interpretation of quantitative data (Gale et al., 2013). Quantitative data collection, on the other hand, is important for tests of efficacy and cost-effectiveness, but falls short in giving an in-depth understanding of the social, cultural and historical context of the intervention. Mixed

methods research where both qualitative and quantitative methods are employed, therefore provides a comprehensive understanding of both the efficacy and effectiveness of intervention programmes (Leeman et al., 2015). In this thesis, qualitative and quantitative methods will be used alongside each other in separate studies, rather than in the same study. Both approaches have been indicated as appropriate for mixed methods research (Johnson & Onwuegbuzie, 2004).

Qualitative research is a tool for increasing understanding of the intervention users' context (de Visser et al., 2015). In the case of adolescents and young adults, including their voices and respecting their opinions on their experiences with alcohol and tobacco consumption using qualitative research methods might increase the credibility and persuasiveness of intervention content (Mandel & Qazilbash, 2005). Health communication should be developed *with* the receivers of that communication, not *for* them (Nutbeam, 2000).

Participatory design as a health communication development method

Traditional health communication distributed at the population level has taken a one-way, sender to receiver approach (Neuhauser & Kreps, 2010). This has been rather instruction-like, where receivers of the communication are expected to act on it, without having any customised information relevant to them or being able to communicate anything back to the senders (Neuhauser & Kreps, 2010). This kind of communication might not influence the behaviour of the receiver if the receivers are adolescents and young adults as they are in the developmental phase where authority figures start to be questioned (Hawe, 1998; Kuhn & Laird, 2011). As other modern recipients of healthcare, adolescents expect to have a say in decisions about their health (Clemensen et al., 2007). This is where digital health communication adds the advantage of not just sending customised information to homogeneous groups of people or indeed, single individuals, but also enabling two-way communication between the sender and the receiver, thus creating a sense of autonomy and engagement in the receiver, which has an impact on their behaviour choices as well (Neuhauser & Kreps, 2010).

The effort to minimise interpretation errors in health communication efforts has led to an increase in participatory design of intervention development, where representatives of the

intervention user population are actively involved in the development of the intervention content (Neuhauser, 2001; Hesse & Shneiderman, 2007; Monk, 2000). This entails co-designing with intervention users, which might lead to more effective interventions (Kreps & Neuhauser, 2010; Sawyer et al., 2012; Zinck et al., 2013). Co-designing interventions with adolescents and young adults might also involve a participatory research design, where they provide insight into their experiences as qualitative research participants, to being involved in the design and development of the content and digital interface of the program (Clemensen et al., 2007). Participatory design is often used in computer science as a part of the user-centred design methodology, which aims to develop technology that places the experience of the user at the centre of the development process (Monk, 2000; Clemensen et al., 2007). It is not just about collecting user views of the technology developed, but about involving them in the development of the content from the beginning and giving them authority over the wording, topics etc (Yardley et al., 2010).

Participatory design is a critical method to realise the potential of digital interventions, which have thus far fallen short of expectations (Bennett & Glasgow, 2009; Neuhauser & Kreps, 2010). The impact of involving participants of interventions in the development process stems from an understanding of health as created by individuals within their own settings, where the interpretation of health information is interpreted in a way that fits the social context of the receivers (Hawe, 1998; Olds, 2000). Participatory design specifically focuses on the development of digital interventions and requires fieldwork to obtain knowledge about the social context of the intervention users (Clemensen et al., 2007). This is especially the case with adolescents and young adults, who are in the developmental phase of rejecting current authority figures in their lives and establishing their own unique identity and autonomy in the world (Eysenbach, 2008; Steinberg & Silverberg, 1986). The use of participatory design in intervention development with adolescents and young adults might result in more persuasive digital health interventions for sensitive topics such as alcohol and tobacco consumption.

Few interventions have been developed with adolescents and/or young adults to date. The challenge of developing interventions using a participatory design lies in the difficulty of predicting the outcome of the process, as the constant input from participants keeps the outcome in a process of constant change (Clemensen et al., 2007; Driedger et al., 2007). Despite such

constant input, it is difficult to achieve a sense of co-designing with participants, possibly due to the power dynamics between participants and researchers in the development process, leading to a lack of ownership taken by the participants for the change process (Bowen et al., 2013; Byrne & Sahay, 2006). Norman & Skinner (2007) successfully engaged in participatory design with adolescents in Canada to develop an online quitting cigarette smoking resource. They achieved active youth engagement in the development process by supporting and respecting the choices of the adolescents involved in the development process and focused on issues identified by the adolescents themselves in the intervention content. This led to the adolescents involved in the development process expressing a sense of ownership and pride over the final output. Other developers of digital interventions for adolescents might find the same kind of approach to participatory design useful (Norman & Skinner, 2007).

Digital interventions and participatory design

Digital health communication holds the promise to be able to customise health information more than was ever possible before and to provide relevant health information across time, place and cultures (Kreps & Neuhauser, 2010). It can provide a balance between effective but expensive interpersonal approaches and cheap but low impact mass media approaches to changing health behaviour at a population level (Hornik, 2002; Napoli, 2001). Effective digitally-delivered health communication works through techniques such as enhancing user control, interactivity, customisation to the individual, use of multimedia and social networking (Neuhauser & Kreps, 2010). Digital interventions have the functionality of providing two-way communication between the program and the user, to create a participatory process to ensure internalisation and acceptance of the messages which might lead to the information being adopted and used later on, but many such interventions are not designed to promote interaction and collaboration (Kreps & Neuhauser, 2010).

The two-way information exchange offered by digital health communication might motivate the receivers to attend to and act on this information and it provides a shift to learning by participation, a concept built on recent development in understanding effective learning processes (Paton et al., 2011; Berliner & Calfee, 1996). Digital health communication also

enables the autonomy development of adolescents and young adults, which empower individuals to direct their own information-seeking outside of the traditional authority figures of parents and teachers and allow peers to replace traditional authority to a certain extent (Eysenbach, 2008).

Estonia as a sociocultural context for developing and testing digital interventions

This thesis will investigate the feasibility of developing and testing digital interventions with adolescents and young adults in Estonia.

Estonia is a democratic republic located in the Northeast of the European Union (EU). Estonia joined the EU in 2004 and has been an independent republic since 1991, after gaining independence from the Soviet Union. Similarly to other post-Soviet countries Estonia experienced an acute increase in mortality due to the lack of public health infrastructure at the beginning of the new republic and a rise in detrimental health behaviours (Põlluste et al., 2005; Reitan, 2000; Reitan, 2004). Alcohol and tobacco consumption increased rapidly (Steptoe & Wardle, 2001). This increase was due to a lack of regulation and only started decreasing around 1994 once the newly independent republic could implement regulations (Raudne, 2012).

Since gaining independence, Estonia has prioritised the development of its IT infrastructure, quickly becoming one of the most advanced digital societies in the world (The Economist, 2013). Estonia uses a national chip and pin ID card, which gives every citizen access to the e-cabinet, -school and –healthcare system and allows foreigners to apply for e-residency (Kwang, 2017). Estonia has capitalised its technological know-how to innovate in the technology startup market, with successful enterprises such as Skype, Transferwise and Starship Technologies all being of Estonian origin (Walt, 2017). This unique IT environment might be conducive to developing and testing digital health interventions. Estonia has already recognised the potential of health technology, with several centres for health technology development having been established in the past few years (Estonian HealthTech Cluster, 2016). The focus in Estonian health technology has thus far been on issues such as HIV prevention, telemedicine and diagnostics (Estonian Health Tech Cluster, 2017). Despite each of these areas involving important behaviour change components, Estonia is only just beginning to introduce behavioural science into its

health technology efforts both in the public and private sectors. The first ever behaviour change training course took place in October, 2016 (Tehnopol, 2016). Estonia's focus on health technology development, but lack of expertise in behaviour change creates an especially interesting environment to develop and test digital behaviour change interventions in.

The problem of Estonian adolescent and young adult alcohol and tobacco consumption

Alcohol and tobacco consumption in adolescents and young adults is a serious public health concern in Estonia today. Of 15-year-old-girls 40% and of the boys 49% report having first smoked a cigarette before the age of 13 (WHO, 2016[2]). Alcohol consumption in Estonia is characterised by heavy drinking episodes during the weekends and binge drinking (Helasoja et al., 2007). There is also an acceptance of public drunkenness, similarly to the Nordic countries of Denmark, Finland, Iceland, Sweden and Norway (Popova et al., 2007). In Estonia, the legal age to buy and consume alcohol and tobacco is 18. Since the 'protection of second-hand tobacco exposure - Article 8 of the WHO Framework Convention on Tobacco Control was enforced by the World Health Organization in 2005 (WHO, 2016[3]), many European countries, including Estonia have enforced smoke-free environments and banned smoking in public places. Alcohol consumption legislation is similarly strict in Estonia. Estonia follows zero-tolerance law in terms of drinking and driving, restricts sales of alcohol between 10pm and 10am, and proof of identification is required from anyone buying alcohol that looks under the age of 30 (Health Development Institute, Estonia, 2016[1]). However, despite these increasingly strict legislative measures, alcohol and slightly less so, tobacco consumption, remain normalised in Estonian society (Raudne, 2012; Kollom, 2012).

Few interventions exist to reduce Estonian adolescent and young adult alcohol and tobacco consumption, and none employ digital technology to deliver personally relevant information to individual adolescents and young adults. Currently, there are no digital intervention programmes targeting adolescents' and young adults' alcohol or tobacco consumption available in Estonian. Hospital-based smoking cessation services and alcohol disorder treatment centres do exist (Ojala et al., 2010, National Health Development Institute, 2015[1,2]). There are also newly redeveloped

websites on both alcohol and tobacco consumption with dedicated sections for youth (National Health Development Institute, 2016[2,3]). School-based prevention programmes are delivered to adolescents, but these have a narrow primary focus on the risk of cancer and addiction (Riigi Teataja, 2002). There are no programmes specifically designed for young adults. Estonia as a country, however, does have a strong digital technology focus, identifying itself as a 'Digital Society' (Estonian ICT Export Cluster, 2016). As such, Estonia may provide a conducive environment for the development and testing of digital interventions.

DISCUSSION

Effectively intervening in adolescent and young adult alcohol and tobacco consumption might ensure positive health outcomes for the rest of the life course (Sawyer et al., 2012). However, the most common approach to changing adolescent alcohol and tobacco consumption, school-based interventions, has been found to be largely ineffective (Steinberg, 2015), and the interventions targeting young adults show mainly small short-term effects (Moreira et al., 2009). Estonian adolescents and young adults in particular have been shown to engage in high levels of alcohol and tobacco consumption (WHO, 2016[2]). Digital interventions might provide a way to increase the effectiveness of interventions for both adolescent and young adult alcohol and tobacco consumption, but further research is required into context-sensitive, tailored interventions that are engaging and persuasive for adolescent and young adult users.

A relatively new area of research is that of multiple behaviour change and specifically of changing co-occurring alcohol and tobacco consumption in adolescents and young adults. There are only a few digital interventions that have targeted both alcohol and tobacco in adolescents and young adults, despite the high level of co-occurrence. The majority had no effect on either alcohol or tobacco consumption, which might be reflective of there being no clear consensus yet on the best practices to design, develop and implement multiple behaviour change interventions (Nigg et al., 2008; Rasanen et al., 2006). There is a clear need for additional research into changing adolescent and young adult alcohol and tobacco consumption in one intervention.

Potential elements of digital interventions aiming to reduce adolescent and young adult alcohol and tobacco consumption that might engage more users and provide for more effective interventions are the use of mixed methods and participatory research designs (Shaw et al., 2014; Bennett & Glasgow, 2009). In the case of this research, mixed methods approaches to intervention development provide insight into the sociocultural context within which alcohol and tobacco consumption occurs in subgroups of adolescents and young adults. Participatory design approaches allow adolescents and young adults to become a part of the intervention development process, which might increase the credibility and persuasiveness of the intervention content as well as emphasising their autonomy as individuals, an important developmental goal in these age

groups (Mandel & Qazilbash, 2005). There are no existing digital interventions targeting both adolescent and young adult alcohol and tobacco consumption which have described using a participatory design for intervention development. This thesis aims to address this research gap and will present a web and mobile phone-based intervention aimed at reducing Estonian adolescent and young adult alcohol and tobacco consumption, developed using participatory design.

Aims of this thesis

This thesis aims to do the following:

1. **Chapter 2**: Systematically review the effectiveness of digital interventions in reducing adolescent and young adult alcohol and tobacco consumption and the behaviour change techniques associated with intervention effectiveness.

2. **Chapter 3** Explore the sociocultural context of Estonian adolescent and young adult alcohol and tobacco consumption and the potential appeal of an individually tailored digital intervention using focus group methods.

3. **Chapter 4**: Develop an autonomy supportive digital intervention program to reduce Estonian adolescent and young adult alcohol and tobacco consumption using participatory design.

4. **Chapter 5**: Pilot test the digital intervention program to investigate feasibility, acceptability and estimate short-term efficacy in Estonian adolescents and young adults.

CHAPTER 2
Do digital interventions reduce alcohol and tobacco consumption in adolescents and young adults? A systematic review and meta-analysis.

ABSTRACT

Background

Several digital interventions have targeted adolescent and young adult alcohol and tobacco consumption, but it is unclear whether they effectively reduce these behaviours in both groups. It is also unclear which behaviour change techniques might increase effectiveness of such interventions. This review aims to answer both questions.

Method

We searched five electronic databases (CINAHL, EMBASE, MEDLINE, ASSIA and PsycINFO) for randomised controlled trials of digital interventions targeting adolescents and young adults who smoked and/or drank alcohol in the past month aged 15-24, reporting behavioural outcomes. Random effects meta-analyses of behavioural outcomes were undertaken to estimate pooled effects and five behaviour change techniques were pre-selected based on existing evidence of effectiveness and meta-regression was used to examine associations with behavioural outcomes.

Results

Out of 2908 unique articles, 32 were included in the meta-analyses. Digital interventions reduced adolescent and young adult alcohol consumption, weekly drinking (mean difference = -0.55, 95% CI (-1.04, -0.05), I^2=93%) and monthly binge drinking (mean difference = -0.30, 95% CI (-0.55, -0.05), I^2 = 75%). Digital interventions increased smoking cessation (risk ratio = 1.70, 95% CI (1.37, 2.11), I^2= 35%). No significant associations with intervention effectiveness were found for the 'tailored interactions', 'performance feedback' and 'information on excessive consumption' BCTs in alcohol consumption studies or the 'provide information on withdrawal symptoms' BCT in tobacco consumption studies.

Discussion

Digital interventions can reduce alcohol and tobacco consumption in both adolescent and young adult populations.

BACKGROUND

Orientating intervention content and delivery mode to adolescent and young adult populations separately from adult alcohol and tobacco consumers is important due to differences in appealing intervention content, such as the prioritisation of peer norms and the potential mistrust of information from known authority figures, but which adolescents and young adults have in common (Eysenbach, 2008; Steinberg & Silverberg, 1986; Bobo & Husten, 2000). Adolescents and young adults also differ from adults in terms of preferences for health information and the context within which their health behaviours occur, thus warranting an intervention approach separate from adult populations (Sawyer et al., Smith et al., 2013; Eysenbach, 2008).

Adolescents and young adults are avid everyday users of digital technologies (Eurostat, 2016) and might prefer the personalised content and reduced stigmatisation that such interventions allow compared to traditional school- or paper-based intervention approaches (Naughton & Sutton, 2011; Cunningham et al., 2011). Adolescents and young adults also find it difficult to address their health concerns in face-to-face interactions with teachers or doctors, a barrier which digital interventions could overcome (Harvey et al., 2008). Existing reviews have investigated only the mobile phone text messaging or Internet delivery channels in adolescent and young adult populations (Mason et al., 2014) or have only included university student populations and interventions that might also include a face-to-face component (Gulliver et al., 2015; Bhochhibhoya et al., 2015). No existing reviews have included both adolescent and young adult populations, strictly digital intervention delivery channels only and both alcohol and tobacco consumption behaviours.

Despite their potential, digital interventions suffer from high attrition rates, which also reduces their effectiveness (Eysenbach, 2005). This is especially the case in adolescent and young adult populations (Crutzen et al., 2011). Understanding which digital interventions are associated with effectiveness in adolescents and young adults requires the content features, such as the included behaviour change techniques, to be investigated (Abraham & Michie, 2008; Black et al., 2016). Binge drinking is most prevalent in young adult populations (WHO, 2014[2]), and specific features of interventions associated with effectiveness are important to identify for binge drinking

intervention programs also. No existing reviews have examined associations of specific content features with effectiveness in digital interventions targeting adolescent and young adults.

Some digital intervention content features that might be associated with effectively reducing adolescent and young adult alcohol and tobacco consumption include targeting intervention content to subcultures of adolescents and young adults or tailoring content to individual users of interventions (Crutzen et al., 2011). Such content might be especially appealing, as both techniques increase personal relevance of intervention content which might engage adolescents and young adults more than generic messages (Crutzen et al., 2011; Eysenbach, 2008; Hawkins et al., 2008). There is some evidence from individual trials indicating that tailoring in digital interventions is associated with effectiveness in adolescent and young adult tobacco and alcohol consumption (Skov-Ettrup et al., 2014; York et al., 2012; Fjeldsoe et al., 2009). Other commonly used behaviour change techniques include providing information on normative behaviour of peers and feedback on performance towards the goal behaviour (Doumas et al., 2010; Alfonso et al., 2012). No existing systematic reviews have investigated whether these behaviour change techniques are associated with effectiveness in digital interventions aimed at reducing adolescent and young adult alcohol and tobacco consumption.

Two gaps still exist in the evidence base on the use of digital interventions for adolescent and young adult alcohol and tobacco consumption: (1) do digital interventions designed specifically for adolescents and young adults reduce their alcohol and tobacco consumption and (2) which behaviour change techniques in digital interventions designed for adolescents and young adults are associated with effectiveness? The current review aims to fill these gaps in the evidence base.

Primary Objective

Are digital interventions set in organisations, institutions or spaces designed for young people effective at reducing adolescent and young adult weekly alcohol and tobacco consumption compared to minimal intervention or no intervention comparison groups in randomised controlled trials?

Secondary objectives

1. Which of the most commonly used behaviour change techniques are associated with digital intervention effectiveness?

2. Is the choice of comparator associated with intervention effectiveness?

METHOD

Protocol and registration

The protocol for this review was registered in the PROSPERO database of reviews (http://www.crd.york.ac.uk/PROSPERO/, registration number CRD42015032476). The PRISMA checklist for reporting systematic reviews and meta-analyses can be viewed in Appendix 1.

In addition to the primary and secondary objectives stated above, in the protocol we outlined that we would compare trials using different types of digital media, assess how digital interventions affected participants' perceptions of social norms and summarise measures of intervention acceptability. Unfortunately, due to no or too few studies looking at these, we were unable to investigate them.

Eligibility criteria

Selection of studies and participants

We considered randomised controlled trials published in English and targeting adolescents between the ages of 15 and 24 who are current tobacco and/or alcohol consumers. Participants older than the age of 24 were included if they were a part of the setting aimed at adolescents or

young adults where the intervention was carried out. These definitions are widely used with adolescent and young adult participant populations and aimed to capture the full range of smoking and drinking behaviours (e.g. Paschall et al., 2011; An et al., 2013). This review includes alcohol consumers often identified as 'risky' or 'heavy' drinkers but not 'problem' drinkers who often identify individuals with alcohol dependence. Interventions targeting individuals who have never consumed tobacco or alcohol were not included, as we did not aim to assess prevention interventions. If the intervention involved a prevention element targeted at participants who do not engage in alcohol or tobacco consumption behaviours, but also included an intervention component targeted at those who do, the trial was included in the review. Participants were not specifically selected based on their intention to quit smoking and/or reduce alcohol consumption. Participants were also not specifically selected based on proactively seeking help for quitting smoking and/or reducing their alcohol consumption.

Types of Interventions

Interventions that targeted alcohol consumption or cigarette smoking or both behaviours were considered. Interventions had to have been specifically designed for adolescent and young adult populations. Trials had to involve comparisons between a digital intervention and a control group receiving intervention content in a non-digital format, no intervention, minimal intervention content via a digital medium or intervention content about a health behaviour other than alcohol consumption or cigarette smoking. Minimal intervention content was defined as brief information on the behaviour in question, for example basic feedback on personal alcohol use. Included interventions must have measured tobacco and alcohol consumption or at least one of these behaviours directly. Tobacco consumption also included the use of smokeless tobacco.

Definition of a digital intervention

A digital intervention was defined as any intervention that uses at least one digital medium to deliver the primary intervention material via a direct interface with the participants. The digital medium used could be email, text messages, smartphone applications, websites, videos, audio messages, picture messages, social networking sites and multi-media, which would include a combination of different media. This did not include interventions that use digitally delivered materials only for screening or follow-up purposes. A digital intervention, therefore, must deliver

the main content of the intervention material via a digital medium. Interventions where the materials have been produced through computer or digital technology but presented in paper or one-to-one consultation format were not included. Nor were interventions where there was a one-to-one consultation between the participant and the individual delivering the intervention, which was a part of the primary intervention content. A digital intervention was not included if it involved interpersonal communication for example if the intervention material was delivered through a digital communication program, such as video chat, involving personal interaction between the participant and the intervention deliverer.

Outcome measures

Two primary outcome measures were selected to reflect widely used measures in both tobacco and alcohol consumption interventions. For tobacco consumption, this was self-reported 7-day point-prevalence abstinence (e.g. Buller et al., 2014; Free et al., 2011) and for alcohol consumption the self-reported number of drinks consumed in the past week (e.g. Bewick et al., 2008; Voogt et al., 2013). For tobacco and alcohol consumption interventions, the minimum follow-up period for inclusion was 1 month. A short-term follow-up period was chosen as it is the most common type of follow-up reported for trials on adolescent and young adult alcohol and tobacco consumption and might enable the inclusion of the most number of studies into the analysis.

Secondary Outcomes

One secondary outcome measure was selected for alcohol consumption interventions; number of binge drinking instances in the past month. This is a widely-used measure of binge drinking (e.g. Suffoletto et al., 2015; Moore et al., 2005).

Search strategy

Five bibliographic databases were searched in June 2016 MEDLINE, PsycINFO, ASSIA, EMBASE and CINAHL. In EMBASE, the search was limited to studies published between 1996 and 2016. A combination of the keywords adolescent, young adult, student, university, alcohol,

drinking, smoking, tobacco, Internet, mobile, text message and other variations of these words was used. A highly sensitive search strategy was created for MEDLINE. Full search terms can be viewed in Appendix 2.

Study selection

Studies from all databases were compiled into one search result in the Mendeley referencing system by one of the researchers. Duplicates were removed, after which the complete list of study titles was screened by one of the researchers and relevant study titles were identified. Two researchers then independently screened the relevant study titles and a list of abstracts was compiled for further review. The abstracts identified by both researchers were compared and any disagreements were settled among all three researchers. Through the screening of abstracts, full text articles were identified for further screening. Two researchers read the chosen full text articles independently. All three researchers discussed the studies to be included in the meta-analysis.

Behaviour change technique coding

Behaviour change techniques were coded using a combination of the V1 behaviour change taxonomy (Michie et al., 2013), the alcohol-specific taxonomy (Michie et al., 2012) and the smoking-specific taxonomy (Michie et al., 2011). As this review investigated both alcohol and tobacco consumption behaviour, it was decided that both of the behaviour change taxonomies specific to these behaviours should be used. As some behaviour change techniques in the alcohol- and tobacco-specific taxonomies overlapped, whilst others differed, it was decided that the full V1 behaviour change taxonomy should also be included in order to ensure the most comprehensive list of behaviour change techniques that might be reported in alcohol and tobacco consumption trials in adolescents and young adults. Two researchers analysed all three taxonomies for similarities and differences and created a comprehensive list of behaviour change techniques that were uniquely represented in each of the three taxonomies. This ensured coverage of all the alcohol- and smoking-specific behaviour change techniques as well as general techniques from the V1 taxonomy. The full list of BCTs used for this review can be viewed in Appendix 3.

Data collection process

The data extraction form was created based on the recommendations of the Cochrane Collaboration Handbook for Systematic Reviews of Interventions Version 5.1.0 (Higgins & Green, 2011). After extraction forms were piloted, all three researchers extracted risk of bias, outcome data and BCTs and one researcher extracted general study information. Inter-rater reliability was adequate, with kappas of 0.72 for randomisation, 0.94 for blinding and 0.75 for attrition. For both outcome data and BCT coding the rate of agreement was 98%. The authors of two studies were contacted for further information about the data to be included in the meta-analysis.

Effect size measures

The measure of effect size used for the alcohol consumption outcome was the difference in means and for the tobacco-smoking outcome it was the risk ratio (Higgins & Green, 2011).

Analyses

Quantitative synthesis of study data was undertaken using the meta-analysis software programme RevMan. A random effects model was used for the meta-analysis, as it allows for different true effect sizes across studies. Primary analyses investigated the effect of digital alcohol consumption interventions on the number of drinks consumed per week by adolescents and young adults and on 7-day point prevalence abstinence from cigarette smoking.

Potential effect modifiers and sources of heterogeneity were identified using meta-regression analyses with the Comprehensive Meta-Analysis software. Three meta-regression analyses with BCTs were pre-specified based on evidence of effectiveness from individual alcohol consumption studies. Firstly, we planned to assess the effect of tailoring on number of alcoholic drinks consumed per week, number of binge drinking episodes per month and 7-day point prevalence abstinence from cigarette smoking (Kroeze et al., 2006; Richards et al., 2007; Noar et al., 2007) However, due to the small number of tobacco consumption interventions and varied use of BCTs, we were unable to complete this analysis for the 7-day point prevalence abstinence

from cigarette smoking outcome. Instead we conducted an exploratory analysis planned after data collection had taken place comparing interventions that did and did not include the presence of providing information on withdrawal symptoms on the outcome 7-day point prevalence abstinence, as this has been indicated as an effective BCT in individual tobacco consumption interventions (McCarthy et al., 2010). Secondly, we planned to assess the effect of normative information on number of alcoholic drinks consumed per week and number of binge drinking episodes per month (Bewick et al., 2008; Turner et al., 2008; Werch et al., 2000). It was not possible to carry out this due to too many studies having included it. Instead, we conducted an exploratory meta-regression planned after data collection had taken place on interventions that did and did not include the effect of the providing feedback on performance BCT on the outcome number of alcoholic drinks consumed per week, as this has been indicated as a BCT associated with effectiveness in individual studies (Riper et al., 2009). Lastly, we planned to assess the effect of the providing information on the consequences of excessive alcohol consumption BCT on the number of drinks per week and number of binge drinking episodes per month outcomes (Murphy et al., 2001; Doumas & Andersen, 2009). We were only able to carry out this analysis on the number of drinks per week outcome due to none of the interventions reporting the number of monthly binge drinking episodes using this BCT.

We planned to assess the effect of different comparison groups on intervention effectiveness on the drinks per week, binge-drinking episodes per month and 7-day point prevalence abstinence outcomes. We were only able to undertake this analysis on the drinks per week and number of binge drinking episodes in the past month but not on the 7-day point prevalence abstinence outcome due to the lack of variety in the comparison groups in the tobacco consumption studies.

Heterogeneity was assessed using the I^2 statistic, which indicates the percentage of variability in effect estimates being due to heterogeneity rather than chance (Higgins & Green, 2011; Higgins et al., 2003). The results are reported as the pooled effect size with 95% CI calculated; alpha was set at 5%.

Assessment of risk of bias

Risk of bias in individual studies was assessed using the risk of bias tool recommended in the Cochrane Collaboration Handbook for Systematic Reviews of Interventions Version 5.1.0 (Higgins & Green, 2011). All categories of bias were assessed as ‘low risk’, ‘high risk' or ‘unclear’. Risk of bias was assessed at the study level.

RESULTS

Study selection

We found 2908 unique articles. From those, we retained from abstract and reference searching 80 studies for full text screening and included 32 studies in the meta-analyses.

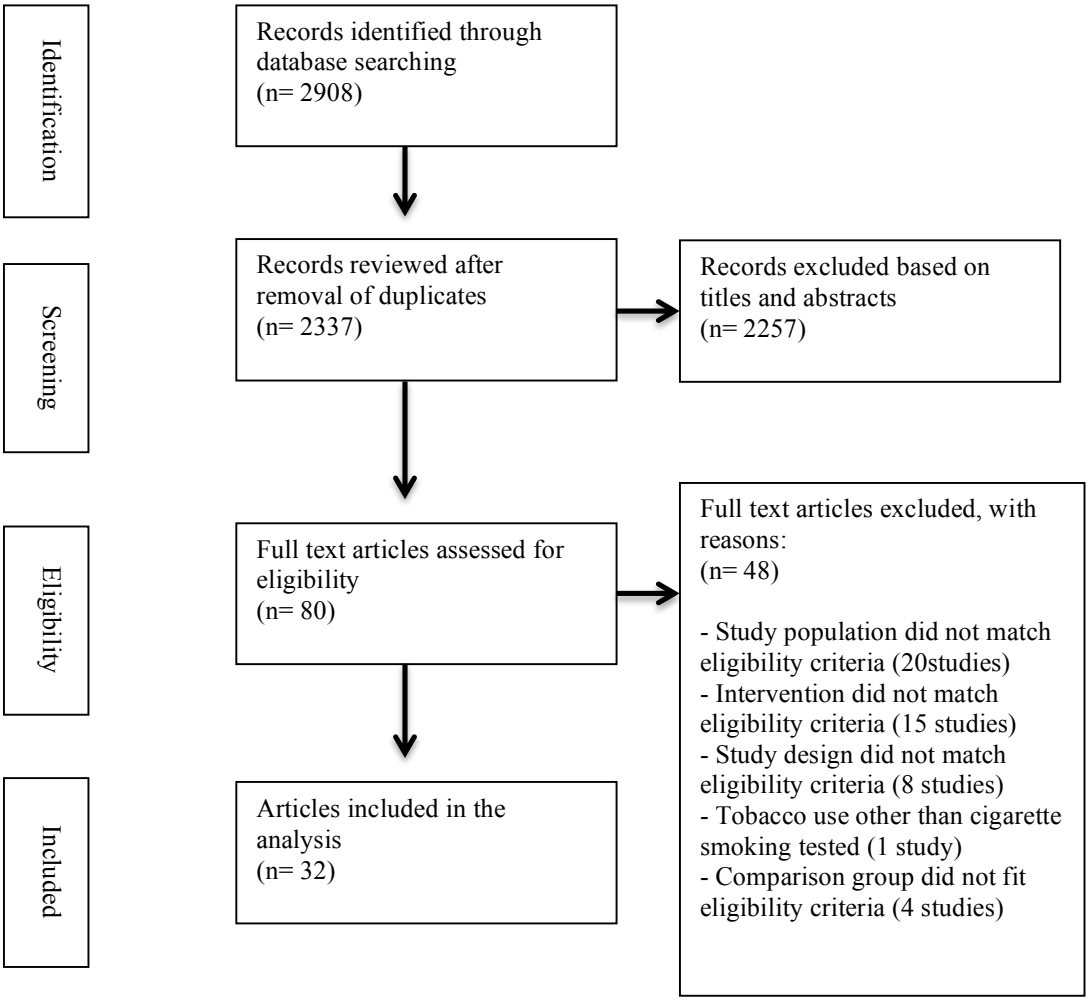

Figure 1. Study selection flow.

Study and sample characteristics

Twenty-six alcohol consumption studies were included in a meta-analysis, of which 22 reported the number of drinks per week outcome and 9 reported the binge drinking episodes in the past month outcome. Analyses were run on these two outcomes. Alcohol consumption studies were conducted in the USA (15/26 studies), the UK (2/26), Sweden (3/26), Switzerland (1/26) and New Zealand (4/26). One study was conducted across Belgium, Germany, Sweden and the Czech Republic (1/26). Participants in the alcohol studies were on average 20 years old, 44% male and 63% Caucasian. Screening and immediate feedback interventions were delivered by 20/26 alcohol studies. The longest intervention delivered by one of the alcohol studies was 12 weeks (Suffoletto et al., 2015). Follow-up periods across alcohol studies ranged from 1-24 months. Recruitment rates averaged at 56.8% and attrition rates at 21.8%.

A second meta-analysis was conducted with six tobacco consumption studies. Tobacco consumption studies were conducted in the USA (3/6 studies), New Zealand (1/6), Sweden (1/6) and China (1/6). Participants in the tobacco studies were on average 21 years old, 55% male and 69% Caucasian. One tobacco study (Whittaker et al., 2011) reported an average age of 27.5, which is higher than the 15-24 years in this review's inclusion criteria, but the trial was included as the intervention was specifically designed for adolescents and young adults and the high average age of participants was due to recruitment difficulties of finding adolescents. Tobacco consumption interventions were between 6 and 30 weeks long with follow-ups ranging between 1 and 6 months. Recruitment rates averaged at 49% and attrition rates at 19%.

All alcohol and tobacco consumption studies determined baseline alcohol and/or tobacco consumption through a screening process during participant recruitment.

Risk of bias results

For the alcohol consumption studies, 52% of risk assessments across all 26 studies were categorised as low risk of bias, 36% as unclear risk of bias and 18% as high risk of bias. Blinding of participants and personnel was the most frequent bias category where a high risk of bias was

found, in 15/26 alcohol consumption studies. Blinding of outcome assessment was the second most frequent bias category where a high risk of bias was found, in 11/26 alcohol consumption studies. Incomplete outcome data was the third bias category, where a high risk of bias was found, in 6/26 alcohol consumption studies. Unclear risk of bias was most frequently found in the selection bias category, due to lack of reporting on the generation of the randomisation sequence or the method of concealing allocation.

For the tobacco consumption studies, 26% of risk assessments across all 6 studies were categorised as low risk of bias, 31% as unclear risk of bias and 43% as high risk of bias. Blinding of participants and outcomes were the categories of bias where most studies were found to be of high risk, found in 5/6 tobacco consumption studies. Incomplete outcome data was the second bias category most likely to be found to have a high risk, found in 4/6 tobacco consumption studies. Allocation concealment was the bias category most likely to have unclear risk of bias, found in 4/6 tobacco consumption studies.

Descriptions of individual alcohol and tobacco consumption studies can be viewed in Tables 1 and 2, respectively.

Legend	
High risk	
Unclear risk	
Low risk	

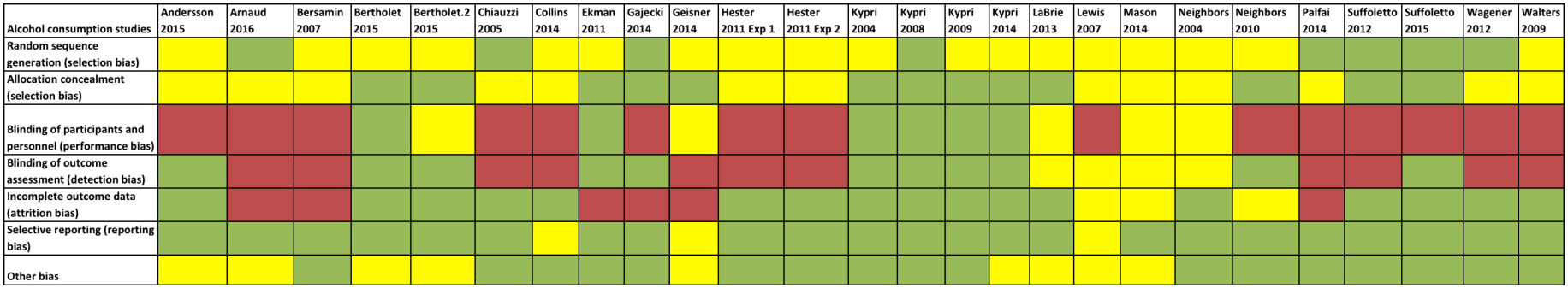

Figure 2. Risk of bias table for alcohol consumption studies.

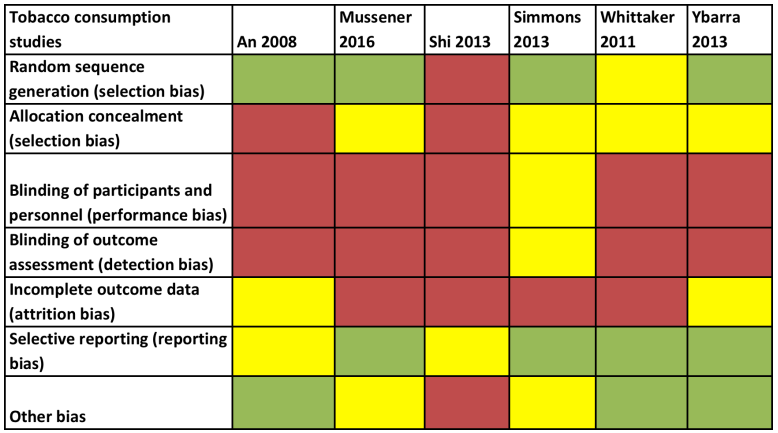

Figure 3. Risk of bias table for tobacco consumption studies.

ALCOHOL CONSUMPTION STUDIES

Author	Country	Intervention	Comparison	Participants	Measures	Recruitment rate %	Attrition %	Findings
Andersson 2015	Sweden	Website	No intervention	University students	DDQ (Daily Drinking Questionnaire)	59.2%	15.3%	ANCOVA change score for DDQ quantity (-1.0, -1.7;-0.3 95% CI), Model fit R2 = 0.638. Adjusted Cohen's d = 0.21
Arnaud 2016	Sweden, Belgium, Czech Republic, Germany	Interactive website	No intervention	16-18 year olds	AUDIT	71.8%	85.4%	Mean change in AUDIT score: -0.85 (95% CI -1.49; -0.26) Adjusted mean difference between intervention and control: 1.02(95% CI 0.25; -1.79) Cohen's d = 0.26
Bersamin 2007	USA	Website	No intervention	University students	Baseline drinking status Heavy drinking Negative alcohol-related consequences	26.5%	39.4%	Drinking status Cohen's d = 0.15 for baseline drinkers and 0.01 for baseline non-drinkers
Bertholet 2015	Switzerland	Website	No intervention	Twenty-one-year-old men from Switzerland with unhealthy alcohol use (>14 drinks/week or ≥ 6 drinks/occasion at least monthly or Alcohol Use Disorders Identification Test (AUDIT) scores ≥ 8)	Number of drinks per week AUDIT	45%	8%	Relative to control group, number of drinks per week in intervention group was reduced by 1.68 drinks. Intervention: mean difference = -1.68, (95% CI, -2.47; -0.89) Control: mean difference = -0.39, (95% CI, -1.27; 0.50)
Bertholet 2015 (2)	Switzerland	Computer program	No intervention	19-20 year-old males in general population	AUDIT Alcohol consumption frequency Alcohol consumption quantity	37%	48.9%	Relative to control, intervention group reported less drinking at 1 month follow-up: IRR = 0.87, (95% CI, 0.76; 1.00), p = 0.05)
Chiauzzi 2005	USA	Website	Minimal intervention	University students	DDQ Rutgers Alcohol Problem Index	NA	20%	Average number of binge drinking episodes in typical week within-groups change: F(1, 213)= 124.03, p<0.001)
Collins 2014	USA	Website	No intervention	Undergraduate students in the US	Drinking frequence Drinking quantity Rutgers Alcohol Problem Index	NA	27.9%	Mean difference = -0.80 (95% CI, -0.36; 0.20)
Ekman 2011	Sweden	Website	Minimal intervention	University students	Weekly consumption Frequency of heavy episodic drinking Highest blood alcohol	5%	6.1%	Relative change in average weekly consumption: Intervention (-12%), control (-1%) Absolute change in average weekly

					concentration in past 3 months			consumption (g) Intervention (-15.3 g), Control (-1.7 g), p = 0.147
Gajecki 2014	Sweden	Website	No intervention	The current members of the student unions at Stockholm University and the Royal Institute of Technology in Stockholm, Sweden	DDQ AUDIT	40%	70%	No differences between intervention and control group detected for any outcomes.
Geisner 2015	USA	Website	Assessment-only	University students from the US	Beck Depression Inventory AUDIT DDQ Rutgers Alcohol Problem Index	95%	8.3%	No main effects for typical weekly drinking (F = 1.51, p = 0.054) or consequences (F = 1.51, p = 0.28)
Hester 2011	USA	Computer program	Assessment only	University students	AUDIT Brief Drinker's Profile Rutgers Alcohol Problem Index	72%	2.8%	Between-group effect size: Cohen's d = 0.34
Hester 2011	USA	Computer program	Assessment only	University students	AUDIT Brief Drinker's Profile Rutgers Alcohol Problem Index	78.8%	1.2%	Between-group effect size: Cohen's d = 0.82
Kypri 2004	New Zealand	Website	Minimal intervention	Users of the Student Health Service of the University of Otago	Frequency of drinking Typical occasion quantity Total volume Frequency of very heavy episodes Personal, social, sexual and legal consequences of episodic heavy drinking Consequences related to academic performance AUDIT	53%	17.3%	Ratio of geometric means for frequency of drinking outcome: At 6 weeks followup, ratio = 0.8 (95% CI, 0.63; 1.02), p = 0.08 Frequency of very episodic heavy drinking: At 6 weeks follow-up ratio = 0.63 (95% CI, 0.42; 0.94), p = 0.02
Kypri 2008	New Zealand	Website	Minimal intervention	University students	Number of drinking days in the preceding 2 weeks Typical occasion quantity in the preceding 4 weeks Total volume in the preceding 2 weeks Frequency of very heavy	43.5%	12%	Relative to control, intervention group at 6 months reported a lower frequency of drinking (RR, 0.85; 95% CI, 0.73; 0.98) Reduced episodic heavy drinking (RR, 0.65; 95% CI, 0.45; 0.93)

					episodes in the preceding 2 weeks Personal, social, sexual and legal consequences of episodic heavy drinking Consequences related to academic performance AUDIT			
Kypri 2009	New Zealand	Website	Screening only	University students	Frequency of drinking Number of standard drinks per typical drinking occasion Alcohol Problems Scale Academic Role Expectation and Alcohol Scale AUDIT	18.7%	21.8%	Relative to control, intervention group at 6 months follow-up reported a lower frequency of drinking (RR, 0.91; 95% CI, 0.85; 0.97) Lower total consumption (RR, 0.89; 95% CI, 0.82; 0.96)
Kypri 2014	New Zealand	Website	Screening only	17-24 year old students in a New Zealand university who did not select Maori in response to the ethnicity question on the university enrolment form.	Frequency of drinking in past 4 weeks Amount consumed per typical drinking occasion Academic Role Expectations and Alcohol Scale	22%	16.7%	Relative to control, intervention group 5 months follow-up reported No difference in number of drinking days (RR, 0.95; 95% CI, 0.88; 1.03), p = 0.08 Lower number of drinks on typical drinking occasion (RR, 0.93; 95% CI, 0.86; 1.00), p = 0.005
LaBrie 2013	USA	Website	Assessment control	Undergraduate students	DDQ Drinking Norms Rating Form Rutgers Alcohol Problem Index	38%	10.5%	No significant differences for total weekly drinks (RR = 0.96, 95% CI: 0.85, 1.09), peak drinks (RR = 1.01, 95% CI: 0.94, 1.10), total drinking days (RR = 1.00, 95% CI: 0.91, 1.09), and drinking related problems (RR = 0.91, 95% CI: 0.67, 1.25).
Lewis 2007	USA	Website	Baseline survey only	University students	DDQ Drinking Norms Rating Form	72.3%	27.2%	Multivariate results revealed a significant main effect for group, Wilks' Λ = .91, F (4, 398) = 3.91, p < .01, $\eta p2$ = .04. Multivariate tests were not significant for either sex or the interaction between sex and intervention condition. Univariate follow-up analyses further revealed significant group differences in drinks per week, F (2, 200) = 4.33, p = .01, $\eta p2$ = .04, and drinking frequency, F (2, 200) = 7.91, p < .001, $\eta p2$ = .07.

Mason 2014	USA	Text messages	No intervention	Undergraduate psychology courses	Fagerstrom Tolerance Questionnaire Smoking intentions Smoking behaviour in past 30 days Readiness to stop smoking Peer social support Peer smoking behaviour Refuse cigarettes from peers Family smoking context	100%	0%	Relative to control condition, intervention group decreased the number of cigarettes smoked in the past 30 days: F(1, 55) D 4.39, P < .01
Neighbors 2004	USA	Computer	Assessment only	University students	Drinking Norms Rating Form Alcohol Consumption Index Drinking Motives Questionnaire	66.5%	17.9%	The effect size for the intervention effect on drinking at 3-month follow-up was in the small-to- medium range, B = - 0.254, SE = 0.092, p = 0.01, d = 0.35.
Neighbors 2010	USA	Website	No intervention	University students	DDQ Rutgers Alcohol Problem Index	39%	7.7%	The biannual gender-specific intervention group reported approximately 1.5% fewer average weekly drinks. From the 6-month follow-up assessment point to the 24-month follow-up assessment point, this difference translates to 22% less drinking relative to the control group (i.e., RR = 0.78).
Palfai 2014	USA	Web Email	No intervention	First year undergraduate students in the US	Health behaviours survey AUDIT Indices of risky alcohol use	53%	53%	No significant effect of the alcohol intervention on past-month heavy drinking episodes IRR = 0.91 (95 % CI, 0.73; 1.14
Suffoletto 2012	USA	Text message	No intervention	Young adults identified during their Emergency Department visit with hazardous drinking behaviour	AUDIT -C Timeline Followback method of alcohol consumption Rutgerrs Alcohol Problems Index	86.5%	11.5%	Change in number of heavy drinking days in past month: Intervention (-3.4; 5.4), Control (-1.1; 4.1), p = 0.04
Suffoletto 2015	USA	Text message	No intervention	18-25 year old patients at an emergency department	Binge drinking days in past 30 days Drinks per drinking day in past 30 days Alcohol-related injury/prevalence in past 30 days	25%	21.8%	Relative to control group, intervention group reported less number of drinking days at 9-month follow-up: IRR = 1.20 (95% CI, 1.08; 1.34)
Wagener 2012	USA	Computer	Assessment only	University students	DDQ Brief Young Adult Alcohol Consequences	84%	6.6%	Results of the repeated- measure ANOVAs indicated a significant Condition × Time interaction for weekly

					Questionnaire Program Satisfaction Questionnaire			drinking quantity, F(3, 136) = 2.72, p = .047; typical BAC, F(3, 136) = 3.37, p = .02; and peak BAC, F(3, 135) = 4.90, p = .003.
Walters 2009	USA	Computer	Assessment only	Heavy drinking university students	7-day drinking calendar modified from the DDQ Rutgers Alcohol Problem Index Normative drinking perceptions Protective Behavioural Strategies Survey Readiness to change	84%	13.6%	Intervention group reported consuming 5.26 fewer drinks per week than participants in the control group, t(275)= -2.63, p = 0.01, effect size of 0.41

Table 1. Summary of alcohol consumption interventions.

TOBACCO CONSUMPTION STUDIES

Author	Country	Intervention	Comparison	Participants	Recruitment %	Attrition %	Measures	Findings
An 2008	USA	Email, website	Minimal intervention	University of Minnesota Twin Cities 2004 undergraduate enrollment	32%	8%	Self-reported 7-day abstinence 30-day abstinence CO validated abstinence	At week 30, 40.5% of intervention group reported not smoking any cigarettes in the prior 30 days compared with 23.1% in control group (odds ratio (OR) 2.26, 95% CI 1.55–3.32).
Mussener 2016	Sweden	Text message	Delayed intervention	University students in Sweden	Unclear	Unclear	Self-reported 7-day abstinence	At 4 months, 25.9% of intervention group reported not smoking any cigarettes compared to 14.6% in the control group, OR = 2.05, 95% CI 1.57-2.67
Shi 2013	China	Text message	Non-digital intervention	16-19 adolescents in Shanghai	Unclear	Unclear	Self-report 7-day point-prevalence abstinence 30-day point prevalence abstinence Reduction in cigarette consumption Moving forward in quitting stages	No significant differnce between quit rates in intervention (13%) versus control group (7%) RR = 1.76, 95% CI 0.74; 4.20
Simmons 2013	USA	Website, video	No intervention	University students in South Florida	100%	7.6%	7-day point prevalence abstinence (CO verified), 30-day point prevalence abstinence, motivation to quit smoking, Stages of change	At 6 month follow-up the intervention group abstinence rate (32.1%) did not differ from any of the control (22.6%, OR = 1.62, 95% CI = 0.81 – 3.23, p = .173)
Whittaker 2011	New Zealand	Video	No intervention	Young adults, especially Maori	Unclear	Unclear	Continuous abstinence from quit day to 6 months, point prevalence abstinence	No significant difference between quit rates in intervention group (26.4%) or control group (27.6%), p = 0.80
Ybarra 2013	USA	Text message	No intervention	18-25 year olds general population US	14%	41%	Verified quit status, quit at 4 weeks, 7-day point prevalence	No significant different between quit rates in intervention (40%) versus control group (30%), OR = 1.62, 95% CI 0.82; 3.21)

Table 2. Summary of tobacco consumption interventions.

Digital Intervention Characteristics

There were no studies evaluating an intervention that targeted both alcohol and smoking behaviours.

Alcohol consumption interventions

Alcohol consumption interventions consisted of a website (18/26 studies), a computer program (5/26) or mobile phone text messaging (3/26). Intervention content varied between studies in terms of the amount of information given to the participants, the length of intervention, the BCTs employed and the interactivity of the digital intervention interface. The most common BCTs used in these 26 alcohol consumption studies were providing normative information about others' behaviour (24/26), tailoring interactions (17/26) and providing information on the consequences of excessive consumption (17/26), as illustrated in Figure 4. Only 2/26 alcohol studies reported having a basis in theory, both named the Theory of Planned Behaviour (Suffoletto et al., 2015; Gajecki et al., 2014). Of the 26 alcohol studies, 3 reported that the intervention was based on Motivational Interviewing techniques (Arnaud et al., 2016; Mason et al., 2014; Wagener et al., 2012).

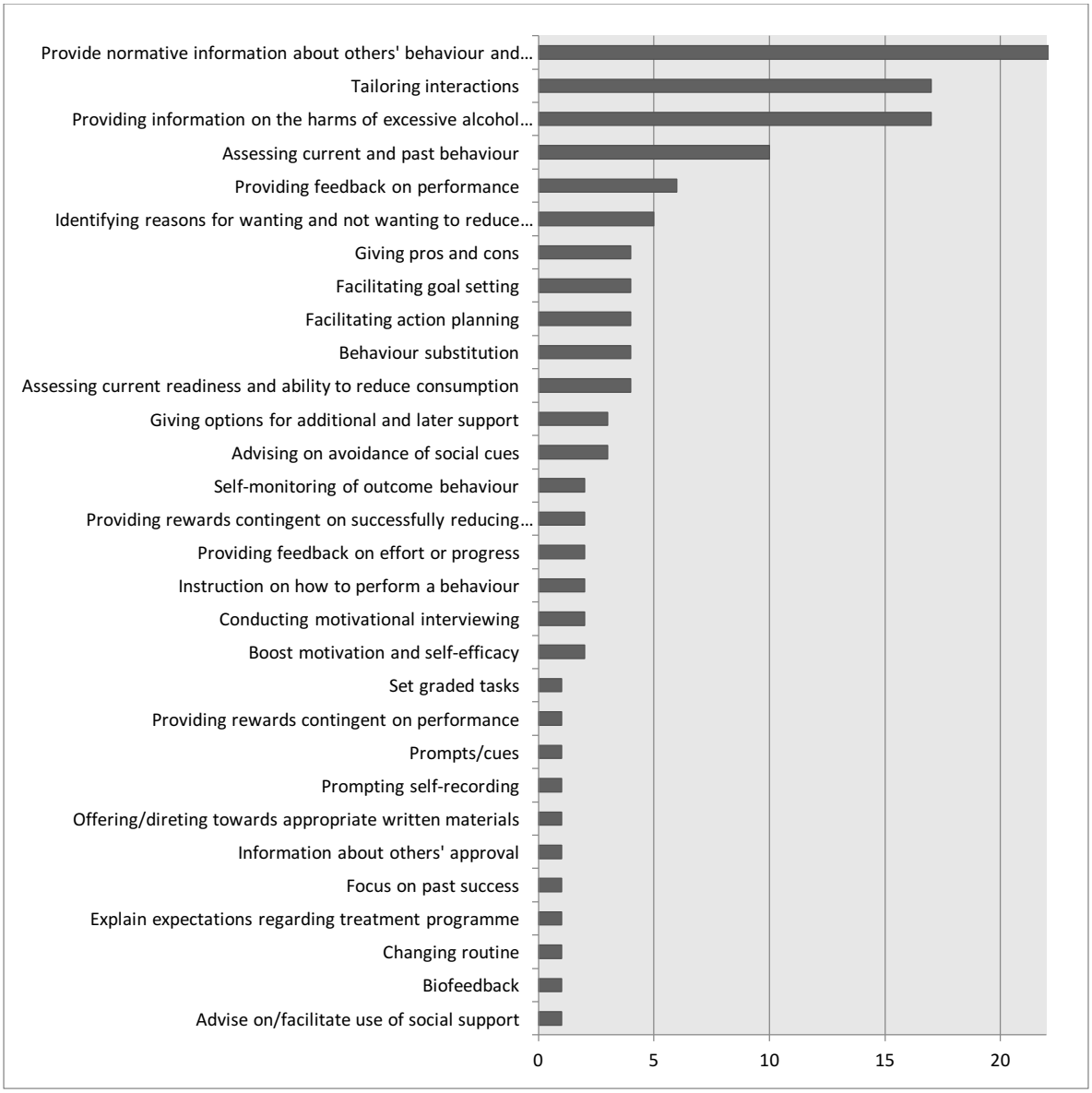

Figure 4. Use of behaviour change techniques across alcohol consumption interventions (N= 26).

Tobacco consumption interventions

Tobacco smoking cessation interventions consisted of websites (2/6 studies), mobile phone text messaging (3/6 studies) and video technology (1/6). The most commonly used BCTs in the 6 tobacco consumption studies were advising on the use of social support (5/6), facilitating action planning (5/6) and tailoring interactions (4/6), as illustrated in Figure 5. Theoretical basis was reported by 4/6 tobacco studies, naming Social Cognitive Theory in 2/6 studies (An et al., 2008; Whittaker et al., 2011), the Transtheoretical Model in 1/6 studies (Shi et al., 2013) and cognitive dissonance theory in 1/6 studies (Simmons et al., 2013).

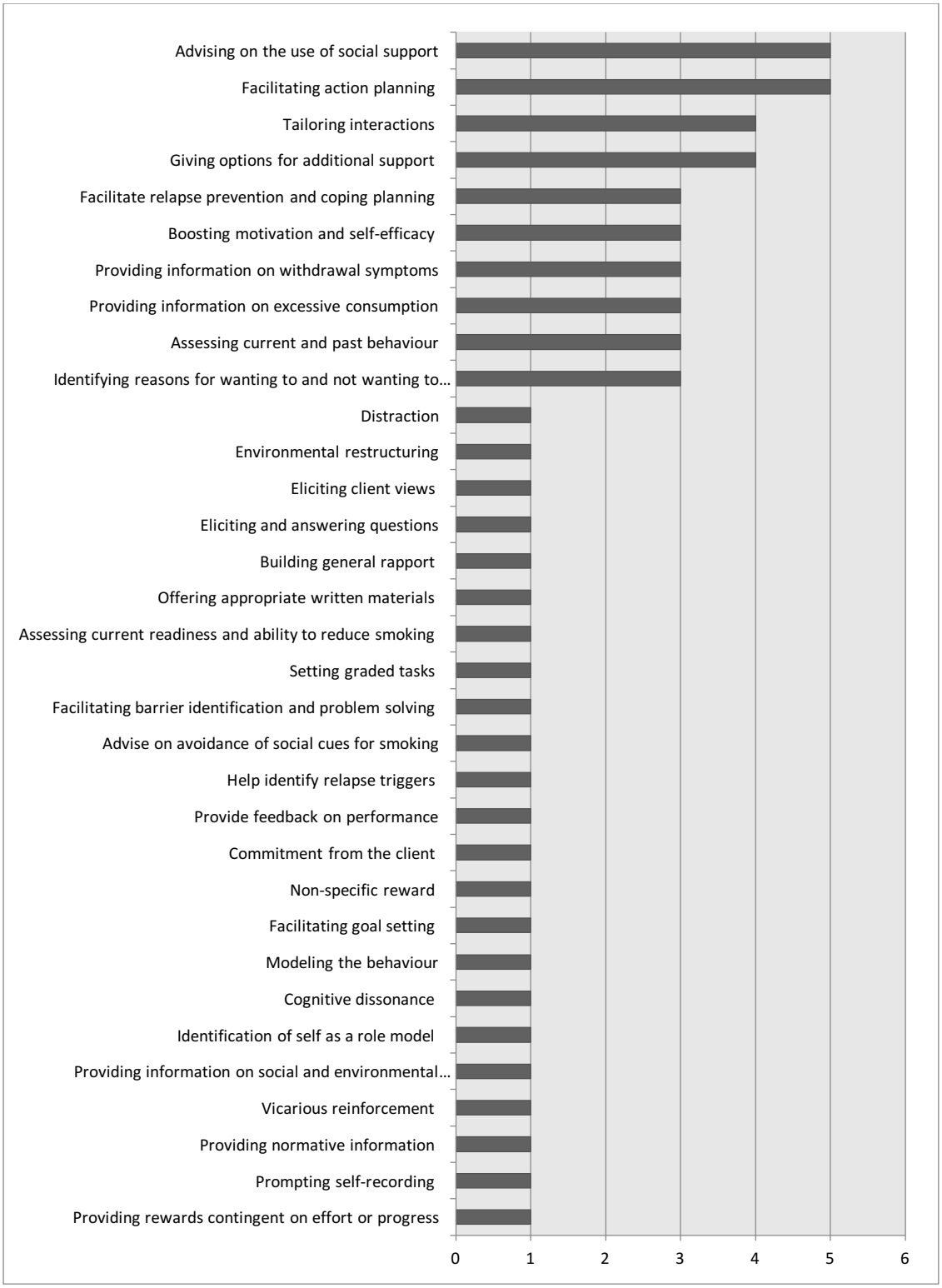

Figure 5. Use of behaviour change techniques across tobacco consumption studies (N=6).

Effectiveness of alcohol consumption interventions

When trials were pooled, digital interventions were found to reduce adolescent and young adult alcohol consumption by just over half a drink per week (mean difference = -0.55, 95% CI (-1.04, -0.05), I^2=93%), with substantial heterogeneity present (Figure 6). Binge drinking episodes (Figure 7) were reduced by 0.30 instances in the past month (mean difference = -0.30, 95% CI (-0.55, -0.05), I^2 = 75%), also with substantial heterogeneity present.

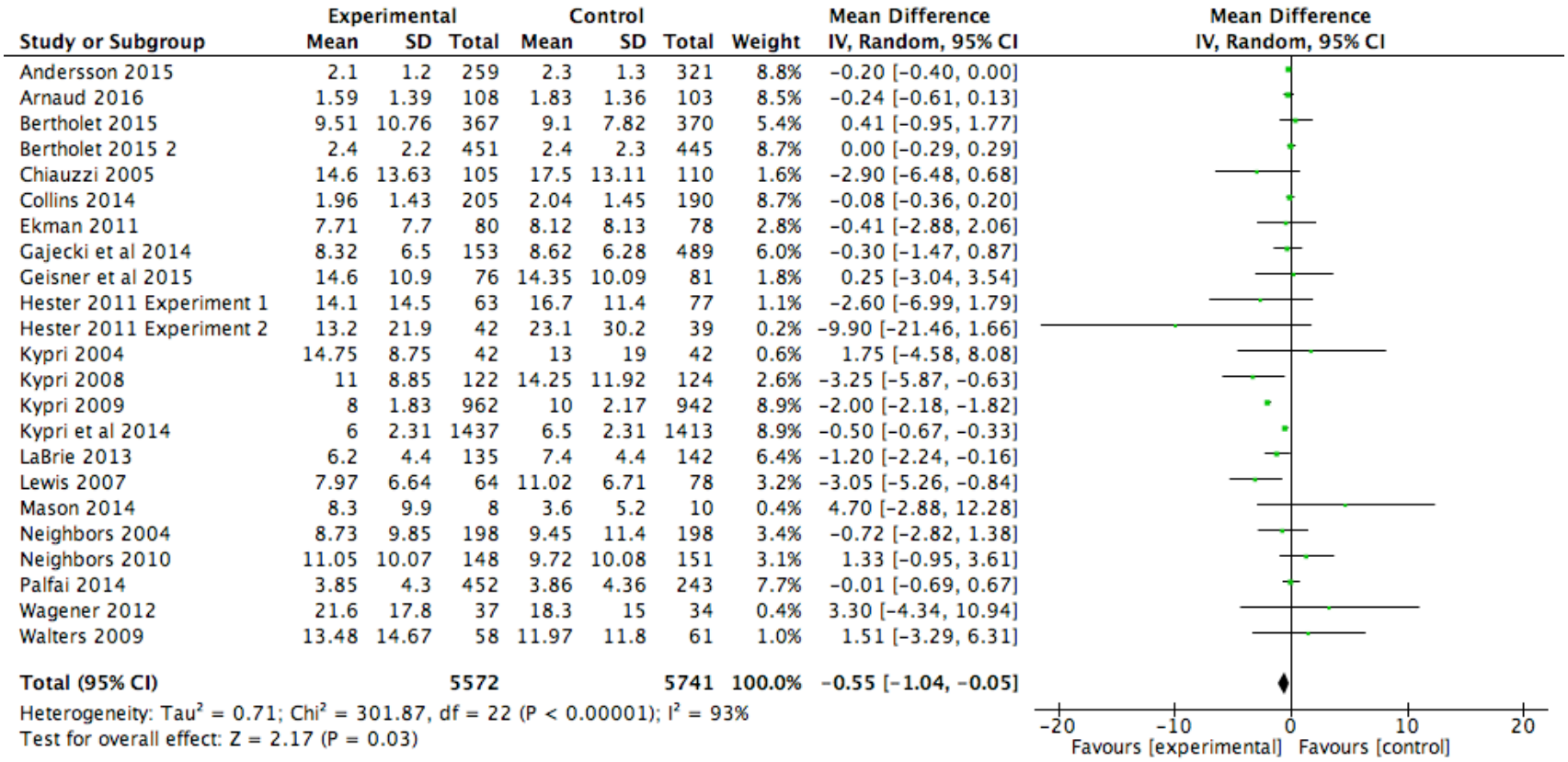

Figure 6. Meta-analysis of digital intervention effectiveness in reducing the number of alcoholic drinks consumed per week in adolescents and young adults.

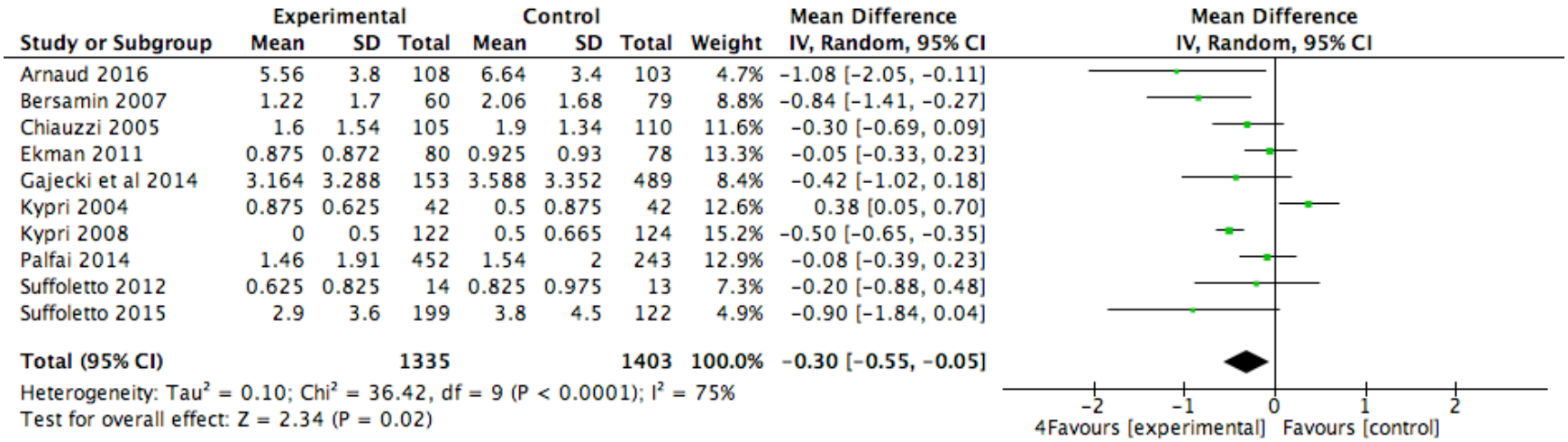

Figure 7. Meta-analysis of digital intervention effectiveness in reducing the number of binge drinking episodes in the past month in adolescents and young adults.

Effectiveness of tobacco consumption interventions

As seen in Figure 8, digital interventions increased adolescent and young adult abstinence from cigarette smoking in the intervention group by 1.7 times that of the control group (RR = 1.70, 95% CI (1.37, 2.11), I^2= 35%), with moderate heterogeneity present.

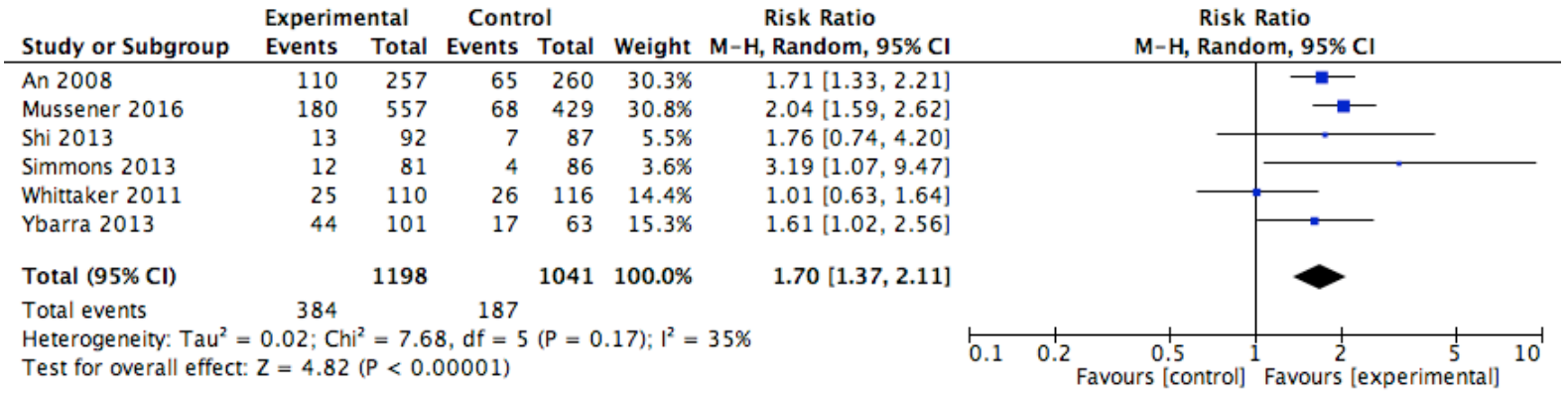

Figure 8. Meta-analysis of digital intervention effectiveness in increasing 7-day point prevalence abstinence from cigarette smoking in adolescents and young adults.

Moderators of intervention effects

Meta-regression analyses were conducted to identify potential moderators of intervention effectiveness, as shown in Table 3.

	Reference group	Coefficient	Standard Error	95% Lower	95% Upper	Z-value	p-Value
Alcohol consumption studies							
Drinks per week outcome							
Type of comparison group (Minimal or no intervention)	No intervention	0.00	0.23	-0.45	0.47	0.04	0.97
Length of follow-up 3 months	1 month follow-up	0.24	0.29	-0.32	0.81	0.85	0.39
Length of follow-up 6 months	1 month follow-up	0.00	0.23	-0.45	0.45	0.00	0.99
Tailored interaction BCT	BCT not present	0.05	0.18	-0.31	0.41	0.28	0.78
Provide feedback on performance BCT	BCT not present	-0.30	0.15	-0.57	0.03	-1.73	0.08
Provide information on consequences of excessive consumption BCT	BCT not present	-0.02	0.19	-0.39	0.34	-0.13	0.90
Binge drinking episodes per month outcome							
Comparison group	No intervention	-0.13	0.06	-0.16	0.07	-0.75	0.45
Tailored interactions BCT	BCT not present	-0.11	0.10	-0.30	0.08	-1.12	0.26
Tobacco consumption studies							
7-day point-prevalence abstinence outcome							
Withdrawal BCT	BCT not present	0.22	0.39	-0.56	0.99	0.55	0.58

Table 3. Meta-regression results on potential moderators of intervention effectiveness.

Moderators of alcohol consumption intervention effectiveness

Meta-regression analyses indicated that a minimal intervention comparison group was associated with a decrease in the number of drinks consumed in the past week, but not significantly so (Coefficient = 0.00, 95% CI (-0.45, 0.47), p = 0.97). The 3- and 6-month follow-up periods were also associated with a decrease in the number of drinks consumed in the past week, but not significantly so (Coefficient = 0.24, 95% CI (-0.32, 0.81), p = 0.39; Coefficient = 0.00, 95% CI (-0.45, 0.45), p = 0.99). The tailored interactions BCT was also associated with a decrease in the number of drinks consumed in the past week, but not significantly so (Coefficient = 0.05, 95% CI (-0.31, 0.41), p = 0.78). The provide feedback on performance and provide information on the consequences of excessive consumption BCTs were not associated with a decrease in the number of drinks consumed in the past week (Coefficient = -0.30, 95% CI (-0.57, 0.03), p = 0.08; Coefficient = -0.02, 95% CI (-0.39,

0.34), p= 0.9). A minimal intervention comparison group or the presence of the tailored interactions BCT were not associated with a decrease in the number of binge drinking episodes in the past month (Coefficient = -0.13, 95% CI (-0.16, 0.07), p = 0.45; Coefficient = -0.11, 95% CI (-0.30, 0.08), p = 0.26).

Moderators of tobacco consumption intervention effectiveness

Meta-regression on the 7-day point prevalence abstinence outcome in tobacco consumption interventions indicated an association with effectiveness of the providing information on withdrawal symptoms BCT being present in the digital intervention, but not significantly so (Coefficient = 0.22, 95% CI (-0.56, 0.99), p = 0.58).

DISCUSSION

To our knowledge, this is the first systematic review to investigate the effectiveness of a range of digital intervention delivery channels targeting adolescent and young adult alcohol and tobacco consumption as well as to assess the relationship between behaviour change techniques used in the intervention and behavioural outcomes. When pooled, digital interventions reduced adolescent and young adult alcohol consumption by just over half a drink per week, and increased abstinence from cigarette smoking in the intervention group by 1.7 times that of the control group. We did not find any significant associations between the presence of the tailoring interventions, providing feedback on performance or providing information on the consequences of excessive alcohol consumption BCTs and larger effect sizes for the number of drinks consumed per week or the number of binge drinking episodes in the past month. We did not find a significant association with the presence of the providing information on withdrawal symptoms and intervention effect size on abstinence from cigarette smoking. Although our aim was to include digital interventions targeting both alcohol and tobacco consumption, we found no studies matching this inclusion criterion.

This review adds to the findings from previous research on the use of digital interventions to reduce adolescent and young adult alcohol and tobacco consumption. Gulliver et al. (2015) reviewed technology-based interventions for tobacco and other drug use in university students and, similarly to the current review, found an increase in abstinence from tobacco use (RR = 1.54; 95% CI (1.20, 1.98); I^2 = 32%). However, their review inclusion criteria specified interventions where only some part of the content had to be delivered via a digital channel, such as reminders or follow-up content, where our review only included interventions where the main intervention content was delivered digitally and no face-to-face contact components. Our results indicated a higher relative abstinence in the intervention than the control group (RR = 1.70; 95% CI (1.37, 2.11), I^2= 35%), indicating that only digital intervention delivery mechanisms can also effectively reduce adolescent and young adult tobacco consumption.

Bhochhibhoya et al. (2015) reviewed the use of Internet-delivered interventions for preventing binge drinking among the university student population. Similarly to Gulliver et

al. (2015), they also included interventions with face-to-face components or other non-digital components and found face-to-face interventions to be typically more effective than Internet-delivered interventions and Internet-delivered interventions were found to be more effective than traditional print-based interventions. Our findings support this evidence, as we also found Internet-delivered interventions to effectively reduce adolescent and young adult alcohol and tobacco consumption.

To our knowledge, Black et al. (2016) is the only other existing review to examine the associations of behaviour change techniques with reductions in alcohol consumption behaviours. They found larger intervention effects to be associated with providing normative information, providing feedback on performance, prompting commitment and goal review BCTs present in interventions. They also found smaller effects of interventions to be associated with the providing information on the consequences of excessive consumption BCT being present. Our review also found that the providing information on the consequences of excessive consumption BCT is not associated with larger digital intervention effect sizes, although our result was not statistically significant. The presence of the providing feedback on performance was also not associated with larger intervention effects in our review, although not significantly so. Our review also added the finding that the tailored interactions BCT is associated with larger digital intervention effects in reducing adolescent and young adult weekly drinking, although not significantly so. Our review added the finding that providing information on withdrawal symptoms is associated with intervention effectiveness in reducing adolescent and young adult tobacco consumption, although the result was not statistically significant. The results of our review and the Black et al. (2016) review are the beginning of an investigation into which behaviour change techniques are associated with larger digital intervention effects. Our review has begun the investigation into the BCTs associated with larger intervention effects in adolescent and young adult populations, a necessary examination to further the understanding of appealing intervention content and delivery mechanisms in these age groups (Crutzen et al., 2011).

Our review adds several findings that might be beneficial for future research or intervention development. Firstly, the quality of digital alcohol and tobacco consumption interventions targeting adolescents and young adults could be improved. Although alcohol consumption

studies included in this review were generally of high quality (52% categorised as low risk of bias), there is room for improvement in ensuring that the high risk of attrition bias is reduced. The rate of attrition in individual alcohol consumption studies ranged from 0%-85.4%, indicating that whilst some interventions succeed in engaging participants for the whole duration of the intervention or trial, others do not. Attempts at examining the features of interventions that ensure low attrition in digital interventions targeting adolescent and young adult populations have been plagued by inconsistent reporting and lack of controlled testing of singular intervention components to determine effectiveness (Crutzen et al., 2011). It has also been noted that adolescents and young adults do not seem to engage with intervention features frequently used and suggested by experts, indicating that there is still a lack of evidence on which intervention features are appealing to adolescent and young adult populations (Crutzen et al., 2011).

Alcohol studies included in this review were also found to have a high risk of performance and detection bias, related to the use of self-report measures to assess alcohol and tobacco consumption and the inevitability of participants knowing whether they are using an intervention or not. Of the tobacco consumption studies reviewed here all but one verified tobacco use status through objective CO measurements, but no alcohol consumption studies used objective alcohol use status measures. The tobacco consumption studies were found to have a high risk of bias across several categories, performance, detection and attrition bias, with only 26% of all risk categories identified as low risk. Tobacco consumption studies were also found to have predominantly unclear selection bias, mostly due to lack of reporting of random sequence generation and allocation. Future studies should report these aspects of methods more fully.

A notable finding in this review was the lack of technological diversity found in the alcohol consumption interventions and to a lesser extent, in the tobacco consumption interventions. Only three of the alcohol consumption studies employed mobile phone text messaging technology; the others used either a website or a computer program. The tobacco consumption interventions reviewed here adopted a wider variety of technological features, including mobile phone text messaging, websites and video technology. This is an important consideration for the development of future digital interventions, as the use of websites and

other digital programs is increasingly moving towards mobile phones and away from desktop computers, especially in the adolescent and young adult age groups (Pew Research Centre, 2015). To better engage adolescent and young adult users in digital interventions, a wider range of technologies might need to be tested, and more of an emphasis on mobile phone use might be relevant (Lenhart, 2015). The introduction of wearables as an intervention delivery channel or objective behaviour measurement tool might also be feasible in adolescent and young adult populations (Ridgers et al., 2016).

Although this review did not find any evidence of effectiveness of the BCTs reviewed on the primary outcomes, this in itself is an important finding. We were unable to review the most commonly used BCT in adolescent and young adult interventions, namely providing normative information, due to most studies including this BCT. However, the BCTs reviewed are also widely used and were found to be associated with intervention effectiveness here, although not significantly so. Thus, the providing feedback on performance, providing information on the consequences of excessive consumption and tailoring interactions in the case of weekly alcohol outcomes and providing information on withdrawal symptoms in the case of abstinence from cigarette smoking outcomes BCTs warrant further investigation in reducing adolescent and young adult alcohol and tobacco consumption in the future, when more high-quality trials are available. The lack of significant associations found between the presence of BCTs and digital intervention effectiveness in this review might be explained by poor reporting of BCTs, thus introducing error into BCT coding and analyses (Hawkins et al., 2008). Improved reporting of the use of BCTs in interventions might aid in the examination of their association with effectiveness. BCT coding produces observational data and relies on the description of intervention content reported in publications, which leaves room for misinterpretation or lack of insight into the intervention. These issues with the execution, reporting and coding of BCTs might be improved by the ongoing research into the use of ontologies in behaviour change (Larsen et al., 2016).

Strengths

The main strength of this study was that, to our knowledge, it was the first to systematically review the evidence on the use of digital interventions targeting both alcohol and tobacco consumption in adolescent and young adult populations. Rigorous review methods;

standardised protocols for assessing study quality and standardised BCT coding techniques were used. I undertook training in BCT coding to reduce errors in the BCT coding process.

Limitations

This study also had several limitations. Across alcohol consumption studies, there was a moderate to high degree of heterogeneity, the source for which was not identified. This might have undermined the rigour of comparing alcohol consumption studies. Adolescent and young adult age groups were not reviewed separately due to the lack of studies only including adolescents, which limited the conclusions that we can draw on the effectiveness of digital interventions in adolescent populations. Most studies reviewed here involved university students, which limits the conclusions that can be made about the effectiveness of digital interventions in other settings.

Implications for further research

As outlined in the findings of this review, several research questions in the field of digital adolescent and young adult alcohol and tobacco consumption interventions remain. First, research with a wider variety of technological tools might be appropriate, given the shift of technology usage from desktop computers to mobile phones (Pew Research Center, 2015). Second, more research with adolescents under the age of 18 is needed, as a very limited number of studies have tested digital interventions with the younger adolescent population. Third, digital interventions targeting both alcohol and tobacco consumption in adolescents and young adults is needed, given the prevalence of co-occurrence of these behaviours and the additional harm caused to health (Falk, 2004). Fourth, only four of the trials included in this review clearly stated a theoretical basis for their interventions. It has been shown that theory-based interventions are more effective than those not based in theory (Webb et al., 2010). More attention to designing and reporting interventions that are theory-based would be beneficial for developing effective interventions. Lastly, more investigation into the effect that various BCTs have on the effectiveness of digital interventions targeted at adolescents and young adults would provide clearer guidance on specific intervention components that increase effectiveness.

Conclusions

Digital interventions reduce adolescent and young adult alcohol and tobacco consumption. More research is needed into the systematic execution, reporting and coding of behaviour change techniques to draw reliable conclusions on their associations with digital intervention effectiveness. Digital interventions targeting adolescent and young adult populations outside of the university setting are needed to examine the applicability of such interventions in the wider youth population. Digital interventions targeting adolescents and young adults might also benefit from focusing increasingly on mobile technologies rather than websites or computer programs accessed on a desktop computer to reflect the trends in technology use in adolescent and young adult populations.

CHAPTER 3
Estonian adolescent and young adult perspectives on alcohol and tobacco consumption: a focus group study

ABSTRACT

Background

Adolescent and young adult alcohol and tobacco consumption is influenced by their sociocultural context. Digital interventions can be tailored to sociocultural context, but few are. This study aims to explore the sociocultural context of Estonian adolescent and young adult alcohol and tobacco consumption to inform the development of a tailored digital intervention.

Method

A focus group study was conducted with three semi-structured discussions held in Tallinn, Estonia. Participants were 22 adolescents and young adults between the ages of 13 and 24 of both Estonian and Russian descent. Data was double-coded by native Estonian speakers and thematic analysis was used to analyse the data.

Results

Four themes emerged from the data: 1) *Estonian adolescent and young adult experiences with alcohol and tobacco consumption* where participants felt that consumption is determined by the amount of willpower one has, but can also be influenced by parents, peers, school or work responsibilities and a commitment to sports, 2) *Definitions of consumption* where participants felt that their consumption habits were not related to addiction but also expressed a lack of knowledge of addiction and the effects of alcohol and tobacco consumption on their health, 3) *Legislation implementation* where participants described the ease of accessing alcohol and tobacco under the legal age limit in Estonia but the young adult participants expressed concern over the amount of underage consumption; and 4) *Current and potential interventions* where participants expressed wanting personalised intervention content and a supportive communication style, rather than an instructional one.

Discussion

Estonian adolescents and young adults are motivated to change the alcohol and tobacco consumption culture, and tailored digital interventions are appealing to them. Barriers to change include peer as well as parental consumption behaviours, which should be a focus of future interventions in this sociocultural context.

BACKGROUND

Sociocultural factors predict adolescent alcohol and tobacco consumption initiation as well as maintenance throughout young adulthood and beyond (Bobo & Husten, 2000). Adolescents and young adults imitate the alcohol and tobacco consumption behaviours of their parents and such imitations can become a part of the social context of their peer relationships (Rimal, 2003; Smith et al., 2013). Interventions aiming to change adolescent and young adult alcohol and tobacco consumption behaviours should demonstrate insight into the sociocultural context-specific meanings of these behaviours (Neuhauser & Kreps, 2010).

Digital interventions, such as health information delivered over the Internet, can be tailored to individual preferences and sociocultural contexts and hold the potential to reduce adolescent and young adult alcohol and tobacco consumption (Hawkins et al., 2008; Chapter 1 of this thesis). Health information cannot simply be transferred from one sociocultural context to another, but must be adapted to or custom-designed for each specific context (Petrakaki & Klecun, 2015; Graham et al., 2006; Domenech Rodriguez et al., 2011). The general offering of health information on the Internet has a context-deficit, meaning that the source of the information, the recipients it is intended for and the credibility of the information are unclear (Eysenbach, 2008). In health, more so than other fields of information found on the Internet, relevance to individuals and context is important in creating positive health outcomes, as even accurate information can have negative consequences, if applied in the wrong context (Eysenbach, 2008).

The delivery of credible health information to its specific recipients in a format that is reflective of their sociocultural context is important if the information is to be effective in producing changes in behaviour (Eysenbach, 2008). Analysis of context is a key component of knowledge transfer models, where considerations of the context of readers impacts the communication delivered to them (Ward et al., 2009). The rooting of intervention content in the sociocultural context of the intervention users is critical for reflecting their health behaviour in their everyday lives (Kreps & Neuhauser, 2010). Such insights into the context of alcohol and tobacco consumption can aid in the tailoring of digital intervention content, increasing its personal relevance to users, which might increase intervention effectiveness (Kreuter & McClure, 2004).

Qualitative research is a tool for increasing understanding of the intervention users' context (de Visser et al., 2015). In this study, this is the context within which Estonian adolescent and young adult alcohol and tobacco consumption occurs. The context of Estonian adolescent and young adult alcohol and tobacco consumption or how this might best be tailored in an individual-level behaviour change intervention is not yet well understood. Only one previous study has explored Estonian adolescents' views on their alcohol consumption in the specific context of attending parties (Parder & Vihalemm, 2015). This found that Estonian adolescents consider alcohol consumption as central to their identity when in the context of a party and not consuming would be harmful to their social identities. No existing studies have yet explored the sociocultural context of Estonian adolescent and young adult alcohol and tobacco consumption, and the existing interventions have not been evaluated systematically.

Aims

This study aims to explore the social context of Estonian adolescent and young adult alcohol and tobacco consumption to inform the development of a digital behaviour change intervention.

The objectives of this focus group study are as follows:

- To explore the experiences of Estonian adolescents and young adults with tobacco and alcohol consumption.
- To investigate which features and delivery mechanisms of current digital interventions are considered engaging and appealing for Estonian adolescent and young adult users and which features and delivery mechanisms might be appealing in future interventions.

METHOD

Epistemology and ontology

This study takes the position that quantitative evidence alone would not provide sufficient information to understand the context of the intervention, acceptability, feasibility and implementation issues, which are all important to consider in intervention research (Shaw et al., 2014). Quantitative data collection is important for tests of efficacy and cost-effectiveness, but falls short in giving an in depth understanding of the social, cultural and historical context of the intervention. Qualitative methods fill a gap in implementing interventions effectively (Shaw et al., 2014). This study is a part of a larger mixed-methods research project and represents the qualitative component of that project. This study takes the position that adolescent and young adult experiences with and views on alcohol and tobacco consumption are a type of research data and should be placed on equal standing with quantitative evidence in the development of interventions (Johnson & Onwuegbuzie, 2004).

Design

This study is a focus groups study, using a semi-structured discussion methodology. Focus groups have been identified as an effective tool for gathering in-depth information on health-related topics in adolescents and young adults (Heimann-Ratain et al., 1985). The focus group design is unique in its ability to reduce the role of the researcher compared to an individual interview design, through the synergistic development of discussion between the participants of the group (Ritchie et al., 2014). If in an individual interview, the participant only frames their opinions and responses according to the researcher's questions, then in a focus group setting, participants are able to experience the social context of the topic they are discussing and therefore gain deeper levels of insight into their own viewpoints (Ritchie et al., 2014). In the case of this study and exploring adolescent and young adult alcohol and tobacco consumption, this design was deemed appropriate given the highly social nature of these behaviours in these age groups. Focus groups were also preferred to individual interviews in this study as a way of equalising the power dynamic between researcher and participants, aiding participants in communicating their opinions to the researcher more fully (Wilkinson, 1998). The interactivity of focus groups results in enhanced disclosure of

information from participants (Kitzinger, 1994; Wilkinson, 1998[2]). In the case of health research, as in the case of this work, focus groups foster an opportunity to co-construct meaning together with participants (Wilkinson, 1998[2]). This is particularly useful in identifying the motivators of and barriers to carrying out different types of health behaviours, where focus group participants share their experiences of such behaviours and researchers can then use the participants' own language to design intervention or health promotion efforts (Wilkinson, 1998[2]). Unlike individual interviews, focus groups also allow for the exploration of the participants' social context (Wilkinson, 1998), an important influence on adolescent and young adult alcohol and tobacco consumption behaviour. Focus groups of six to eight participants are recommended to elicit in-depth discussion but ensure that every voice gets heard (Ritchie et al., 2014). It is the role of the researcher in such a setting to ensure that the strongest voices in the group do not overshadow more shy participants and to ensure there is a friendly and trusting dynamic within the group (Ritchie et al., 2014).

Participants

The participants of this study were 13-24-year-old Estonian-speaking adolescents and young adults. The participants were recruited in Tallinn, the capital of Estonia. Recruitment took place in three educational institutions, the Kopli Youth Centre, Mustamäe High School and Tallinn University of Technology. Eligible participants were 13-24 year olds. Participants were asked to indicate prior to being selected for the study whether they had consumed at least one alcoholic drink in the past month and/or smoked at least one cigarette in the past week. Those who were non-consumers of either were also accepted into the study to provide a contrasting viewpoint to the experience of the participants who were alcohol and/or tobacco consumers. This 13-24 range was chosen, as it is a frequently used definition of adolescence and young adulthood (e.g. Boyd et al., 2006; Arnett, 2000). Although the 15-24 age range is also often used (e.g. Paschall et al., 2011; An et al., 2013), and was used in the systematic review and meta-analysis in Chapter 2 of this thesis, given the exceptionally early initiation of alcohol and tobacco consumption in Estonian adolescent (WHO, 2016[2]), the 13-24 age range was chosen for this study to ensure the youngest consumers would also be captured. The participants were invited to attend through a poster on a noticeboard in the educational establishment particular to them, a notification e-mail sent through the general e-mail list set up in the educational establishment, or by a presentation by me where I shared information

sheets with my contact details at the end of lessons and lectures in the recruitment locations. A screening questionnaire was sent to those participants who registered interest in taking part in the study along with the consent form. The screening questionnaire identified the consumption level of the potential participants. All participants who filled in the screening questionnaire and consented to participating in the study were accepted into the study. The screening question served the purpose of identifying the extent to which different participants consumed alcohol and/or tobacco, if at all. As there were representatives of non-consumers, consumers of both alcohol and tobacco and consumers of either alcohol or tobacco in the first 22 participants who expressed interest in the study, recruitment was halted. Had there been less variation in the types of consumers, recruitment would have continued until representatives of all types had been selected for the study. Potential participants would have been excluded from the study had they been under the age of 18 and had not received parental consent, which is required by Estonian law.

Data Collection

This was a focus group study of three groups. Focus groups lasted for two hours each. Participants were incentivised with €10 vouchers for a large department store in Tallinn, Estonia. The 13-24 age range was split into three to produce three focus groups of participants of relatively similar age. One focus group consisted of participants aged 13-15, another of participants aged 16-18 and the third group of participants aged 19-24. The aim was to recruit eight participants into each group. The focus group discussions were audio recorded. There were two facilitators in each focus group, one of which was me. An interview guide (Appendix 3) was used for the semi-structured discussions to stay in line with this study's aims but still allow a bottom-up approach for emerging themes to be offered by the participants, which the facilitator does not touch on (Willig, 2001). The discussions were transcribed and then the data.

Data Analysis

The data were analysed using thematic analysis, which allows for the identification, analysis and reporting of patterns or themes in data (Braun & Clarke, 2006; 2012). Themes are

identified based on the prevalence of it across the data set as well as the meaning of each data item (Braun & Clarke, 2006). However, which themes are identified as priorities for understanding the dataset do not always depend on being the most prevalent themes in the data, as less prevalent topics might be more important in terms of answering the research question (Brain & Clarke, 2006). The identification of themes is therefore a process of finding the most relevant information in the data to address the research question. Thematic analysis can either be used to describe an entire dataset or give a more detailed and nuanced description of one or more specific themes (Braun & Clarke, 2006). Describing themes in an entire dataset is particularly useful when the topic in question is not yet well-researched or if the participants offer an unknown point of view (Braun & Clarke, 2006). In the case of this research, given the relative lack of understanding of Estonian adolescents' and young adults' views on alcohol and tobacco consumption, it was chosen to use thematic analysis to provide a description of the entire dataset, thus providing insight into a relatively new area of research. An inductive approach to identifying themes was chosen (Braun & Clarke, 2006), to give more scope for new research questions to evolve and provide insight into the relatively under-researched topic of Estonian adolescent and young adult alcohol and tobacco consumption. A semantic approach to theme identification was chosen, focusing on themes explicit in the data (Boyatzis, 1998).

The analysis approach was decided on before data collection. The three focus group interview recordings were transcribed into Microsoft Word format, one by me and the other two by a professional transcription service in Estonia. The transcripts were then printed out and the data analysed by hand, as it was a manageable dataset and it was found that working with the data on paper was more conducive to identifying its nuances. The analysis followed a six-phase process, as outlined by Braun & Clarke (2006, 2012). The analysis process was recursive more so than linear, involving moving back and forth between the phases as required (Braun & Clarke, 2006; 2012).

The six phases of analysis involved the following steps:

1. Familiarising oneself with the data
2. Generating initial codes
3. Searching for themes
4. Reviewing potential themes
5. Defining and naming themes
6. Producing the report

One of the transcripts (a third of the data) was double-coded (phases 1 and 2) for purposes of reliability, with initial coding done by me and another researcher. The second coder was a PhD student at the University of Cambridge with experience of analysing qualitative datasets, who was also a native Estonian speaker. I was already somewhat familiar with the data, having collected it myself, which was not the case for the second coder who was new to the material. Both myself and the second coder familiarised ourselves with the data in depth through repeated reading of the focus group transcripts and taking notes on our ideas for coding the data. After familiarising ourselves with the first transcript, we independently and manually labeled each line of the transcripts with labels that identified interesting features of each section of the data. Similarities of codes were then compared and points of disagreement discussed.

Once all the data was coded, I organised the different codes into potential themes by combining codes into overarching main and sub-topics (phase 3). Themes were reviewed to ensure they captured well the coded data associated with them, and that they adequately reflected the data set as a whole and data re-coded according to new themes or sub-themes (phase 4). Themes were refined and sorted into main themes and sub themes, with some themes discarded and remaining themes named (phase 5). In phase 6, themes and illustrative quotes were arranged into a written report so as to tell the story of the data in relation to the research question of this chapter (Braun & Clarke, 2006; 2012).

Positionality

My positionality as a PhD student at a prestigious university was an important consideration during focus groups. The reputation of the University of Cambridge is likely to have added

legitimacy, thus potentially inducing openness in participants. However, being a part of a research study on a behaviour that is illegal for underage adolescents appeared to have had the opposite effect in some participants. The youngest participants expressed feeling unsure of how much they could reveal to me, despite having received an in-depth participant information sheet before the study and having had reassurance from their mentor at the youth centre where they were recruited from. However, I introduced myself as a person living and working abroad, it may have given me a more neutral and open perspective than adults living and working in Estonia for discussing these topics, as seen by the participants. To facilitate a safe and comfortable space for them, I covered the information on confidentiality and ethics guidelines with them again, asked them what their specific fears were and built trust by talking to them about other topics at the beginning of the session, getting to know them better and telling them more about myself. This provided a comfortable space for us to discuss the research questions, and the rest of the discussion went smoothly. Having experienced the Estonian alcohol and tobacco consumption culture, while living in Tallinn also gave me an advantage in connecting with the participants, and many of them thanked me at the end of the discussions for trying to understand these issues and attempting to find solutions.

In the young adult group, the participants might also have been influenced by the University of Cambridge's reputation, as one of the participants asked me after the discussion whether he could contact me to ask for advice on applying to study at the University. This group was more confident about taking part in a research study than the youngest group and was more relaxed already at the beginning of the session.

My identity as an Estonian and Estonian native speaker facilitated rapport with native Estonian participants, to a lesser extent with ethnic Russian participants for whom Estonian is a second language. This might not only have reduced how comfortable the ethnic Russian participants felt in the focus groups and thus how much they contributed which in turn may make the findings of this study less applicable to ethnic Russian youth in Estonia.

RESULTS

Characteristics of participants

A total of 22 participants were recruited, ten of whom were male and twelve female. There were three non-consumers of alcohol and tobacco across groups, seven consumers of both alcohol and tobacco, 11 consumers of only alcohol and one consumer of only tobacco (Table 4). There were four participants recruited from the youth centre, eight from the high school and ten from the university. All participants were Estonian speakers, and three of them were of Russian descent, one in the 13-15 year olds' group and two in the 19-24 year olds' group. There were no participants of Russian descent in the 16-18 year olds' group. This is important to note as many Estonians of Russian descent speak Estonian as a second language and might therefore require different support from me as the focus group facilitator to have their opinions heard (Estonian Ministry of Culture, 2015). It is also important for the analysis of data from native Russian speakers, as their use of the Estonian language might not reflect the meaning of their opinions accurately and therefore requires an additional level of interpretation. No participants had to be excluded due to lack of parental consent having been given.

Participant ID	Age	Gender	Recruited from	Ethnicity	Substance consumed
1	15	Female	Kopli Youth Centre	Estonian	Alcohol Tobacco
2	15	Female	Kopli Youth Centre	Estonian	Alcohol Tobacco
3	13	Female	Kopli Youth Centre	Estonian	Alcohol
4	13	Female	Kopli Youth Centre	Estonian	None
5	17	Female	Mustamäe High School	Estonian	Alcohol
6	18	Female	Mustamäe High School	Estonian	Alcohol
7	18	Male	Mustamäe High School	Estonian	Alcohol Tobacco
8	17	Female	Mustamäe High School	Estonian	Alcohol Tobacco
9	17	Female	Mustamäe High School	Estonian	Alcohol
10	18	Female	Mustamäe High School	Estonian	Alcohol
11	18	Female	Mustamäe High School	Estonian	Alcohol
12	18	Male	Mustamäe High School	Estonian	Alcohol Tobacco
13	21	Male	Tallinn University of Technology	Russian	Alcohol
14	20	Male	Tallinn University of Technology	Russian	Tobacco
15	19	Female	Tallinn University of Technology	Estonian	Alcohol
16	19	Female	Tallinn University of Technology	Estonian	None
17	19	Female	Tallinn University of Technology	Estonian	Alcohol
18	20	Female	Tallinn University of Technology	Estonian	None
19	24	Female	Tallinn University of Technology	Russian	Alcohol Tobacco
20	23	Male	Tallinn University of Technology	Estonian	Alcohol
21	21	Male	Tallinn University of Technology	Estonian	Alcohol Tobacco
22	19	Female	Tallinn University of Technology	Estonian	Alcohol

Table 4. Focus group participant characteristics.

THEMATIC FRAMEWORK

The data in this study can be categorised into four overarching themes:

1. Experiences with alcohol and tobacco consumption
2. Definitions of consumption
3. Legislation implementation
4. Current and potential interventions

1. EXPERIENCES WITH ALCOHOL AND TOBACCO CONSUMPTION

Quitting/reduction attempts

Several participants in each of the focus groups in this study expressed that alcohol drinking and cigarette smoking seem inevitable to them in the Estonian context. The participants thought that individuals with a strong character and a lot of willpower are able to be in control of their consumption behaviours, but those with less strength are not and have no choice but to consume. In the 16-18 and 19-24 age groups, participants found that another reason, in addition to having willpower, for not consuming alcohol and/or tobacco might be having a serious health issue (Quote 1). Getting a lung or liver cancer diagnosis was thought to be a situation that would result in abstaining from alcohol and/or tobacco consumption. There were also dissenting opinions, for example, where one participant shared a story about his uncle who had been referred to treatment for alcoholism by a doctor and who kept drinking even after this treatment.

Quote 1

'My opinion about quitting is rather that when something actually happens to a person as a result of smoking, then it will knock some sense into you.' (Participant 11, 18-year-old female)

Many participants across focus groups said that they have made frequent quit attempts for tobacco consumption. In the youngest age group, all four participants said they have tried and want to keep trying to also quit alcohol consumption. Two of the participants in the middle

age group said they have tried to reduce their alcohol consumption but have failed. None of the participants in the oldest age group expressed an attempt or a current desire to reduce their alcohol consumption. Expressions of previous and desired future quit attempts were mainly made by female participants, with the male participants more often expressing that they did not care about the consequences of alcohol and tobacco consumption. Adolescents said that they keep an eye on their alcohol and tobacco consumption by identifying feelings of a hangover or noticing that they are smoking a pack of cigarettes a day several days in a row. One participant said that if he feels he has over-consumed, he tries to make sure he has a period of only drinking once or twice a week and/or using a packet of rolling tobacco over a period of two weeks to cut down their tobacco consumption (Quote 2).

Quote 2

'It depends on the person a lot as well. Like even if I got a bigger slap in the face. I have such a stupid personality that that wouldn't sway me at all. I would carry on in the same way. That's why I'm trying to keep it within the normal limits. Even if I know that now a couple of weeks ago I went overboard with alcohol, I should keep the consumption low now. Then I know and I hold myself back. I might drink twice a month during that time. Well kind of the same with smoking. If I have really been getting through a pack a day then I take the rolling tobacco for myself and then use it up within two weeks usually.' (Participant 12, 18-year-old male)

Being committed to a sport was a reason for attempting to quit consuming alcohol and tobacco, as two participants reflected. As the costs involved with being committed to a sport are high, the effect that consuming alcohol and tobacco has on the success of sporting achievements seemed to be a good motivator for reducing consumption. Another participant, who was also involved in competitive sports, wanted to quit smoking but was unable to do so, although she was already experiencing a negative impact on her sports performance. One of the young adult participants also mentioned curbing his alcohol consumption to have a better chance of excelling at his sport (Quote 3).

Quote 3

'I drink sometimes as well. But usually I am sober at parties. I am committed to sports and so I don't see a lot of point in drinking.' (Participant 14, 20-year-old male)

Increasing responsibilities

The young adult participants discussed that actions towards reducing consumption, especially alcohol sometimes arise from experiences of adult responsibilities. For example, one young adult described her experience of regretting alcohol consumption if she was not able to meet her responsibilities the next morning (Quote 4). Another participant described that her many responsibilities with university and jobs meant that she would choose not to go out drinking altogether to prevent having a hangover the next day. The young adults discussed that the consideration of responsibilities and how it affected their alcohol consumption habits was more of an issue for them once they graduated from school and left their parents' homes. They reflected that as younger adolescents, they had not felt the same pressures and had also not felt the effects of the hangovers as acutely. Participants in the 16-18 age group, who said they do not experience hangovers, were not as concerned about their responsibilities and stated that they would not keep from going out drinking because of it. The two youngest age groups did not talk about their responsibilities being a reason for reducing their alcohol consumption.

Quote 4

'Well when there are situations where there has been a big party and you are hungover in the morning and then you have to do some serious work and can't spend half the day in bed. And then you start thinking that you wasted a whole day.' (Participant 19, 24-year-old female)

Peer influences

The data revealed that the alcohol and tobacco consumption of peers is an important influence on adolescent consumption choices. Several participants discussed how frequently

nonsmokers would smoke in contexts where they were also consuming alcohol. Many participants agreed that consumption of the two substances co-occurs more often than not (Quote 5).

Quotes 5

'When you are drunk you lose track of time and you don't check how often you have been smoking. Maybe you just came back in from a smoke break but then head straight out again with a group. And there are so many who regularly don't smoke that much but do when they are drunk.' (Participant 12, 18-year-old male)

Participants admitted to experimenting with how much alcohol they can/want to consume and how they feel about tobacco consumption by trying it on several occasions with their peers. One participant expressed feeling nauseous at the smell of cigarettes and needing to keep her distance from people who were smoking, including her friends. She also said that her friends respected her feelings and did not pressure her to smoke. Some participants, on the other hand, said they smoke occasionally and do not experience this nauseating effect of cigarette smoke. The participants who did not feel nauseous at the smell of cigarette smoke also reported often smoking in the presence of friends and that they felt pulled along with the actions of their friends. It appeared that those adolescents, who do not even think about smoking when they are alone, get the urge to do so as soon as they are around friends who are smoking (Quote 6).

Quote 6

'And it is like if I had wanted to quit more, I could have done it. But then it is like someone, a friend who smokes, comes and says, let's go for a smoke. And then I'm like, OK, let's go.' (Participant 8, 17-year-old female)

The data highlighted that there is not much intervention from friends or peers when someone is over-consuming either alcohol or tobacco. Several participants stated that no-one cares

how much an adolescent or young adult consumes and even the individual themselves often do not care how much they are consuming. In terms of alcohol consumption, participants listed events such as birthdays, other celebrations, going out with friends, school holidays and finishing exams as reasons for going out to drink. There was a general consensus that alcohol consumption was not something done alone, although one of the youngest participants in the youngest focus group mentioned that she sometimes also drank alone.

Parent and other adult influences

Participants discussed their experiences of talking to their parents about their alcohol and/or tobacco consumption. Most expressed that their parents did not mind their consumption habits, although a couple of participants mentioned that their mothers had asked them to quit smoking and not drink too much. One of the youngest participants expressed that whilst her mother very much wanted her to quit smoking, because she was unable to do it, her mother had just asked her not to do it in front of her. Differences between the underage adolescents and the young adults were highlighted in these discussions, as the young adults expressed only how their parents had communicated with them on these topics before they turned 18. The consensus amongst young adults seemed to be that once they turned 18, their parents no longer offered an opinion on their consumption habits but rather thought that as adults, they were responsible for their own decisions and the consequences. The participants who were nonsmokers and/or nondrinkers described having experienced less permissive parenting styles in their home environments, and they attributed their ability to say no to alcohol and/or cigarettes to the parents rather than their own individual characteristics (Quote 7).

Quote 7

For me actually, my dad said that I am not allowed to smoke or drink. And well I personally think that that's how it should be in a family, the father or mother has to say that it is not allowed.' (Participant 13, 21-year-old male)

Whereas participants in the 16-18 and 19-24 age groups discussed their experiences with their parents not interfering in their alcohol and/or tobacco consumption choices, but rather

seeing them as independent adults who could decide for themselves, this was not the case in the youngest age group. Two of the four adolescents in the 13-15 age group expressed that their parents did not know that they had consumed alcohol and/or tobacco and that they did not discuss these topics openly with their parents. The other two participants in that group were both daily smokers and also consumed alcohol. One of them described her alcohol consumption experiences as often occurring together with her mother, and her mother also knew that she smoked, but wanted her to quit. The other adolescent also said that she sometimes consumed alcohol together with her mother and that her mother knew she smoked and very much wanted her to quit but felt that there was nothing she could do to help (Quote 8).

Quote 8

'Well I basically talk about it with my mum every day. She knows that I smoke and you know there's nothing she can do about it if I am incapable of quitting. So then she tells me not to do it in front of her.' (Participant 1, 15-year-old female).

Participants across focus groups shared stories of having had their first experiences with alcohol and/or tobacco in their home environments and in response to offers from parents or other adult family members. This was explained in the context of their parents wanting them to try alcohol in the home environment instead of going out and that they wanted to keep their adolescents from getting into trouble because of underage alcohol consumption. Adolescents also reported that they often consumed alcohol together with their parents. One of the youngest participants said that her favourite drink was the same as her mother's favourite drink. Participants said that consuming alcohol with their parents was especially common at celebrations and holidays, such as birthdays, Christmas and New Year’s Eve parties. Even the participants who identified as non-consumers of both alcohol and cigarettes admitted to drinking alcohol at celebrations.

Participants said that in their experience, underage adolescent alcohol and tobacco consumption is tolerated by adults, encouraged by peers and not impacted by the legislation

existing to prevent it. One university student mentioned that her university sells alcohol in the lunch canteen on campus, which she thought was an example of how little is done to prevent or intervene in Estonian young adult alcohol consumption. Another young adult expressed that university students are considered to be adults and therefore their alcohol and tobacco consumption decisions are their own responsibility (Quote 9).

Quote 9

'Maybe at university people assume that you are like adults, you know yourself what you are doing. The information is there and you can find it if it interests you. Websites are all available. If you want the information, you can find it at every corner. (Participant 15, 19-year-old female)

Expecting adult decision-making from the adolescents was reflected in the data as well, where participants expressed that negative consequences from alcohol and tobacco consumption were the responsibility of the adolescents, not the adults in their lives (Quote 10). Participants also shared stories of their teachers' reactions to students smoking in school. Several participants in the youngest age group discussed an incident where one of their teachers had allowed a boy in their class to smoke an e-cigarette in class.

Quote 10

'I also had a lot of freedom and was told that you are a grown up, you know yourself what you're doing. But I haven't been caught by the police or anything. In my parents home I never drink, but they know about it. And if I get caught then it is my own fault, and whatever. (Participant 21, 21-year-old male)

2. DEFINITIONS OF CONSUMPTION

Knowledge of effects of alcohol and tobacco consumption

Participants' responses to the question 'what do you know about the health effects of alcohol and tobacco consumption' were minimal and what was known was based mostly on the content delivered to them in schools. There was only one person who had independently searched for additional information on the effects of alcohol consumption but that was with the aim of finding out how to cure a hangover. Many of the youngest participants indicated that they knew alcohol and tobacco were 'bad for health' but did not know of any specific ways in which they are so. One of the youngest participants did know that alcohol can cause liver damage and that tobacco causes lung cancer and has negative effects on the brain. Another one of the youngest participants indicated that alcohol consumption also has negative effects on the brain after having done a school project on it. The participant who reported knowing the most about the health effects of alcohol and tobacco was a participant whose parent was a doctor. There was consensus across groups that the information on the effects of alcohol and tobacco consumption provided by the school curriculum was neither interesting to them nor memorable.

Despite the information Estonian adolescents and young adults are provided with on the negative consequences that alcohol and tobacco consumption might have, most reported they would consume both alcohol and tobacco anyway. Several participants expressed that even if they personally experienced a negative consequence of alcohol or tobacco consumption, it would probably still not be enough to motivate them to quit. Contrastingly there were a couple of participants who had seen the negative outcomes that alcohol and tobacco consumption can have and expressed that this was one of the reasons why they did not consume anything themselves (Quote 11).

Quote 11

'Actually it can affect your life. I've seen how a person who was drinking jumped into water and he stayed there. There were adults all around. No one did anything. I think it was the fear for yourself like if I go there, maybe he will pull me under as well. And we were actually kids at the time, maybe 13 and we were shouting at that moment like, hey he is drowning. The guys who were drinking with that young man who was fifteen or sixteen, they just laughed. Like literally just watched and laughed.' (Participant 18, 20-year-old female)

Knowledge of addiction

Participants talked about addiction as something that they are not experiencing and something that happens to people who drink alcohol every day. They also discussed that if a person is already drinking that much, there is nothing anyone can do to help them. One participant shared a story of how his uncle had been sent to rehab for alcoholism but despite the medication he was given, he was still an alcoholic. In terms of their own consumption, participants talked about being nonsmokers and nondrinkers if they only consumed either alcohol or tobacco at celebrations. Consumption outside of celebrations and parties was counted as real consuming. Disagreeing with this, there was also one participant who brought up the fact that drinking just at parties still counted as drinking (Quote 12).

Quote 12

'Even if you drink just at parties, it is still drinking and it is still damaging you. We should understand that. Not only when you drink every day, but also if you drink only at parties. That is also drinking and it is still bad for you.' (Participant 14, 20-year-old male)

Many participants also identified themselves as non-consumers based on the fact that they only drink alcohol once a month or so. One of the younger participants thought that drinking three ciders in one sitting counted as not drinking very much. With tobacco consumption, similar thoughts were expressed. Those who identified as nonsmokers admitted to smoking during social situations and celebrations, and most participants indicated that when

consuming alcohol, they would almost always consume tobacco as well (Quote 13).

Quote 13

'So basically, there is nothing to hide, I don't smoke and don't drink. I'm not an addict and so on, but I drink, I'm a wine lover. About smoking, I don't do it. Despite the fact that I have quite a stressful life and job, but I'll say honestly, when there are bigger parties and I drink, then I usually smoke as well, if it's like the right state, let's put it like that. I have a water pipe at home and we smoke it with friends when we meet up, let's say regularly once a month.' (Participant 19, 24-year-old female)

Many participants expressed having sensations akin to withdrawal symptoms when they do not smoke or when they have tried to quit, but they did not identify these as withdrawal symptoms or linked to addiction. Participants did express that they did not like the feeling of 'needing' to smoke and many had tried to quit several times. The participants who had tried to quit smoking had failed and explained that this was probably due to their own lack of willpower. One participant expressed feeling a need to smoke cigarettes, but equating it to the need to eat food rather than a potential withdrawal symptom (Quote 14).

Quote 14

'You need to go to the doctor when it is more like physical addiction. Hands are shaking, you feel nauseous. But if it is just mental, kind of like with eating, you eat when you are really hungry, then it is just about smoking a little and not feeling the need anymore.' (Participant 12, 18-year-old male)

3. LEGISLATION IMPLEMENTATION

Participants across all focus groups expressed that they had no problems accessing both alcohol and tobacco. The underage participants were speaking of their current experiences, whereas the young adults were remembering what it was like before they turned 18 and giving examples of family members and friends they currently have who are under the age of 18. The underage adolescents were knowledgeable about specific sales staff in corner shops and supermarkets that never ask for proof of age. For those few underage adolescents who did not feel comfortable buying alcohol and tobacco directly, they indicated that they relied on older friends who are over the age of 18 to buy it for them. Many underage adolescents said they rarely had to think about buying alcohol and tobacco themselves because so many of their friends had some already that they could just share with those who do not have any. In the young adult group, participants discussed the lack of identification (ID) being checked at nightclubs and bars. One participant expressed that he thought that the rare occasions when the police did come to intervene in underage drinking at such venues, they were doing it just to fill requirements set by the EU. Several participants expressed their surprise at the lack of intervention of adults in underage adolescent alcohol and tobacco consumption (Quote 15).

Quote 15

'You know some people just couldn't care less. I can just go up to people and ask for a smoke.' (Participant 2, 15-year-old female)

Another participant in the youngest age group expressed being scared of being sent to the police if found out that she was smoking cigarettes. She said that if her teachers find out that she is smoking, she would be sent to the police, given a criminal record and probably sent to the psychiatrist and these are all things she is frightened of. Participants thought that this kind of information about being sent to the psychiatrist or the police if someone finds out underage adolescents are consuming alcohol and tobacco, was frightening to them but they also expressed that they were more likely to hide their consumption rather than end it as a result. It was also evident from the way that the consequences of being caught smoking or drinking

as an underage person was being discussed, that the information shared to them in the school curriculum was perceived as slightly threatening. Another one of the youngest participants, however, disagreed with this, and expressed that she did not really care if an adult caught her smoking (Quote 16).

Quotes 16

'I don't care about this stuff. They can do what they like, I already know what I am doing. When I was seven, I was alone in town and I found a cigarette packet on the ground. And I went and smoked. The police gave me a warning and said that the next time I will have to pay a fine but I haven't been caught since then. No one can tell my age.' (Participant 2, 15-year-old female)

A third participant in the youngest age group said that she only smoked inside her home or grandparents' home environment as her grandmother had told her that she should not smoke outside of the house to not embarrass the family by letting the neighbours know that she was smoking. The same participant said that her grandmother often bought her cigarettes.

Surprisingly some of the young adult participants expressed concern over the underage adolescent alcohol and tobacco consumption they were seeing on the streets and had even actively intervened on several occasions by taking the cigarettes and alcoholic drinks away from the adolescents. This was likely to occur especially in smaller countryside towns were the young adult was likely to personally know the adolescent or their family. The young adults specifically expressed concern at the level of alcohol consumption in Estonia in general. They thought alcohol consumption should decrease but they also expressed that although they could take alcohol away from young adolescents, they were just as bad at that age and therefore could not really be telling anyone else to not consume alcohol.

4. CURRENT AND POTENTIAL INTERVENTIONS

Current interventions

Participants in all focus groups shared their thoughts on the government-designed websites that address alcohol and tobacco consumption. The youngest participants found them to include too much text and they thought something more colourful or in a game format would be more interesting to them. The participants in the adolescent group found the websites to include some interesting and useful information and although the tobacco website was thought to have too much static text, the alcohol website seemed to appeal in its layout as well as information included.

In all focus groups, the only existing school-based smoking prevention program in Estonia was also discussed. Participants in the youngest group had not come across the school-based smoking prevention program called 'Smokefree class'. The participants in the other groups had, however, and none of those who had had experience with it themselves thought that it was a useful program. Participants expressed that most children and adolescents involved in the intervention smoked anyway and it was taken more as a joke than a serious effort to prevent smoking. Other participants had had lectures in school where the consequences of alcohol and tobacco consumption were presented to them. These were thought to be rather boring and too formal to be interesting to young people.

Participants across all focus groups expressed that they wanted to change their own consumption of alcohol and/or tobacco, and participants in the 16-24-age category also expressed that the general consumption culture and attitude towards underage consumption in Estonia should change. What participants thought was missing from the school-curriculum based approach was a more interactive one into their alcohol and tobacco consumption behaviour change. Interestingly, a 15- and a 24-year-old participant both expressed that they wanted someone to forcefully make them stop consuming alcohol and/or tobacco (Quote 17). Other participants thought that such an aggressive approach would rather alienate them from the program. These participants thought that what was needed was more honest information on the potential consequences of alcohol and tobacco consumption, as they thought that the information shared in schools and online was rather exaggerated. Two of the participants in the 16-18 age group thought that the current programs were unsuccessful because they tried to convince young people that alcohol and/or tobacco consumption would likely result in

accidents, cancer or death, but they had never seen any of those consequences in their own experiences. Not seeing the information shared in official programs reflected in their own experiences was likely to make them mistrust the program, as they felt that they were being lied to.

Quote 17

'I wish that someone beat me to make me stop smoking.' (Participant 2, 15-year-old female)

Potential digital interventions

The idea of a web and mobile phone based individually tailored program on how to change their alcohol and tobacco consumption was appealing across focus groups and age groups. Participants agreed that a web and mobile phone based program should be tailored to different types of users (Quote 18), should not use scary messages or graphics and should provide the opportunity for users to keep track of their own habits, for example through a diary function. It was also agreed that there should not be too many text messages sent daily through the program, as one would be enough. Otherwise the program risks becoming annoying to its users and they might disengage from it.

Quote 18

'There should be choices to fit what you are like. If you are low in motivation or you really are interested in the scientific information or you want shocking facts. So yeah you can set it according to your preferences.' (Participant 11, 18-year-old female)

For changing tobacco consumption behaviours, it was suggested that some information on what to expect from the experience of withdrawal symptoms each week of the program would be useful. A positive and supportive communication style was thought to be more appealing to the users, instead of reprimanding users for not meeting goals, frightening them

or instructing them to not consume (Quote 19). Participants wanted to be able to decide what objectives they would set for themselves in the program, and a community-linking feature was also said to be appealing. Participants discussed that the community feature could take the format of a chat room or social networking function within the program so that users could contact each other and motivate each other to keep going in their quit attempt. The participants also thought that if changing their alcohol and tobacco consumption behaviours meant they could not spend much time with their current friends anymore, they could find new, non-drinking and -smoking friends from the program. A competitive element was also suggested by some of the participants, where the users of the program would have their achievements displayed on a leaderboard that would exhibit other users and would rank users according to success in quitting alcohol or tobacco consumption or reducing alcohol consumption. Others felt that this might add a negative tone to the program and be discouraging for the users who are at the bottom of the leaderboard.

Content personalisation

Participants in both the 16-18 and the 19-24 age group discussions stated that the intervention program should provide the functionality to allow the user to change the settings on the program in terms of frequency of messages, the type of message content they are looking to receive and the extent of privacy they want to have in the program. There was a discussion on the extent to which anonymity was important to program users which led to suggestions on operating the program through Facebook. Not all participants thought that this was a good idea, however, as some wanted to limit their use of Facebook or other social media sites rather than expanding it.

In addition to users being able to regulate the program per their preferences in terms of the type and frequency of information received, one participant highlighted that feedback should also be built into the program with the aim of encouraging the person to keep going.

Participants also emphasised that it would be important for the program content to take an encouraging and positive communication style and tone, even if behaviour change goals are not met. The messages should be supportive rather than instructional (Quote 19).

Quote 19

"I don't think that people would like it if there was like an order that, no don't drink today." (Participant 7, 18-year-old male)

In one focus group, participants discussed the importance of forming a connection with the program to stay interested in it and to keep using it. One way to achieve a connection like this was suggested to be feedback from the program on how the user is succeeding in changing their behaviour.

For information on smoking cessation specifically, participants thought it would be useful to get information on what is normal to experience at each stage of the behaviour change process. Some participants thought the whole content of the programme should be built on the challenges and rewards experienced at different timepoints of quitting smoking (Quote 20).

Quote 20

"For example, the first week is the most difficult, then you get the shakes, then the next week is easier so keep going or something like that." (Participant 6, 18-year-old female)

A number of participants across two different focus groups discussed the importance of giving accurate information about the effects of alcohol consumption, not exaggerating with the aim of increasing fear of the consequences. The participants expressed that they lose trust for information which depicts situations that they have never experienced themselves and that seems blown out of proportion to reality (Quote 21).

Quote 21

"It should actually even say that we don't know how exactly it affects every person. So give a range of options, not just the worst without even mentioning the best case scenario. I mean, you could at least put the information on what is actually true. Friends of mine have also said that nothing happened. It shows that unlike what the message was saying, nothing actually happened so clearly the rest of the information is incorrect as well. Why should I trust it more than something I have experienced myself and that has been true? " (Participant 10, 18-year-old female)

As a suggestion of what kind of information the program could offer in order to motivate young people to not drink alcohol, it was suggested that offering alternative events, parties or gatherings that are alcohol-free could be a good way to engage the user. It was suggested that if the program knows which city the user lives in, it could link to the website of upcoming events in that city.

Technical and design components

Having a simple, fast logging in and personalisation process for the program was thought to be important. As well as the functionality to be able to change settings as you go along, for example being able to say that you want less or more of a specific type of message at any point throughout the program (Quote 22).

Quote 22

"It should be as simple as possible to start with the programme. A tick here, a tick there and untick here. And if you feel like it you can change and adjust a lot. For example you can adjust on the go if you want more or less of something. In terms of messages, you can also make changes." (Participant 13, 21-year-old male)

Participants thought that a simple, two-tone colour scheme would be most appealing to the average young person for a website. The importance of an engaging design was emphasised

where participants expressed that if the design of the program interface is too formal or too boring, it will not be appealing to young people. If the design is well thought out and engaging, the young person might spend time on getting to know the program just because the design is appealing. Several participants expressed that too many text messages from the program would become annoying quite quickly and would cause them to disengage.

The ethnic Russian participants expressed the importance of having such a program in three languages, Estonian, English and Russian to increase access to Estonians who are native Russian speakers (Quote 23).

Quote 23

'When we are talking about health, then we need to leave the politics aside. So create websites in three languages, Estonian, Russian and English.' (Participant 14, 20-year-old male)

All of the participants in all focus groups expressed an interest in using the program once ready.

DISCUSSION

This study aimed to explore the sociocultural context of Estonian adolescent and young adult views on alcohol and tobacco consumption and gather insight into the development of a tailored digital intervention program. The findings suggest that many Estonian adolescents and young adults experience alcohol and tobacco consumption as inevitable, it is a social activity they engage in with friends and peers. The participants in this study also shared their experiences of consuming alcohol and/or tobacco their home environments, often without intervention from their parents. Several participants expressed memories of having initiated their alcohol and/or tobacco consumption after having been offered it by a parent or a family member at a celebration event. Participants expressed not knowing much about the physical effects of alcohol and tobacco consumption and did not identify as consumers of either, as they did not view regular use as being relevant to being addicted. Several participants in every focus group also expressed that they had easy access to both alcohol and cigarettes before they turned 18 and little to no intervention from adults when seen consuming alcohol or tobacco. The participants who were interested in quitting smoking and/or reducing their alcohol consumption had made previous quit attempts, were competing in sporting events, had witnessed a person close to them suffer death or cancer due to alcohol and tobacco consumption. Young adults with increasingly demanding work and university responsibilities expressed consuming less alcohol to avoid hangovers that would impact on their responsibilities. Participants in all age groups found the information delivered on alcohol and tobacco consumption in the Estonian school curriculum uninteresting and the web-based information not personally relevant.

There were also some contrasting viewpoints, which emerged from the data. The participants in the youngest group seemed most motivated to change both their alcohol and tobacco consumption behaviours. The participants in the second focus group with 16-18-year-old participants talked about having tried to quit but did not express any current desire to quit smoking or reduce their alcohol consumption. The young adults in the third focus group discussed the issue of underage smoking and drinking in Estonia being a serious problem and something they would want to see resolved but they did not critique their own consumption behaviours in any way. The second major area of differences between focus groups was on the topic of potential interventions. The youngest participants were keen to see something in

the form of a game with lots of colours and videos and interactive components. The 16-18 year olds appeared to not mind the text-heavy government-developed websites as much as the youngest participants did, but they did express wanting to have a more personal approach and a program that they could set to their own preferences. The young adults were also keen on seeing a program that was individualised to their preferences but were also looking for the program to provide motivational messages and feedback on progress.

Regarding the Estonian sociocultural context, Estonian adolescents appear to hold similar viewpoints to adolescents and young adults from other sociocultural contexts. Similarly to Canadian adolescents, Estonian adolescents express a dislike of feeling like they need to smoke and having tried to quit several times, although unsuccessfully (O'Loughlin et al., 2002). Estonian adolescents also found it easy to access cigarettes and often shared packets between friends to reduce the cost, as do Canadian adolescents (O'Loughlin et al., 2002). Similarly to young adults in the US, Estonian young adults view social smoking as not smoking at all and do not consider themselves as smokers if this is the only context they are smoking in (Thompson et al., 2010). Adolescents in the UK find it difficult to say no to alcohol that is offered to them, which also seems to be the case with Estonian adolescents (Davies, 2016).

In contrast to evidence from other sociocultural contexts, Estonian adolescents appear to view alcohol and tobacco consumption as inevitable and the skill to refrain from consuming either as an innate characteristic rather than something that can be learned or practiced. This is a new and important finding in the field of adolescent and young adult alcohol and tobacco consumption, as beliefs about ability to change and self-theories (Yeager et al., 2014) such as these have seldom been studied regarding changing health behaviour. Another new finding in the results of this study was the lack of adult intervention that Estonian adolescents had experienced as underage alcohol and/or tobacco consumers.

Strengths

This was the first study to explore the sociocultural context of Estonian adolescent and young adult alcohol and tobacco consumption and relate it to the development of an individually

tailored intervention. The study data was double coded by native Estonian language speakers, maintaining the linguistic nuances of the data. The focus group facilitator was also a native Estonian speaker and Estonian national, who had prior experience with the sociocultural context of Estonian adolescent and young adult alcohol and tobacco consumption. Another strength was the recruitment of three focus groups all of different age groups, which allowed viewpoints to be collected across the adolescent and young adult spectrum.

Limitations

There were a relatively small number of participants, and since a large age range was covered it might have been beneficial to have more representatives from each age to ensure a plethora of viewpoints. There were only four participants in the youngest age group, therefore perhaps not representing the views of other adolescents of their age. This particular group also happened to be friends with each other, which might have influenced the information they chose to share in the group, perhaps not wanting to disclose too much or express views that might have been unacceptable to their friends. Some of the participants from the other groups knew each other before coming to the discussion, which again might have influenced their responses in light of being together with their friends. Although we recruited participants from three different youth-oriented institutions, they were all based in Tallinn, Estonia and so we might have missed out on important views from adolescents and young adults outside of Tallinn. The participants were also aware that the discussions aimed to inform the development of an intervention program for reducing alcohol and tobacco consumption, which may have influenced what they say about their motivation to change their own consumption behaviours to appease the researcher. Another limitation of this study is that the existing websites developed by the National Health Development Institute on both alcohol and tobacco consumption were updated after this study was conducted. Therefore, the findings on the opinions of adolescents and young adults on the government-produced web-based materials are based on older content.

Implications for intervention development

Several important considerations for intervention development emerged from this dataset. Participants across all age groups agreed that the current information on alcohol and tobacco consumption provided in the Estonian school curriculum is not interesting or memorable. The existing approach to delivering web-based information used by the Estonian government is appealing to older adolescents and young adults but not younger adolescents. Even so, all groups of participants still thought that a program which delivered content based on their personal preferences would be more appealing than the generic information provided on the website. This implies that a digital intervention tailored to individuals might be an appealing and useful addition to the existing school curriculum and web-based materials in Estonia.

The experiences Estonian adolescents and young adults shared here provide important understanding of the context in which their alcohol and tobacco consumption occurs, which can be used to tailor a digital intervention program (Kreuter & Wray, 2003). For example, the stories of how the alcohol and tobacco consumption of the participants in this study revolves around celebrations and spending time with family or friends can be used to write intervention content which gives suggestions for how to reduce alcohol and tobacco consumption in such situations. The information the participants shared on finding it difficult to believe that alcohol and tobacco consumption can lead to accidents, cancer or death if this is not reflective of their own experiences is also an important consideration for developing intervention content, which is in line with existing evidence on adolescents' reactions to explicit messages on the consequences of tobacco consumption (Grandpre et al., 2003). A digital intervention aiming to reduce Estonian adolescent and young adult alcohol and tobacco consumption might need to give examples of other, less severe types of consequences of alcohol and tobacco consumption to seem credible to users. Credibility of intervention content is also important to engage adolescents and young adults, which might also be enhanced by not directly suggesting that the intervention users stop consuming alcohol or tobacco, but rather praising successful instances of not consuming (Davies, 2016). Participants in this study also emphasised the importance of taking a positive and supportive tone in intervention content.

Another important consideration for intervention development in the findings of this study is the use of language surrounding Estonian adolescents' and young adults' alcohol and tobacco

consumption. Credibility of health information is linked to the specific vocabulary, which is perceived as relevant to the user (Calderón & Beltran, 2005). In the case of adolescents and young adults, information reflective of their experiences or information coming from their peers might seem more credible than something shared by traditional authority figures such as parents or teachers (Kuhn & Laird, 2011). Health information for adolescents and young adults therefore, should be credible in the context of their peer interactions to motivate them to process the information with the intention to change their health behaviour (Eysenbach, 2008; Petty & Cacioppo, 1986). The phrases used by the participants in this study can be used to write intervention content that is reflective of the vocabulary Estonian adolescents and young adults are familiar with, thus potentially increasing the credibility and relevance of the intervention. Participants mentioned wanting a supportive rather than instructional communication style in a potential intervention. This is in line with previous findings on the type of information adolescents and young adults might find appealing which have identified an autonomy supportive style specifically to be received well by these age groups (Mandel & Qazilbash, 2005; Miller et al., 2007).

Several links can be identified in the findings of this study and the determinants of adolescent and young adult alcohol and tobacco consumption outlined in Chapter 1 of this thesis. Estonian adolescents and young adults participating in this study expressed several negative outcome expectancies of alcohol and tobacco consumption, for example knowledge of more severe health effects of consumption and lack of time for work or school responsibilities. As a lack of positive outcome expectancies has been associated with a reduction in adolescent and young adult alcohol and tobacco consumption (Vilenne & Quertemont, 2015; Urban, 2010; Engels et al., 1998; Hasking et al., 2011), such negative outcome expectancies could be used in a potential intervention in the Estonian sociocultural context (Scott-Sheldon et al., 2012; Wetter et al., 2004).

Lack of refusal self-efficacy and the pressure of social norms as risk factors for alcohol and tobacco consumption was also considered by the participants in this study, where it was found that although in some situations, it was possible to say no to peers' expectations to consume, in others the mere presence of friends who were known to consume either alcohol or tobacco might trigger consumption. Lack of refusal self-efficacy and the pressure of social norms have also been shown to predict adolescent and young adult alcohol consumption (Young et al., 2006; Hiemstra et al., 2011; Menati et al., 2014; Christakis & Fowler, 2008;

Smith & Christakis, 2008; Mead et al., 2014; Mollen et al., 2013; D'Amico & McCarthy, 2006; Kelly et al., 2012; Trucco et al., 2011; de Vries et al., 1995; Chen et al., 2006; Harakeh & Vollebergh, 2012; Mollen et al., 2013).

It was mentioned by participants in this study that one of the features of a potential intervention might be the formation of a new social community that would allow the intervention user to find friends outside of their current social group and therefore make it easier to maintain new consumption habits. This highlights that participants perhaps did not perceive themselves to be able to or want to go through a period of potential conflict with their current social group to undertake a reduction of their consumption habits, or a lack of confidence in their ability to overcome social adversity (Walton & Cohen, 2011). An intervention targeting Estonian adolescents and young adults might benefit from including a component to increase their skill of overcoming social adversity, as it has also been indicated as a predictor of adolescent and young adult alcohol and tobacco consumption (Schinke et al., 2009; Webb & Baer, 1995; Vidrine et al., 2013).

Finally, the insights into the larger sociocultural context of alcohol and tobacco consumption in Estonian society expressed by the participants in this study is important for understanding what might be realistic objectives for a new intervention program and what might be the barriers experienced by Estonian adolescents and young adults to changing their alcohol and tobacco consumption behaviours. The findings in this study reflected a sociocultural context, where underage adolescents have easy access to alcohol and tobacco, parents encourage the initiation of alcohol consumption in the home environment and severe health scares might be the only experience serious enough to result in someone reducing or ending their consumption habits. Within this context, adolescents and young adults are expected to make decisions for themselves and take responsibility for the consequences of their alcohol and tobacco consumption. From an intervention development perspective, this means that intervention content should acknowledge the pressures on Estonian adolescents and young adults to be independent and responsible and the pressure to conform to peer groups they might experience in social situations.

Conclusions

Estonian adolescents and young adults expressed that they receive a lack of intervention from their parents, caretakers and teachers as well as adults walking past them on the street while they consume alcohol and tobacco. At the same time, both adolescents and young adults expressed that they would like to see the alcohol and tobacco consumption culture in Estonia change and that receiving personally relevant information through a digital intervention might appeal to them.

CHAPTER 4
The development of a digital intervention for Estonian adolescents and young adults using participatory design

ABSTRACT

Background

Behavioural interventions have the potential to reduce the biggest risk factors for noncommunicable diseases, such as alcohol and tobacco consumption. Adolescents and young adults are difficult to engage into interventions and find the commonly used instructional health communication controlling and alienating. Autonomy-supportive health communication might be more appealing. Involving adolescents and young adults in the intervention content development using a participatory design might be a way to develop autonomy-supportive health behaviour change intervention content. This study aims to develop an autonomy-supportive digital intervention for reducing Estonian adolescent and young adult alcohol and tobacco consumption by using a participatory design.

Method

Participatory design, behaviour change theory and techniques, and Kreuter's (2012) framework for tailored computer-based interventions were used to develop this intervention.

Results

MyOwnMe, a web and mobile phone intervention was developed. It is a four-week long intervention with weekly web modules and twice daily text messages on topics relating to the experiences of Estonian adolescents and young adults with alcohol and tobacco consumption as well as providing behaviour change support.

Discussion

Using participatory design for developing interventions for adolescents and young adults enhances the development of autonomy-supportive health communication.

BACKGROUND

Digital platforms hold the potential to deliver health behaviour change interventions to significantly more people than traditional face-to-face or paper-based intervention delivery mechanisms and to do so equitably across socioeconomic groups (Griffiths et al., 2006; Munoz, 2010). Although little is known about adolescents' and young adults' preferences for digital intervention delivery mechanisms and content features (Crutzen et al., 2011), mobile phone text messaging has been found to be an effective intervention delivery mechanism in adults (Fjeldsoe et al., 2009) and provides an opportunity for engaging the user more frequently than a website (Naughton et al., 2016), given that mobile phone users carry them throughout the day. Adolescents and young adults are avid users of mobile phone technology and this might be an appealing intervention delivery mechanism for them (Pew Internet & American Life Project, 2012; 2013).

Adolescence and young adulthood stretches into the early- and mid-twenties (Sawyer et al., 2012; Siegel, 2013) and is a developmental period defined by rapid physical, cognitive and emotional changes (Steinberg, 2010). One difference between adolescents or young adults and adults is how known authority figures are perceived (Eysenbach, 2008). In adolescence and young adulthood, peers are sometimes prioritised as sources of credible information over traditional authority figures such as parents and teachers (Kuhn & Laird, 2011). Social skills outside of the family unit are being developed and for this, peer contact and approval are essential (Bauman et al., 2001; Tanti et al., 2011). Adolescents and young adults might also mistrust the health information delivered by authority figures such as teachers, doctors or researchers, which poses a challenge for delivering behavioural interventions to this age group (Eysenbach, 2008).

Interventions targeting adolescents and/or young adults commonly use an instructional model of health communication, which can seem controlling and alienating to adolescents and young adults (Miller et al., 2007). This is because adolescents and young adults perceive controlling messages as a threat to their psychological freedom (Miller et al., 2007). Adolescents and young adults might prefer autonomy-supportive health communication, which is characterised by respect for the adolescent and young adult point of view, honesty about the health issue described and an egalitarian power model between the authority figure,

for example a health care provider, and the adolescent or young adult (Miller et al., 2007; Ginsburg et al., 1995). An autonomy-supportive communication style was also identified as appealing by Estonian adolescents and young adults in Chapter 3 of this thesis.

A potential method for developing autonomy-supportive health communication to be used in digital behaviour change interventions might be to involve adolescents and young adults in the intervention development process, using a participatory design, which might also increase intervention effectiveness (Zinck et al., 2013; Mandel & Qazilbash, 2005). Participatory design has been proposed as conducive to bridging the computer technology and health intervention research approaches (Clemensen et al., 2007). It has also been successfully used to develop multi-lingual interventions in previous studies (e.g. Neuhauser et al., 2009). As far as I am aware, only one existing study has used this approach in developing a digital intervention for reducing cigarette smoking in adolescents and young adults (Norman & Skinner, 2007). Norman and Skinner (2007) involved Canadian adolescents in developing an autonomy-supportive digital intervention by focusing on personal, social and health issues relevant to and identified by adolescents, respecting adolescents' individual choices, including interactive elements into the website design and involving adolescents in all stages of the intervention development and delivery. No existing studies have used a participatory design of intervention development to reduce both alcohol and tobacco consumption in adolescent and young adults, despite the high rate of co-occurrence and negative implications on health outcomes (Falk, 2004).

The current study aims to develop an autonomy-supportive web and mobile phone intervention for reducing Estonian adolescent and young adult alcohol and tobacco consumption using participatory design.

METHOD

Intervention development and design decision-making

The development and pilot testing of this intervention follows the first two stages of the Medical Research Council Guidance on developing complex interventions, intervention development and feasibility and pilot testing (Craig et al., 2008). The MRC guidance suggests that complex interventions, involving a number of interacting components and behaviours, should be developed systematically and be based on available evidence and theory (Craig et al., 2008). The testing of such interventions should be conducted using a phased approach, including a series of pilot studies (Craig et al., 2008). In this study, the process of identifying the appropriate evidence base and theory for the development of the MyOwnMe intervention will be described and discussed. In Chapter 5 of this thesis, the first phase of pilot testing the MyOwnMe intervention will be described and discussed.

Developing effective behaviour change interventions requires a cumulation of available evidence and the linking of intervention ingredients to both existing evidence and theory (Michie & Johnston, 2012). Currently, there is a dearth of understanding on what makes effective interventions so and systematic investigation into the active ingredients of behaviour change interventions is warranted (Michie & Johnston, 2012). Identifying effective intervention ingredients requires the clear reporting of intervention components (Michie et al., 2009) and

The identification of effective intervention ingredients might also need to take into account differences in cultural context and how this impacts intervention effectiveness (Kreps & Neuhauser, 2010). This is slightly in contrast with the systematisation and standardisation of behaviour change interventions as it requires the prioritisation of the needs of specific intervention target groups rather than uniformity of care (Bernal et al., 2009). The evidence on the effectiveness of culturally adapted interventions is mixed, they have been shown to be effective in some cultural subgroups but not others (Castro et al., 2010). As it has also been suggested that realising the potential of technology in health behaviour change will require increasing tailoring to cultural context (Kreps & Neuhauser, 2010), it was decided that for the development of the MyOwnMe intervention in the Estonian cultural context, a new intervention would be developed, immediately tailored to the preferences and needs of this subculture, rather than adapting an existing intervention.

Recruitment of adolescents and young adults into intervention development

Two adolescents and one young adult self-selected via two non-governmental organisations (NGO) based in Tallinn, Estonia, to consult on the development of the intervention content in this study. One of these organisations is a public health NGO and the other focuses on human rights. Both organisations work with youth across Estonia. The adolescents were volunteers at the public health NGO and the young adult was a student of one of the universities in Estonia and had collaborated with the human rights NGO before starting university. The adolescents and young adult were reached by contacting the directors of each organisation who facilitated contact with them. The adolescents were 17 and 18 years old and the young adult was 20 years old. Two of the adolescents were alcohol consumers and the young adult was a cigarette smoker. It is likely that these adolescents represent highly motivated individuals interested in self-development and healthy lifestyles. The inclusion of only self-selected adolescents and young adults as consultants for the development of this intervention might limit the extent to which adolescents and young adults of lesser motivation to change their alcohol and tobacco consumption behaviours resonate with the intervention content.

Process of participatory design

A participatory design was used to develop autonomy-supportive intervention content, which meant involving the recruited adolescents and young adult in some of the intervention development process (Neuhauser & Kreps, 2010). Autonomy-supportive content was created by supporting the adolescents and young adult recruited into the development process in writing examples of situations within which they had consumed alcohol and/or tobacco and the messages they thought their peers would find interesting and encouraging in terms of reducing consumption. During one year, me, the adolescents and young adult consulting for the study, an Estonian language specialist and a web developer participated in an iterative process of planning, writing and editing intervention content. From here on, this group of participants in the intervention development process will be referred to as the intervention development group. I had monthly meetings with the web developer, four times face-to-face and the rest via Skype. I had four face-to-face meetings with each of the adolescents and the young adult over the course of the year. Otherwise, the three were consulted over Skype, Facebook Messenger and e-mail. The Estonian language specialist I also met with face-to-

face four times over the course of the year and otherwise consulted her via e-mail. The entire development group was familiarised with the findings from Chapter 3 of this thesis during the face-to-face meetings. Findings from Chapter 3 of this thesis were also used as examples of situations where Estonian adolescents and young adults might consume alcohol or tobacco and the potential consequences, as well as what might be acceptable ways of changing these behaviours. The adolescents and young adult recruited into the process advised on the use of appropriate language and expressions that might be resonant of the vocabulary Estonian adolescents and young adults hear from their peers and therefore carry less of a controlling and authoritative tone than something delivered by an adult authority figure. This iterative process and the involvement of the adolescents and young adult recruited into the study was followed from the beginning of compiling the research evidence on adolescent and young adult alcohol and tobacco consumption and theories of behaviour change to the final editing of the intervention content.

Developing intervention content

The following section of this chapter illustrates the approach taken to combine research evidence and input from the participatory process in developing a behaviour change intervention to reduce Estonian adolescent and young adult alcohol and tobacco consumption. Kreuter et al.'s (2012) approach to tailored health messages for intervention development was used as a guiding framework for combining research evidence with experiential information from participants. This framework involves nine phases: 1) analysing the health problem, 2) developing a program framework, 3) developing tailoring assessments, 4) designing feedback, 5) writing tailored messages, 6) creating tailoring algorithms, 7) automating the tailoring process, 8) implementing the program and 9) evaluating the program. In this chapter, the first seven phases will be described, the last two phases of implementing and evaluating the program will be described in the next chapter of this thesis (Chapter 5). The intervention development team was involved in the writing tailored messages phase of the intervention development process; the rest of the phases were completed by me.

Analysing the health problem

This stage of intervention development involves the collating of research evidence on specific health behaviours in specific contexts to 'understand the determinants of the problem one is seeking to address' (Green & Kreuter, 1991). In this thesis, Chapters 1, 2 and 3 all investigated the problem of adolescent and young adult alcohol and tobacco consumption, specifically in the Estonian sociocultural context. Table 5 offers a recap of the findings from Chapter 1, 2 and 3 of this thesis on the determinants of adolescent and young adult alcohol and tobacco consumption and the nuances of consumption specific to the Estonian sociocultural context. Behaviour change theory was also used to add to the understanding of determinants of adolescent and young adult alcohol and tobacco consumption, which will be explored in more detailed later in this chapter. In the analysis of the health problem stage of intervention development, the intervention development team was not involved, I collated the existing research evidence, identified behaviour change theories and techniques.

Chapter	Findings

Chapter 1 - Introduction	• Adolescent and young adult alcohol and tobacco consumption is determined by:
	  • Outcome expectancies
	  • Refusal Self-efficacy
	  • Perception of social norms
	  • Overcoming social adversity
	  • Autonomous motivation
	• Autonomy-supportive health communication style is potentially appealing to adolescents and young adults.

Chapter 2 – Systematic review and meta-analysis	• Digital interventions reduce both alcohol and tobacco consumption in adolescents and young adults. • Few interventions have utilised mobile phone text messaging technology to reduce adolescent and young adult alcohol consumption.
Chapter 3 – Focus group study	• Estonian adolescents and young adults perceive alcohol and tobacco use as difficult to change. • Varying levels of consumption are not perceived as related to addiction. • Lack of knowledge of the effects of alcohol and tobacco consumption. • Lack of belief in health consequences of alcohol and tobacco consumption, if not reflective of own experiences. • A positive tone when delivering information is important. • Lack of refusal self-efficacy. • Lack of skill to overcome social adversity required to change consumption behaviours in peer group contexts. • Autonomy-supportive communication style preferred to instructional communication. • Pressure on Estonian adolescents and young adults to take responsibility for their own consumption behaviours in a context where legislation is lax and adults not only do not intervene in underage consumption, but even facilitate it.

Table 5. Background research on the determinants of adolescent and young adult alcohol and tobacco consumption in the Estonian sociocultural context.

As outlined in Chapter 1 of this thesis, there are several determinants of adolescent and young adult alcohol and tobacco consumption behaviours. In Table 6, I present a summary of these determinants as well as evidence of their modifiability through interventions. Following the behaviour change principles approach to developing multiple behaviour change interventions (Noar et al., 2008), I specifically sought out determinants that are common to both alcohol and tobacco consumption behaviours. Alcohol and tobacco consumption in adolescence and young adulthood is mostly a social behaviour, occurring when young people get together with peers (Parder & Vihalemm, 2015; Kuntsche et al., 2005; Christakis & Fowler, 2008). I therefore focused the content of the intervention on social situations where the user might be faced with the decision of whether to consumer alcohol and/or tobacco or not.

As outlined in the results of the meta-analysis in Chapter 2, I found digital interventions to reduce adolescent and young adult alcohol and tobacco consumption. The meta-analysis also indicated a lack of existing interventions that used mobile phone text messages as the intervention delivery mechanism for alcohol consumption interventions, bar a couple of exceptions (Suffoletto et al., 2012; Mason et al., 2014). Mobile phone text messaging also allows several behaviour change techniques to be delivered directly to the user, such as automated feedback, leveraging social influence, and informational messages (Klasnja & Pratt, 2012). The intervention developed could add to the few existing studies currently employing this technology for alcohol consumption intervention delivery in the adolescent and young adult age groups. Another highlighted finding from the meta-analysis was the lack of association between providing information on the consequences of excessive alcohol consumption and a reduction in alcohol consumption. As a widely-used component of alcohol consumption interventions (e.g. Bersamin et al., 2007; Chiauzzi et al., 2005), this was a surprising finding and one, which was confirmed by another review of alcohol consumption in adults by Black et al. (2016). An explanation of this finding might be that the consequences of alcohol and/or tobacco consumption usually communicated to adolescents and young adults might involve the more extreme consequences, such as cancer or death. As identified in Chapter 3 of this thesis, such extreme consequences might not be credible to adolescents and young adults, unless they have witnessed such consequences in their own lives. As such, it was decided that the intervention content would not feature much of the usual information delivered in school curricula on the effects of excessive alcohol or tobacco

consumption, but would rather focus on lesser known consequences, such as the negative effects on brain development (Goriounova & Mansvelder, 2012; Witt, 2010).

As found in Chapter 3 of this thesis, Estonian adolescents and young adults consume alcohol and tobacco in a context where underage consumption legislation is often not implement and there is little adult intervention into underage consumption of either substance. Adults even facilitate the initiation of Estonian adolescent and young adult alcohol and tobacco consumption, which means the responsibility for preventing or reducing consumption is on the adolescents and young adults themselves. Although Estonian adolescents and young adults are motivated to change their consumption habits, they are lacking in knowledge of the effects of alcohol and tobacco consumption despite learning about this in school and they do not associate varying levels of consumption with nicotine addiction or alcohol dependence. They also find it difficult to believe information on the more extreme negative consequences of alcohol and tobacco consumption, such as cancer, unless it is something they have experienced in their family or peer contexts. Estonian adolescents and young adults do perceive alcohol and tobacco consumption to be difficult to change and lack the refusal self-efficacy and skills to overcome social adversity to engage in the conversations necessary to change their consumption habits in their peer and family contexts. They also emphasised that a positive tone and a supportive communication style are important for intervention programs.

In addition to the findings from Chapter 1, 2 and 3 of this thesis, several other determinants of adolescent and young adult alcohol and tobacco consumption have been highlighted in the research literature. These include age (Windle et al., 2008; Chassin et al., 1996), gender (Huselid & Cooper, 1992; Clayton, 1991), alcohol dependence (Rohde et al., 2001), nicotine addiction (Rojas et al., 1998), parents' consumption of alcohol (Ary et al., 1993), parents' consumption of tobacco (Biglan et al., 1995), friends' consumption of alcohol (Curran et al., 1997), friends' consumption of tobacco (Biglan et al., 1995), motivation to quit tobacco consumption (Newcomb et al., 1988) and motivation to reduce alcohol consumption (Sargent et al., 1998). These determinants have been indicated as both predictive of adolescent and young adult alcohol and tobacco consumption and also modifiable through interventions (Bersamin et al., 2007; Simmons et al., 2013; Voogt et al., 2014; Lotrean et al., 2010; LaBrie et al., 2013; Buller et al., 2008; Hagger et al., 2012; Williams et al., 2006; Yeager et al., 2011; Turrisi et al., 2001; Biglan et al., 1996; Larimer et al., 2001; Campbell et al., 2008;

Monti et al., 2007; Riley et al., 2008; Tevyaw & Monti, 2004), except for age and gender. To increase the personal relevance of the information provided to each user of this intervention (Kreuter & Wray, 2003), it was decided that these determinants would also be included in the program content. Although not modifiable, age and gender determinants can still be used to generate personally relevant intervention content, thus they were included in the list of determinants targeted by the intervention developed in this study.

Behaviour Change Theory and Techniques

Evidence shows interventions that use theory are more likely to be effective (Noar et al., 2007). In the case of tailored interventions such as the one developed through this research, the use of multiple theories is recommended to enhance the quality of the tailored messages (Strecher, 1999). The selection of theories for the development of this intervention was based on the intention to begin developing a causal model for intervention content, guided by the causal modelling approach to intervention development (Hardeman et al., 2008). Fully developing a causal model was beyond the scope of this research project, but will be addressed in future work based on this research. According to the causal modelling approach to intervention development, theory-based behavioural determinants are identified through a process of 1) consulting with experts who in this case were the two supervisors of this PhD thesis, 2) conducting systematic reviews, 3) conducting focus groups and individual consultations and 4) researcher team meetings. The systematic review conducted in Chapter 2 of this thesis identified Social Cognitive Theory (Bandura, 1977) as a theory commonly used for developing smoking cessation interventions for adolescents and young adults. The systematic review identified a lack of theoretical basis for the development of alcohol consumption interventions targeting adolescents and young adults with just two out of 26 studies stating a theoretical basis, namely the Theory of Planned Behaviour. In the expert discussions, it was decided that for both tobacco and alcohol consumption behaviours, motivational, behaviour, personal and environmental factors should all be addressed in the theoretical determinants informing the development of this intervention. The Social Cognitive Theory includes behavioural, personal and environmental; thus, it was chosen as one of the theories to inform the development of this intervention. The Social Cognitive Theory has informed the development of effective digital interventions targeting adolescent and young adult smoking cessation, as found in the systematic review in Chapter 2 of this

thesis. It also includes social environmental factors, such as outcome expectations, which were identified as important determinants of adolescent and young adult alcohol consumption in Chapter 1 of this thesis. Social Cognitive Theory's focus on the social environment of health behaviour might also lead to the development of effective digital interventions that target adolescent and young adult alcohol consumption, given the importance of the cultural context in shaping individual consumption habits (Bandura, 2002). In the focus groups conducted in Chapter 3 of this thesis, findings indicated that Estonian adolescents and young adults find autonomy-supportive communication appealing. The autonomous motivation theoretical construct in the Self-Determination Theory (Deci & Ryan, 2008) of motivation was chosen as a second source for informing the intervention development. It was discussed in the expert sessions that the motivational theoretical construct to inform the development of this intervention should take into account the importance of autonomy in the adolescent and young adult developmental stages. Self-determination theory has previously been used to developed effective interventions to target adolescent health behaviour (Williams et al., 1999). The focus groups conducted in Chapter 3 of this thesis also highlighted Estonian adolescents' and young adults' views on the possibility for change in their alcohol and tobacco consumption behaviours. Participants in the focus groups expressed that the ability to change a behaviour might be an innate characteristic, rather than something that can be learned. Building on the premise the the possibility of change itself should be present in order for motivation to change to increase (Dweck, 1986), it was also decided to inform intervention development based on implicit self-theory, which includes theoretical constructs addressing beliefs in change (Dweck, 2000). The three theories chosen to inform the development of this intervention are all also associated with the five determinants of adolescent and young adult alcohol and tobacco consumption identified in Chapter 1 of this thesis, namely outcome expectancies, refusal self-efficacy, perception of social norms, autonomous motivation and overcoming social adversity. A fuller description of each chosen theory is outlined below.

Social Cognitive Theory

Social Cognitive Theory posits that behaviour is determined by personal, environmental and behavioural factors interacting in a triadic reciprocal deterministic relationship (Bandura, 1977). The core construct of the theory is self-efficacy, defined as the expectation that 'one

can successfully execute the behaviour required to produce desired outcomes' (Bandura, 1977; pg. 193). Health behaviours are a part of everyday life, and interventions should reflect this in order to increase users' perceived self-efficacy and sense of control in actually carrying out changes (Neuhauser & Kreps, 2003). Self-efficacy in adolescent and young adult alcohol and tobacco consumption is an important predictor of behaviour change as outlined in Chapter 1 of this thesis. Refusal self-efficacy specifically has been found to predict adolescent and young adult alcohol and tobacco consumption behaviours (Young et al., 2006, Hiemstra et al., 2011; Menati et al., 2014; Connor et al., 2011; Kear, 2002). Other core constructs of Social Cognitive Theory have also been identified as important predictors of adolescent and young adult alcohol and tobacco consumption, such as outcome expectancies (e.g. Urban, 2010; Vilenne & Quertemont, 2015) and perceptions of social norms (Lewis & Neighbors, 2006; Tyas & Pederson, 1998). Outcome expectancies can also be used to tailor intervention content to specific groups of participants, for example according to the outcome expectancies of consuming alcohol and/or tobacco, such as experiencing peer pressure (Kuntsche et al., 2004; Tomkins, 1966), wanting to reduce stress (Urban, 2010; Shadel & Mermelstein, 1993) or desiring social acceptance (Kuntsche et al., 2005). This might increase the personal relevance of the intervention content to adolescent and young adult participants. From the point of view of intervention development, Social Cognitive Theory has been shown to include constructs that are modifiable through digital interventions targeting adolescents and young adults, as illustrated in Table 6, adding to the rationale for the use of this theory in this intervention development process.

Self-Determination Theory

Self-determination theory is a macro theory of human motivation, development and health (Deci & Ryan, 2008). Its core construct includes the differentiation between autonomous and controlled motivation. Autonomous motivation is posited to be an intrinsic and volitional type of motivation, part of an individual's sense of self. Controlled motivation, on the other hand, is a type of extrinsic motivation dependent on reward and punishment for different behaviours. Given the evidence on the potential alienating effect that controlling health communication has on adolescents and young adults (Miller et al., 2007), this intervention was built around autonomous motivation as the underlying focus of the intervention content. The focus group study findings reported in Chapter 2 of this thesis also showed the high

degree of responsibility that Estonian adolescents carry for their own alcohol and tobacco consumption behaviour. Rather than it being the responsibility of the adults in their lives, adolescents are seen as being adults themselves and needing to take responsibility for their alcohol and tobacco consumption decisions. The evidence on adolescents and young adults asserting their autonomy from their parental and other authority figures as a stage of development (Bauman et al., 2001) supports this finding and lends support to the use of the autonomous motivation construct of the Self-Determination Theory in the development of this intervention. Like the constructs from Social Cognitive Theory, autonomous motivation has been shown to be predictive of alcohol and tobacco consumption behaviours and is modifiable through intervention content (Williams et al., 1999; Williams et al., 2006; Caudwell & Hagger, 2015).

Implicit Self-Theory

In addition to asserting autonomy from family and societal authority figures, another central concept to adolescent and young adult development is the development of a sense of self or identity (Damon & Lerner, 2008). As an individual enters adolescence, they start to develop a sense of identity in relation to their social relationships outside of the family structure (Meeus et al., 2002). This process might involve experiences of social adversity, where the adolescent might be rejected by the social groups they participate in (Morgan & Haglund, 2009). Overcoming such social adversity is an important predictor of adolescent risk behaviours, including alcohol and tobacco consumption and thus important to include in the development of this intervention (Walton & Cohen, 2011). Overcoming social adversity is captured in implicit self-theories, which are learning theories suggesting that individuals either hold an incremental belief about their characteristics and skills, where they have been obtained through practice or effort or hold entity beliefs where their characteristics and skills are seen as innate (Yeager & Dweck, 2012). Self-theories have been shown to be effective in increasing skills of handling social adversity in children and adolescents in the school context (Yeager et al., 2014; Yeager et al., 2011). As far as I am aware, this is the first time implicit self-theories have been used to inform a behaviour change strategy to reduce alcohol and tobacco consumption in adolescents and young adults.

Implicit self-theories are also important for the development of this intervention to capture the social context of Estonian adolescent and young adult alcohol and tobacco consumption, another important characteristic of effective digital interventions (Neuhauser & Kreps, 2010; Eysenbach, 2008). Implicit self-theories explain some of the findings from the focus group study reported in Chapter 2 of this thesis. Estonian adolescents and young adults recognised that changing the Estonian alcohol and tobacco consumption culture would be difficult, especially in social situations. Another finding from Chapter 2 indicated that some participants thought that the ability to change one's alcohol and/or tobacco consumption is dependent on an innate capability and that not everyone would be able to achieve such a change. The adolescents and young adult involved in intervention development also highlighted these finding as important and in line with their views of alcohol and tobacco consumption. These findings were therefore added to the intervention content.

Although behaviour change theory offers a useful basis for intervention development, it lacks in guidance on how it should be translated into intervention content (Michie et al., 2008). Behaviour change techniques, which are theory-based tools to change behaviour, help fill this gap (Michie et al., 2008). A taxonomy of behaviour change techniques has been developed, as well as taxonomies specific to alcohol and tobacco consumption (Abraham & Michie, 2008; Michie et al., 2012; Michie et al., 2011). For the development of this intervention, behaviour change techniques were chosen by me based on the theoretical basis, findings from the systematic review in Chapter 1, the focus group study in Chapter 2 and a review of the techniques used in effective interventions reported in the research literature (Webb et al., 2010). Each of the behaviour change techniques associated with the three behaviour change theories are illustrated in Table 6 and were chosen as the basis for intervention content

Determinant of behaviour	Behaviour	Evidence of predicting behaviour (examples)	Evidence of modifiability (examples)	Relevant theory	Relevant behaviour change techniques in this intervention
Outcome expectancies	Alcohol Tobacco	Urban 2010 Vilenne & Quertemont 2015	Bersamin et al., 2007 Simmons et al., 2013	Social Cognitive Theory Bandura 1977	Provide information on consequences of consumption
Refusal self-efficacy	Alcohol Tobacco	Connor 2011 Kear 2002	Voogt et al., 2014 Lotrean et al., 2010	Social Cognitive Theory Bandura 1977	Boost motivation and self-efficacy
Perception of social norms	Alcohol Tobacco	Lewis & Neighbors 2006 Tyas & Pederson 1998	LaBrie et al., 2013 Buller et al., 2008	Social Cognitive Theory Bandura 1977	Provide normative information about others' behaviour and experiences
Autonomous motivation	Alcohol Tobacco	Williams et al., 2000 Johan et al., 2012	Hagger et al., 2012 Williams et al., 2006	Self-Determination Theory Deci & Ryan 2008	Emphasise choice General communication skills training
Implicit Self-theories	Overcoming social adversity	Yeager et al., 2014	Yeager et al., 2011	Implicit Self-Theory Dweck 2000	Reframing
Parents' consumption of alcohol	Alcohol	Ary et al., 1993	Turrisi et al., 2001	Social Cognitive Theory Bandura 1977	Provide information on consequences of consumption General communication skills training
Parents' consumption of tobacco	Tobacco	Biglan et al., 1995	Biglan et al., 1996	Social Cognitive Theory Bandura 1977	General communication skills training
Friends' consumption of alcohol	Alcohol	Curran et al., 1997	Larimer et al., 2001	Social Cognitive Theory Bandura 1977	Boost motivation and self-efficacy Provide feedback on performance
Friends' consumption of tobacco	Tobacco	Biglan et al., 1995	Campbell et al., 2008	Social Cognitive Theory Bandura 1977	Provide information on consequences of consumption
Gender	Alcohol Tobacco	Huselid & Cooper, 1992 Clayton, 1991	NA	Not targeted in this intervention	NA

Age	Alcohol Tobacco	Windle et al., 2008 Chassin et al., 1996	NA	Not targeted in this intervention	NA
Alcohol dependence	Alcohol	Rohde et al., 2001	Monti et al., 2007	Not targeted in this intervention	Provide information on withdrawal symptoms
Nicotine addiction	Tobacco	Rojas et al., 1998	Riley et al., 2008	Not targeted in this intervention	Provide information on withdrawal symptoms
Motivation to reduce alcohol consumption	Alcohol	Newcomb et al., 1988	Tevyaw & Monti, 2004	Self-determination Theory Deci & Ryan 2008	Boost motivation and self-efficacy
Motivation to quit tobacco consumption	Tobacco	Sargent et al., 1998	Tevyaw & Monti, 2004	Self-determination Theory Deci & Ryan 2008	Boost motivation and self-efficacy

Table 6. Evidence of determinants of adolescent and young adult alcohol and tobacco consumption and their modifiability.

Developing a program framework

The overall goals of the intervention program were reducing Estonian adolescent and young adult alcohol and tobacco consumption. However, more specific objectives were identified as relevant for the Estonian sociocultural context, as per findings from Chapter 3 of this thesis, illustrated in Table 7. Intervention objectives can be met through assessment modules, which are used to inform the intervention content and feedback modules, which deliver tailored feedback to the intervention users. Intervention objectives, content, assessment and feedback modules are illustrated in Table 7.

Objective	Delivery Mechanism	Assessment	Feedback
Facilitate understanding of consequences of alcohol and tobacco consumption	Website linked to Mobile phone text messages	Baseline 1-month post-intervention using tailoring and follow-up questionnaires	Daily for 1 month
Facilitate increase in refusal self-efficacy			
Increase autonomous motivation for behaviour change			
Facilitate skills for overcoming social adversity			
Facilitate autonomous decision making			
Facilitate habit formation			

Table 7. Program framework connecting program objectives, content modules, assessment and feedback.

A website linked to a text-messaging program was chosen as the delivery mechanism for this intervention. This decision was based on the positive stance expressed towards websites and text messages by the participants in the focus group study in Chapter 3 and the intervention development group. The program objectives of facilitating understanding of the consequences of alcohol and tobacco consumption, increasing autonomous motivation, and facilitating habit formation required a longer, educational intervention component, for which websites have been shown to be effective (Bertholet et al., 2015; Simmons et al., 2013; meta-analysis results on alcohol consumption behaviour in Chapter 1). The text-messaging component had the aim of delivering daily behaviour change support directly to the participants. Text messages have shown

promise as an effective intervention delivery mechanism for substance use in adolescents and young adults (Mason et al., 2014).

Developing a tailoring assessment questionnaire

Tailored health communication is based on assessment (Kreuter et al., 2012). The determinants of a health behaviour identified in the analysis of the health problem step of the intervention development process must all be measured before content relevant to each user can be written. The determinants of behaviour are therefore also the tailoring variables of intervention content, based on which content is decided and message wording chosen. To measure determinants of behaviour, a tailoring assessment questionnaire was compiled. The tailoring questionnaire is also a baseline assessment for measuring program effectiveness.

In this intervention, I identified 15 tailoring variables, as illustrated in Table 8. The tailoring variables map onto the modifiable determinants of adolescent and young adult alcohol and tobacco consumption summarised in Table 6. Table 8 also lists the measurement tools used to assess each determinant, which formed the tailoring assessment questionnaire. The tailoring assessment questionnaire can be viewed in Appendix 11. Once assessed, the tailoring variables were placed into tailoring matrices, which were used as a tool for writing intervention content. Different combinations of these variables were developed into relevant messages depending on the combination of tailoring variables at hand. The website was tailored to two variables, age and outcome expectancies. The mobile phone messages utilised all 15 tailoring variables to generate content. The tailoring matrices can be viewed in Appendix 9.

Tailoring variables/ Determinants of behaviour	Measurement tool	Previously used by
Self-theories	Self-report questionnaire measuring whether individuals have an entity or incremental personality	Yeager 2011
Drinking refusal self-efficacy	Self-report questionnaire measuring the extent to which participants believe they are able to say no to an alcoholic drink	Oei 2005
Smoking refusal self-efficacy (adapted* from drinking refusal self-efficacy questionnaire)	Self-report questionnaire measuring the extent to which participants believe they are able to say no to a cigarette	Oei 2005
Treatment self-regulation questionnaire (adapted* for alcohol and tobacco consumption)	Self-report questionnaire measuring the autonomous motivation theoretical construct and indicating the extent to which the act of changing a behaviour is intrinsically motivated versus extrinsically controlled from the perspective of the participant, includes an item to assess whethere the person is motivated to change their consumption behaviour	Ryan & Connell 1989
Smoking expectancy	Self-report questionnaire measuring the likelihood with which participants expect smoking cigarettes to affect their lives in terms of stress reduction, emotion regulation, health outcomes, relationship and friendship outcomes	de Vries 1988
Alcohol expectancy (adapted* from smoking expectancy questionnaire)	Self-report questionnaire measuring the likelihood with which participants expect drinking alcohol to affect their lives in terms of stress reduction, emotion regulation, health outcomes, relationship and friendship outcomes	de Vries 1988
Parents' consumption of alcohol	Single item self-report on parents' alcohol consumption	Song 2012
Parents' consumption of tobacco	Single iterm self-report on parents' tobacco consumption	White 2000
Friends' consumption of alcohol	Single item self-report on friends' alcohol consumption	Song 2012
Friends' consumption of tobacco	Single iterm self-report on friends' tobacco consumption	White 2000
Gender	Multiple choice	NA
Age	Free text	NA
Alcohol dependence	AUDIT questionnaire	Bailey 2004
Nicotine addiction	Single iterm self-report on time to first cigarette in the morning	Prokhorov 1996

*Questionnaires were adapted by Silja-Riin Voolma

Table 8. Assessment tools used to compile the tailoring questionnaire.

A spotlight on linguistics

An added level of complexity with this intervention was the translation of behaviour change theory and the Kreuter et al. (2012) approach of tailoring health messages into Estonian language intervention content that is reflective of the language used by Estonian adolescents and young adults. To ensure high quality translation, an Estonian language editor and translator consulted on the project, ensuring all the web and mobile phone content was adjusted appropriately. This was an iterative process within the intervention development group, with different versions of the text being passed back and forth between the three groups as well as being translated into English to aid discussion on operationalisation of theory with collaborators. It was imperative to

have a team representing all three areas of interest: adolescent and young adult viewpoints, linguistic accuracy and theory-based operationalisation of content.

To test the readability of the website content, the text was translated into English and tested on an online reading level assessment platform. The results indicated that the text had an average reading level of a 13-year old. There are no such assessment tools available in the Estonian language, meaning that it is not clear whether this result would translate into the Estonian version of the text as well, but the readability of the Estonian version was confirmed by a professional translator and an Estonian language teacher. It was not within the scope of this project to also develop a Russian- or English-language versions of the program, which should be a priority in future iterations of the content, as identified in Chapter 2 of this thesis.

Developing design templates

This stage of the intervention development process involves the principles of user centred-design and extends to the aesthetic of the intervention as well as the quality of the experience of use (Monk, 2000). This entails an enjoyable user experience and personal relevance more so than any utilitarian gain (Kim et al., 2013). In the case of this intervention, I chose the colour palette of the website as well as the design of the homepage. Due to the lack of design expertise in the intervention development group or the research team, the design of the program was basic. Examples of the website page design can be viewed in Appendix 6.

Message concepts and writing the messages

Once the tailoring questionnaire and the intervention framework were in place, the next step was to determine what the aim of each message included in the intervention would be. This step aided the writing of targeted messages that would include not only an element of personalisation, but would also be conducive to meeting the program objectives outlined in Table 7. This required message concepts to be developed, which involve a list of aims that each part of the intervention should address. Examples of message concepts can be viewed in Table 9. Writing

the messages was a matter of combining the message concepts with the tailoring variables. This is where the intervention development group was most actively involved and formed the topic of my meetings with each of the group members. Templates of the content for each page of the website were developed, iteratively updating and editing the text based on the recommendations from the intervention development group. The same process was followed for the mobile phone text messages. I wrote the first drafts of content for both the web and mobile phone text messaging components and subsequently additions and edits were made through consultation with the intervention development group. The Estonian language specialist edited final versions of both website and mobile phone text messaging content.

Message concept	Substance	Example message
Addiction	Nicotine addiction	Hi #name! You mentioned that you smoke less than an hour after waking up in the morning. This is a symptom of nicotine addiction. We will give you some tips on how to give up smoking.
	Referral message for alcohol addiction	Hi #name! Your alcohol consumption is higher than average. Please contact a specialist service to help you reduce consumption from http://alkoinfo.ee/et/kust-saada-abi/kust-saada-nou-ja-abi
Health effects	Smoking	Hi #name! Try to replace at least two smoke breaks with a different activity today. For example, you could go running after school.
	Alcohol	Drinking alcohol at celebrations might feel compulsory. But alcohol doesn't make achievements better or more important, it is just an outdated habit.
Consumption guidelines	Alcohol	As a woman you should have several sober days a week and not consume more than 1-2 units of alcohol at any single drinking occasion.
Smoking/alcohol effects on stress, stress reduction methods	Smoking	When your responsibilities are piling up and you start getting tired and stressed, drink green tea. It helps keep you alert but does not include toxins like cigarettes do.
Role of smoking/alcohol in socialising	Alcohol	Estonia tends to have an inflexible socialising culture. Why don't you break the mold and make a point of talking to someone who doesn't drink at the next party?
Social pressure to smoke/drink alcohol in Estonia	Smoking	There is not a lot of freedom to be a nonsmoker in Estonia. We think it is our independent choice, but we are actually pressured by what is the norm in our social groups.
Autonomous decision making	Alcohol	We often think that if people view us a certain way, it cannot be changed. Make your own decisions and show others as well that you are growing and changing. It is possible!
Motivation	Smoking	Giving up smoking is difficult. But it doesn't have to be perfect on the first try. Allow yourself days when things do not go so well.
Saying no to parents	Alcohol	Hi #name! If your mother/father is drinking alcohol in your presence, invite them to drink tea with you instead. Then you can still do something together but it doesn't have to involve alcohol.
Saying no to friends	Smoking	If your friends offer you a cigarette, you can say, no thanks, maybe later. That way you don't have to say no, but you at least postpone the next offer.
Goal-setting	Alcohol	The longer you do not drink alcohol, the more your energy levels increase. Will you try to not drink in the next week? Answer 1=YES 2=NO
Action plan	Smoking	If you feel like having a cigarette, then try to distract yourself by calling a friend or going for a walk and wait until the craving has passed.
Self-theory change/maintenance	Alcohol	The fact that you are a drinker now doesn't have to continue; even this part of your identity can be changed.

Table 9. Message concepts and examples.

Developing autonomy-supportive content

In the development of this intervention, the combination of behaviour change theory, techniques, previous research and findings from the systematic review in Chapter 1 and the focus group study in Chapter 2 was aimed at developing autonomy-supportive intervention content. This was achieved by emphasising as often as possible the participants' freedom of choice in whether/how they decide to change their alcohol and/or tobacco consumption behaviours, to include content on the development of autonomy and identity in adolescence and young adulthood and to give examples of how choosing to consume alcohol/tobacco might not be an autonomous choice, but rather a result of imitating adults and peers alike who might exhibit these behaviours in the participants' social environment. This information is not covered in the Estonian school curriculum on alcohol and tobacco use or in the existing web-based information directed at adolescents and young adults.

Linking messages and algorithms

Once the content was written and tailored, the algorithm for linking the tailoring questionnaire to each individual type of user was created. This involved three stages of algorithms. Each question from the tailoring questionnaire was given response values and definitions. Based on these definitions, rules were written to direct participants to the different user profiles, labelled as 'Raw variables' (Figure 9). Based on the user profiles, further rules were written to define which specific messages should be sent to each user depending on every answer they gave in the tailoring questionnaire, labelled 'Intermediate variables' and 'Feedback variables' (Figures 10, 11). Feedback variables were the last step of the process linking messages and users, where the algorithm developed identified the specific message code of the message that the user should receive.

Variable name	Description	Possible values	
R_consumptionalcoholfrequency	How often do you have a drink containing alcohol?	1	Never
		2	Monthly or less
		3	2-4 times a month
		4	2-3 times a week
		5	4 or more times a week
		empty = not entered	
R_consumptionalcoholmonth	In the past month, how often have you consumed any alcoholic drinks?	1	Never
		2	Just a sip
		3	Once or twice
		4	Three or four times
		5	Weekly
		6	Once or twice a week
		7	Three or four times a week
		8	Four or five times a week
		9	Daily or almost daily
		empty = not entered	
R_consumptionalcoholday	How many alcoholic drinks do you typically consume on a typical drinking day?	1	0
		2	Just a sip
		3	1 or 2
		4	3 or 4
		5	5 or 6
		6	7, 8 or 9
		7	10 or more
		empty = not entered	
R_Consumptionbinge	How often do you have six or more drinks on one occasion?	1	Once a month
		2	Several times a month
		3	Once a week
		4	Several times a week
		5	Daily or almost daily

Figure 9. Raw variables of message algorithms.

Variable name	Description	Formula
I_consumptiondrink	Has the participant consumed alcohol at least once in the past month?	IF R_consumptionalcoholmonth > 3 INCLUDE
		IF R_consumptionalcoholmonth < 3 THEN DO NOT INCLUDE
I_consumptionsmoke	Has the participant consumed tobacco at least once in the past month?	IF R_consumptiontobaccomonth > 3 THEN INCLUDE
		IF R_consumptiontobaccomonth < 3 THEN DO NOT INCLUDE
I_consumptiondrinkdependencemen	Is participant dependent on alcohol? Yes (4) No (<4) in men	IF R_consumptionalcoholfrequency + R_consumptionalcoholday + R_Consumptionbinge >3 AND R_Gender = Mees THEN DEPENDENT
		IF R_consumptionalcoholfrequency + R_consumptionalcoholday + R_Consumptionbinge AND R_Gender = Mees THEN <4 NOT DEPENDENT
I_consumptiondrinkdependencewomen	Is participant dependent on alcohol? Yes (3) No (<3) in women	IF R_consumptionalcoholfrequency + R_consumptionalcoholday + R_Consumptionbinge >2 AND R_Gender = NAINE THEN DEPENDENT
		IF R_consumptionalcoholfrequency + R_consumptionalcoholday + R_Consumptionbinge AND R_Gender = NAINE THEN <3 NOT DEPENDENT
I_consumptionsmokeaddicted	Is participant addicted to nicotine? Very low dependence (1-2), lot to moderate dependence (3), moderate dependence (4), high dependence (5+)	IF R_consumptiontobaccoday + R_Consumptionsmokewakeup = 3 THEN DEPENDENT
		IF R_consumptiontobaccoday + R_Consumptionsmokewakeup <3 THEN NOT DEPENDENT
I_age	Is the participant an adolescent or young adult?	IF R_DOB <01.03.1998 THEN 12-18 AGE GROUP
		IF R_DOB >01.03.1998 THEN 19-25 AGE GROUP
I_consumptiondrinkreason	What reason best explains why the participant consumes alcohol?	IF R_Consumptiondrinkreason = 1 THEN STRESS
		IF R_Consumptiondrinkreason = 2 THEN SOCIAL
		IF R_Consumptiondrinkreason = 3 THEN PRESSURED
		IF R_Consumptiondrinkreason = 4 THEN JUST LIKE IT
I_consumptionsmokereason	What reason best explains why the participant smokes cigarettes?	IF R_Consumptionsmokereason = 1 THEN STRESS
		IF R_Consumptionsmokereason = 2 THEN SOCIAL
		IF R_Consumptionsmokereason = 3 THEN PRESSURED
		IF R_Consumptionsmokereason = 4 THEN JUST LIKE IT

Figure 10. Intermediate variables of message algorithms.

Variable name	Description	Algorithm
F_Introduction	Which introduction message is received on Day 1 of the programme.	IF I_consumptiondrink = INCLUDE, THEN INTRODUCTION 1
		IF I_consumptionsmoke = INCLUDE, THEN INTRODUCTION 2
		IF I_consumptiondrink AND I_consumptionsmoke = INCLUDE THEN INTRODUCTION 3
F_Dependence	Does participant get message about nicotine addiction or a referral message for alcohol dependence support? Does participant get message about health effects of smoking or guidelines to stick to when drinking alcohol?	IF I_consumptiondrinkdependencemen = DEPENDENT THEN daamy
		IF I_consumptiondrinkdependencemen = NOT DEPENDENT THEN dnaamy
		IF I_consumptiondrinkdependencewomen = DEPENDENT THEN daafy
		IF I_consumptiondrinkdependencewomen = NOT DEPENDENT THEN dnaafy
		IF I_consumptionsmokeaddicted = DEPENDENT AND I_gender = MALE THEN dacmy
		IF I_consumptionsmokeaddicted = NOT DEPENDENT AND I_gender = MALE THEN dnacmy
		IF I_consumptionsmokeaddicted = DEPENDENT AND I_gender = FEMALE THEN dacfy
		IF I_consumptionsmokeaddicted = NOT DEPENDENT AND I_gender = FEMALE THEN dnacfy
F_Outcomeexpectancy	Does participant get messages about the effect of smoking and/or drinking on stress, socialising, feeling pressured or liking it?	IF I_consumptiondrinkreason = STRESS AND I_age = 12-18 AGE GROUP AND I_consumptiondrink = INCLUDE THEN oesay
		IF I_consumptiondrinkreason = STRESS AND I_age = 19-25 AGE GROUP AND I_consumptiondrink = INCLUDE THEN oesao
		IF I_consumptiondrinkreason = SOCIAL AND I_age = 12-18 AGE GROUP AND I_consumptiondrink = INCLUDE THEN oesocay
		IF I_consumptiondrinkreason = SOCIAL AND I_age = 19-25 AGE GROUP AND I_consumptiondrink = INCLUDE THEN oesocao
		IF I_consumptiondrinkreason = PRESSURED AND I_age = 12-18 AGE GROUP AND I_consumptiondrink = INCLUDE THEN oepreay
		IF I_consumptiondrinkreason = PRESSURED AND I_age = 19-25 AGE GROUP AND I_consumptiondrink = INCLUDE THEN oepreao
		IF I_consumptiondrinkreason = JUST LIKE IT AND I_age = 12-18 AGE GROUP AND I_consumptiondrink = INCLUDE THEN oelikeay
		IF I_consumptiondrinkreason = JUST LIKE IT AND I_age = 19-25 AGE GROUP AND I_consumptiondrink = INCLUDE THEN oelikeao
		IF I_consumptionsmokereason = STRESS AND I_age = 12-18 AGE GROUP AND I_consumptionsmoke = INCLUDE THEN oescy
		IF I_consumptionsmokereason = STRESS AND I_age = 19-25 AGE GROUP AND I_consumptionsmoke = INCLUDE THEN oesco
		IF I_consumptionsmokereason = SOCIAL AND I_age = 12-18 AGE GROUP AND I_consumptionsmoke = INCLUDE THEN oesoccy
		IF I_consumptionsmokereason = SOCIAL AND I_age = 19-25 AGE GROUP AND I_consumptionsmoke = INCLUDE THEN oesocco
		IF I_consumptionsmokereason = PRESSURED AND I_age = 12-18 AGE GROUP AND I_consumptionsmoke = INCLUDE THEN oeprecy
		IF I_consumptionsmokereason = PRESSURED AND I_age = 19-25 AGE GROUP AND I_consumptionsmoke = INCLUDE THEN oepreco
		IF I_consumptionsmokereason = JUST LIKE IT AND I_age = 12-18 AGE GROUP AND I_consumptionsmoke = INCLUDE THEN oelikecy
		IF I_consumptionsmokereason = JUST LIKE IT AND I_age = 19-25 AGE GROUP AND I_consumptionsmoke = INCLUDE THEN oelikeco

Figure 11. Feedback variables of message algorithms.

Creating the tailoring program

The developer involved in the project created a website linked to a mobile phone text messaging program by using the algorithms written by me and the message content written by me and edited together with the intervention development group. This linking process involved taking the items from the tailoring questionnaire and programming the algorithms written by me to be associated with specific message content. This then meant that anyone filling in the tailoring questionnaire would receive message content on the website and via mobile phone text messaging according to which answers they gave in the tailoring questionnaire.

Implementing a tailored health communication program

The eigth and ninth steps in the Kreuter et al. (2012) text on creating tailored health computer-based programs are aimed at instructing how to effectively implement and evaluate the program. These steps will be described and discussed in Chapter 5 of this thesis.

RESULTS

Naming the program

The name MyOwnMe was chosen for the program, to emphasise autonomous decision-making in participants.

Logo design

A design student from the Estonian Academy of Art designed a logo for the program based on the Estonian translation of MyOwnMe which is 'Oma Mina'. Figure 12 illustrates the Estonian language logo for the MyOwnMe intervention program.

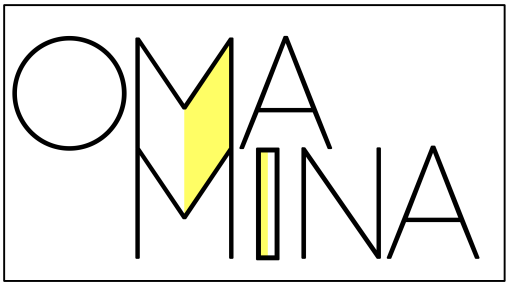

Figure 12. Logo designed in Estonian for the MyOwnMe intervention program by Kermo Aruoja, a design student at the Estonian Academy of Art.

Intervention description

A Worpress hosted website was created and linked to the Twilio text messaging service. This is a plugin in Wordpress, which can send and receive mobile phone text messages in Estonia as well as many other countries. A description of the topics covered, behaviour change techniques applied and goal-setting exercises used can be viewed in Table 10.

Intended users

The intervention is intended for users who are current consumers of either alcohol and/or tobacco, 12-25 years of age and Estonian language speakers. Users do not have to state an intention to quit smoking and/or reduce their alcohol consumption.

Website

The website was tailored to two age groups, 12-18-year-olds and 19-25-year-olds. This was to reflect the differing experiences of school versus university students and to allow for age-appropriate examples and in-text references. It was also tailored to four types of alcohol and tobacco outcome expectancies: fitting in with peers (Kuntsche et al., 2004; Tomkins, 1966), stress reduction (Urban, 2010; Shadel & Mermelstein, 1993), desiring general social acceptance (Kuntsche et al., 2005) or expecting enjoyment (Kuntsche et al., 2005). In the tailoring questionnaire participants indicate the reason they usually drink and/or smoke, choosing one out of four options:

1. Drinking alcohol and/or smoking cigarettes to help deal with stress.
2. Drinking alcohol and/or smoking cigarettes to be social.
3. Drinking alcohol and/or smoking cigarettes because of feeling pressured by those around you.
4. Drinking alcohol and/or smoking cigarettes because it is enjoyable.

The website is designed to be engaged with over a period of four weeks and is divided into four parts: an introduction page, a page on habit formation, a page on autonomy development and a conclusion page. The autonomy development page (labelled as 'My Story' in the website) differs the most depending on the outcome expectancy profile of the user. For example, a user who has identified that they expect their alcohol consumption to reduce stress will receive different information in the autonomy development page than a user who has identified that they expect their alcohol consumption to facilitate socialising. The rest of the website pages have less variation depending on outcome expectancy profile. Examples of web pages can be viewed in Appendix 7.

Participants can enter the MyOwnMe website on the home screen, where they can register to be a user. Once the registration is complete, they are directed to the online tailoring assessment questionnaire, which then opens the appropriate website content to them, tailored to their age and outcome expectancy profile. There are goal-setting exercises on each page of the website to help participants determine differences in their behaviour in different social contexts, practise saying

'no' to alcohol and cigarettes and set goals to change their alcohol consumption and cigarette smoking habits.

In total, 55 units of website content were written.

Mobile phone text messages

Text messages sent to the participants' mobile phones are linked to the website and these serve the functions of reminding participants what they have read on the website, providing additional information relating to the website content and facilitating goal-setting for the habits the participants have indicated they wanted to develop and the change in behaviour they want to achieve.

Twice daily text messages are sent from the website based on user preferences indicated in the tailoring assessment questionnaire. The messages start on the same day that the user is e-mailed the weblink to the MyOwnMe web portal. Two-way text messages are included for weekly alcohol consumption reduction and smoking cessation support, asking participants whether they have reduced/quit in the past week. Participants can reply yes/no to these messages, based on which messages will be sent encouraging them to continue reduction/quit behaviour for another week or set a goal for the next week if participants have consumed alcohol or tobacco. Text messages will also be used to remind participants to engage with the website content, as will e-mail reminders. Text messages serve as a data collection tool as well as providing additional information and skill development opportunities for all users. Text messages were tailored to the same age categories and outcome expectancy profiles as the website, but the text messages were also tailored to all 15 tailoring variables identified in the previous section of this Chapter using tailoring matrices which can be viewed in Appendix 9.

In total 1528 text messages were written.

Intervention component	Objective	BCTs used	Topics covered	Goal-setting exercises
Website	Facilitate understanding of consequences of alcohol and tobacco consumption Facilitate autonomous decision making Facilitate increase in refusal self-efficacy Facilitate autonomy development Facilitate habit formation	• Reframing • Provide information about others' approval • Self-affirmation • Identity associated with changed behaviour • Identify reasons for wanting and not wanting to reduce excessive alcohol consumption and cigarette smoking • Emphasise choice • Boost motivation and self-efficacy • General communication skills • Instruction on how to perform a behaviour • Facilitate goal setting • Give options for additional and later support	• Adolescence and young adulthood as a period of exploration and growth. • Introduction to effects of social context on habits. • Stress management techniques • Socialising skill development • Increasing motivation to change • Increasing refusal self-efficacy • Identity development • Autonomy development • How does social context affect identity development? • What are habits? • How are habits formed? • Effects of nicotine and/or alcohol on brain development • Additional support options	• Practising a new skill without consuming alcohol or tobacco • Socialising without consuming alcohol or tobacco • Reducing stress without consuming alcohol or tobacco • Saying 'no' to offers of alcohol and/or tobacco • Forming a habit of not consuming alcohol and/or tobacco
Text Messages	Facilitate increase in refusal self-efficacy skills Facilitate understanding of consequences of alcohol and tobacco consumption Increase motivation for behaviour change Facilitate skills for handling social adversity Facilitate habit formation	• Boost motivation and self-efficacy • Provide normative information about others' behaviour and experiences • Provide information on consequences of excessive consumption • Emphasise choice • Boost motivation and self-efficacy • Reframing • Prompt review of goals • Provide feedback on performance • Provide information on withdrawal symptoms	• Refusal self-efficacy support • Tackling myths about outcomes of alcohol and tobacco consumption on socialising, stress, peer acceptance. • Motivation to make decisions independent of social context • Facilitating beliefs in personal change being possible • Developing socialising skills to handle social adversity. • Weekly quit/reduction support	

Table 10. Intervention structure and content linked to program objectives and BCTs to achieve them.

DISCUSSION

In this study, the process of developing a tailored digital intervention to reduce Estonian adolescent and young adult alcohol and tobacco consumption was described. The guidance on tailoring health messages by Kreuter et al. (2012) and participatory design, an iterative process of co-development with program users, were used to write the content of the intervention. The developed intervention, called MyOwnMe, is based on the Social Cognitive Theory of behaviour (Bandura, 1977), the Self-Determination Theory of motivation (Deci & Ryan, 2008) and implicit self-theories of learning (Dweck, 2000). The intervention content is described in terms of the behaviour change techniques for alcohol and tobacco consumption identified by Michie et al. (2011; 2012) and the full behaviour change taxonomy (Abraham & Michie, 2008). Tailoring was used to enhance the personal relevance of intervention content to each individual user. With the input from two adolescents and one young adult recruited into the intervention development process, all the content created for the MyOwnMe program aims for an autonomy-supportive health communication style, emphasising the freedom of the participants to choose whether and how to change their alcohol and tobacco consumption behaviours.

Strengths

This is the first digital individually tailored intervention to be developed for and by Estonian adolescents and young adults. As far as I am aware, this is one of two existing studies that have used participatory design to develop a digital intervention program targeting adolescents and young adult tobacco consumption and the only one to target adolescent and young adult alcohol consumption. The use of a participatory design ensured insights into the type of information and use of vocabulary that might be construed as autonomy-supportive by the users, an important consideration with adolescent and young adult intervention participants (Miller et al., 2007). Another strength of this development process was the use of the experiential information shared by the focus group participants in Chapter 2 and the adolescents and young adult involved in intervention development on their experiences of consuming alcohol and tobacco. This

experiential information could be used as a story-telling technique in examples of alcohol and tobacco consumption situations presented in the intervention, a technique which has also been associated with intervention effectiveness (Kreps & Neuhauser, 2010). MyOwnMe is based on behaviour change theory, behaviour change techniques and determinants of adolescent and young adult alcohol and tobacco consumption shown to be associated with intervention effectiveness (Wangberg et al., 2011).

Limitations

The development of MyOwnMe did not include any organisations likely to implement the program in the future, which has been shown to also impact digital intervention effectiveness (Craig et al., 2008). The intervention development team did not include a user interface designer, which limited the aesthetic appeal that could be achieved in the website component of the intervention, but it has been shown that adolescents and young adults might in any case prefer a simpler website design, if the content is relevant to them (Nielsen & Loranger, 2013).

A limitation of using the Kreuter et al. (2012) approach to intervention development was the lack of guidance on developing interventions that target multiple behaviours. Tailored digital interventions targeting multiple behaviours risk overburdening the participants especially in terms of the length of the tailoring questionnaire as well as the amount of information delivered in the intervention itself (Prochaska et al., 2008). This is especially the case with users in the adolescent and young adult age groups, who are increasingly using programs with ever-shorter activity spans, e.g. Snapchat (Chew, 2016). To overcome this challenge of multiple behaviour change interventions, the content of MyOwnMe attempted to find the common underlying determinants of adolescent and young adult alcohol and tobacco consumption and develop the content based on these, switching between the words "alcohol" and "tobacco" to hone in on individual behaviour. As of yet, no intervention development frameworks exist to specifically guide the development of multiple behaviour change interventions. This presented a challenge for the intervention development process in this research.

There are also no existing frameworks that specifically guide the development of interventions for adolescents and young adults. This is an area that warrants further research, as the requirements and preferences of adolescents and young adults are quite different from adults and thus might require a different approach to intervention development (Mandel & Qazilbash, 2005; Harvey et al., 2008). One feature that would be beneficial to include in the development of such a framework might be the inclusion of adolescents and young adults in the intervention development process to ensure autonomy-supportive intervention content. In the current research, the limitation with the adolescents and young adults recruited into the intervention development process was that they represented the more active, autonomously motivated and involved groups of adolescents and young adults, being a part of many different youth related projects, startups and youth government. Adolescents and young adults representing the less autonomously motivated adolescents and young adults might have added unforeseen insights to the intervention content to make it more appealing to such individuals.

Issues in the development process

There were a number of unforeseen issues that arose in the development process which will be described and discussed here in the interest of aiding the work of other researchers developing similar interventions.

Due to the financial constraints of this research project, there was a lack of software development and management expertise involved in the intervention development process. It was difficult to find an experienced software developer for the budget that was set aside for building the intervention, meaning that a less experienced developer was hired. This meant that the development process took longer than was expected, which reduced the time available for the testing of the intervention and for running a pilot study on it. Due to the lack of time for pre-study testing, the technical errors still present in the intervention at the beginning of the pilot study meant that some of the first participants to enter the online platform could not register their profiles and were lost to the study. The longer development period also resulted in the first recruitment phase being conducted too early and the participants recruited being lost to having had to wait for too long to be able to start their participation in the pilot study. Fifteen

participants were recruited into the pilot study in the first phase of recruitment, but only two of those fifteen participated in the pilot study, as they were willing to wait for the delayed development process to be completed. During the running of the pilot study, the programmer who had been hired to work on this intervention unexpectedly quit, leaving a situation where the technical errors which arose during the study had to be fixed by me. Having no computer programming expertise, these fixes took me several days, during which more participants were lost from the study. The experience of this intervention was likely to be less engaging and simple to use than expected by the participants, which might have limited the accuracy of the data collected during the pilot study and thus the conclusions which may be drawn.

Such issues with planning the scope of the software development work required for developing digital behaviour change interventions might be lessened by including more multidisciplinary expertise from the discipline of computer science in the research team (van Gemert-Pijnen et al., 2011). This would bring more experience in the management of software development projects and might aid in their timely and accurate delivery. Design expertise might also be useful to include in digital intervention development teams to increase the appeal of the user interface and improve the experience of using the program, which might increase engagement beyond what the content of the intervention can do (Anderson et al., 2016).

The issues encountered in the development of this intervention might be useful in a general discussion on the process of digital technology development in a research environment in terms of the expertise required in the development team as well as the centrality of the user interface in engaging users. These topics will be discussed in detail in Chapter 6 of this thesis.

Conclusions

Estonian adolescent and young adult alcohol and tobacco consumption is initiated early and requires early intervention. Digital interventions might be appealing to Estonian adolescents and young adults. A digital intervention aiming to reduce Estonian adolescent and young adult alcohol and tobacco consumption was developed using participatory design and Kreuter et al.'s (2012) framework for developing tailored computer-delivered interventions. A website linked to a mobile phone text messaging intervention was developed.

CHAPTER 5
Digital intervention for reducing Estonian adolescent and young adult alcohol and tobacco consumption: a randomised controlled pilot study

ABSTRACT

Background

Adolescent and young adult alcohol and tobacco consumption predict negative health outcomes throughout the lifecourse, thus early intervention is imperative. This study aimed to assess the feasibility, acceptability and estimate the short-term efficacy of a digital intervention for reducing Estonian adolescent and young adult alcohol and tobacco consumption.

Method

A total of 22 adolescents and young adults aged 15-24 were randomised to use MyOwnMe with usual care or a usual care control group. Feasibility outcomes were measures of recruitment, uptake, use and retention and acceptability measures of ease of understanding intervention content, interactivity, intervention length, clarity of behaviour change information and likeability of design. Behavioural outcomes were monthly alcohol consumption and cigarette smoking measured by single item self-report. Analysis of covariance was used to assess continuous and risk ratio in dichotomous outcomes. Intention-to-treat principles were applied in the analysis.

Results

The intervention was feasible to implement in Estonia and the web content was easy to understand and appealing to the target group. The text messages were not read by participants. No difference was found between the intervention and control group in alcohol (mean difference = -0.2 95% CI (-0.9, 0.6), p = 0.62) or tobacco consumption (30-day abstinence from cigarette smoking RR = 1.25, 95% CI (0.81, 1.94)) after the 8-week study period.

Discussion

A web and mobile phone text messaging intervention was found to be feasible to implement and acceptable to Estonian adolescents and young adults, but further technical development is needed before a larger cost-effectiveness trial can be conducted.

BACKGROUND

Digital interventions, which are delivered through web and mobile phone technologies, might be appealing to adolescent and young adult users as their first-choice information source for health topics is the Internet (Bernhardt & Hubley, 2001), but so far engagement with such interventions has been low (Curry et al., 2007; Eysenbach et al., 2005; Crutzen et al., 2011; Skinner et al., 2003). Low engagement rates might be explained by the lack of content that is personally relevant to adolescents and young adults (Crutzen et al., 2011). Adolescence and young adulthood is characterised by an increase in autonomy from parents and other authority figures (Fuligni & Eccles, 1993; Siegel, 2013). Autonomy-supportive health communications might be more persuasive to adolescents and young adults than information about the negative health consequences of alcohol and tobacco consumption (Miller et al., 2007). There might also be a lack of sociocultural context-specific information in existing intervention programs, rendering the content less persuasive (Eysenbach, 2008).

A digital intervention, called MyOwnMe and comprising of a website linked to a mobile phone text messaging program, has been developed to reduce Estonian adolescent and young adult alcohol and tobacco consumption. The acceptability, feasibility and short-term efficacy of this intervention now needs to be determined to inform a larger cost-effectiveness trial (Craig et al., 2008). This pilot trial is one stage of the general process of developing, testing and evaluating complex interventions aiming to change health behaviour, as outlined by the Medical Research Council (Craig et al., 2008).

Trial objectives:

The objectives of this pilot trial are:

1. To assess the feasibility of conducting a future cost-effectiveness trial of the web and mobile phone intervention.
2. To assess the acceptability of the web and mobile phone intervention among Estonian adolescents and young adults.

3. To estimate the short-term effectiveness of the intervention with existing web-based information in decreasing the number of alcoholic drinks consumed in the past 30 days and increasing 7-day point prevalence abstinence from cigarette smoking.

METHOD

Design

This study had a two-arm parallel group randomised controlled trial (RCT) design with 1:1 individual allocation comparing existing web-based health information on the risks of alcohol consumption and cigarette smoking (Control) with existing web-based information plus the MyOwnMe program (Intervention).

Participants

Participants were eligible for inclusion if they met all the following criteria: were Estonian citizens, Estonian language speakers, 12-25 years of age, had smoked one cigarette and/or consumed one alcoholic drink in the past month, consented to participate in the study and, if under the age of 18, also provided parental/legal guardian consent to participate. Participants were included in the study regardless of their intention to change alcohol and/or tobacco consumption behaviour. Participants were also included in the study regardless of their motivation to change their alcohol and/or tobacco consumption behaviour.

Participants were excluded if they were under the age of 18 and did not provide parental consent to participate in the study and if they had smoked less than one cigarette in the past month and/or consumed less than one alcoholic drink in the past month. Participants were also excluded if their alcohol consumption exceeded the AUDIT questionnaire's score of 8, which is associated with hazardous and harmful drinking (Conigrave et al., 1995). If this was found to be the case, the participant was referred on to specialist addiction disorder services in Tallinn, Estonia.

Recruitment channels

Participants were adolescents and young adults from Estonia. The aim was to recruit 100 participants, with 50 in the intervention group and 50 in the control group. This was calculated to be an adequate sample size to estimate relevant proportions (e.g. uptake of the intervention, follow-up rate) with the required precision. For example, with this sample size, a follow-up rate observed in the range 70% to 90% would have a 95% CI width of between +/-6% and +/-9%. Participants were recruited through two recruitment channels:

1. **In-person recruitment:** I personally visited two schools and two universities in Estonia, who had agreed to participate in the study. I gave one presentation in each school to classes of 20-30 students in order to introduce the study to students and inform them of the opportunity to participate. I also left promotional materials such as posters and leaflets with the invitation to participate and contact details for potential participants to be able to get in contact and express interest in the study. In total, 19 adolescents and young adults contacted me via e-mail, because they had either seen one of the presentations or a study poster in their schools and were interested in the study. Leaflets were also left in 10 popular cafes in the city centre of Tallinn, where event posters and flyers are left and where adolescents and young adults often spend their free time. No adolescents or young adults contacted me after having seen one of the flyers in the cafes. The members of the intervention development group also introduced the study in person to their friends and acquaintances who were of appropriate age. Five adolescents and young adults contacted me about participating in the study as a result of invitations from the intervention development group.
2. **Online recruitment:** I also contacted potential participants via e-mail received from teachers in schools, other than the in-person recruitment schools, and Facebook, where three student organisations, the Estonian Youth Organisations Association, the University of Tartu Student Association and a youth centre based in the South of Estonia, were contacted to advertise the study. I was also referred to 20 adolescents through three high school teachers and one basketball coach, who happened upon one of the Facebook advertisements about the study and who contacted me themselves. The study advertisement on Facebook reached 1877 people and was shared 13 times onto other

Facebook sites. Despite such a wide online reach, I was only contacted by 20 adolescents and young adults who were interested in the study through Facebook.

Control condition

The control intervention involved being e-mailed a link to the existing websites on the health effects of alcohol consumption and tobacco smoking, designed by the Institute of Public Health, a sub-branch of the Ministry of Social Affairs in Estonia. The websites on both substances were redesigned and relaunched in 2015 and cover information targeting refusal self-efficacy in addition to the traditional medical information on the health effects of consuming alcohol and/or tobacco. Refusal self-efficacy is also one of the components of the MyOwnMe intervention, except it is delivered through individually-tailored messages directly to the user's personal mobile phone. The existing web-based information provides a suitable control group, as this is most indicative of the information Estonian adolescents and young adults might find online on their own and reflects the curriculum on substance use and addiction which they have already been introduced to in school. The existing websites are thus useful as a 'usual care' comparison group. The control group participants were invited to peruse this web content in their own time.

Intervention condition

MyOwnMe is based on the Social Cognitive Theory (Bandura, 1977), Self-Determination Theory (Deci & Ryan, 2008) and implicit self-theories (Dweck, 2000). Intervention content aims to increase participants' refusal self-efficacy skills, autonomous motivation, ability to overcome social adversity and reduce positive outcome expectations for alcohol and tobacco use. The intervention utilises the following behaviour change techniques: reframing, providing information about others' approval, self-affirmation, identity associated with changed behaviour, identifying reasons for wanting and not wanting to reduce excessive alcohol consumption and/or cigarette smoking, emphasising choice, boosting motivation and self-efficacy, general communication skills, instruction on how to perform a behaviour, facilitating goal setting, giving options for additional and later support, providing normative information about others' behaviour and experiences, providing information on the consequences of excessive consumption,

prompting review of goals, providing feedback on performance, providing information on withdrawal symptoms.

MyOwnMe consists of a website containing information on adolescent brain development, habit development, autonomy development, alcohol consumption and cigarette smoking culture in Estonia, and overcoming social adversity in peer contexts. In addition, the intervention group was also e-mailed links to the national websites on the harms of alcohol consumption and cigarette smoking developed by the Estonian Ministry for Social Affairs. The web and text message support lasted for four weeks with two text messages a day sent during these weeks (70 messages sent to each participant). MyOwnMe was not aimed at giving adolescents and young adults a comprehensive overview of the risks associated with alcohol and tobacco consumption, but to complement existing web content already delivering risk-based information with a more skill-based element of changing consumption habits.

Recruitment procedure and baseline measurement

Potential participants filled in an online screening questionnaire determining their current status as alcohol consumers and/or cigarette smokers. If they indicated consumption of either or both substance at least once in the past month, they were invited to participate in the study via e-mail, where an attachment to the participant information sheet and participant consent form was shared. If the participants continued to be interested in the study based on the information sheet, they were asked to consent to participating in the study. Once consent had been indicated, the participant was randomised into either the intervention group or the existing web-based information control group using a randomisation sequence generated in the statistical software programme Microsoft Excel. Simple randomisation was used to allocate participants to either the intervention or the control group. I randomised participants manually to each group using the randomisation sequence generated in Excel. The intervention group was e-mailed the link to the MyOwnMe web environment and the existing websites designed by the Estonian Ministry for Social Affairs. The participants created a user profile with a personal username and password in this environment to gain access to the intervention content. The participant then filled in the online baseline questionnaire including tailoring questions, based on which the web and mobile

phone program was tailored to their individual characteristics. Demographic information as well as past alcohol consumption and cigarette smoking was measured in the baseline questionnaire, which can be viewed in Appendices 11 (intervention group) and 12 (control group).

The control group was e-mailed a link to the online baseline questionnaire, which was a Google Form document. The control group participants were also e-mailed links to the existing websites designed by the Estonian Ministry for Social Affairs only.

At four weeks after baseline, all participants were invited by e-mail to fill in the online follow-up questionnaire which included the same questions as the baseline questionnaire, with an addition of program acceptability questions.

Outcome Measures

Feasibility

Measures to assess recruitment, uptake, use and retention included: (1) participation rate (the proportion of eligible patients who agree to take part) (Sutton et al., 2013); (2) the proportion of participants in the intervention group who created a user profile in the MyOwnMe web environment (uptake rate); (3) the proportion of participants in the intervention group who use the programme for one week, 3 weeks and 5 weeks; (4) the proportion of participants who complete the follow-up questionnaire and provide complete outcome measures; and (5) reasons for loss to follow-up (Lillevoll et al., 2014).

Acceptability

A 14-item self-report measure was used to assess: 1) whether intervention content was easy to understand in both the web pages and the mobile phone text messages, 2) whether intervention content was interactive enough, 3) whether intervention length was appropriate, 4) whether there were clear instructions on changing habits, and 5) whether the design of the program was likeable (Berg, 2012). These items were scored with yes/no responses.

Behavioural outcomes

Alcohol consumption was measured using self-report of number of drinking occasions in the past 30 days. Tobacco consumption was measured using self-report of 30-day abstinence from cigarette smoking. These measures are most commonly used in multiple health behaviour change intervention trials as well as large national and international surveys of adolescents and young adults and capture social alcohol and tobacco consumers as well as those who consume more frequently (Palinkas et al., 1996; An et al., 2013; Werch et al., 2011; Grossbard et al., 2010; Bachman et al., 2006).

Cognitive outcomes

Theoretical constructs which the MyOwnMe intervention was designed with and which have been found to be cognitive determinants of adolescent and young adult alcohol and tobacco consumption were also assessed. Refusal self-efficacy, autonomous motivation, self-theory and outcome expectancies were measured with the self-report questionnaires described in Table 11.

Outcome measured	Adapted from	Reliability/ Validity	Description of measurement tool	Items used in this study	Scoring of measurement tool
Outcome expectancies	Hine et al., 2007	Hine et al., 2007	43-item self-report	All	9-point scale where 0 = Completely unlikely, 9 = Completely likely
Refusal self-efficacy	Oei et al., 2005	Young et al., 2007	31-item self-report	'When someone offers me a drink, it is difficult for me to say no' 'When someone offers me a cigarette, it is difficult for me to say no'	6-point Likert-type scale, 1 = Never true, 6 = Always true
Autonomous motivation	Ryan & Connell, 1989	Levesque et al., 2007	19-item self-report	'Quitting alcohol consumption is a choice I would like to make for myself.' 'Reducing my alcohol consumption is a choice I would like to make for myself.' 'Quitting smoking is a choice I would like to make for myself.'	7-point Likert-type scale, 1 = not at all true, 7 = very true
Implicit Self-theories	Yeager et al., 2011	None available	6-item self-report	'To what extent do you think you could change your own personality?'	6-point Likert-type scale, 1= I definitely cannot, 6 = I definitely can

Table 11. Pilot study outcome measurement tools and scoring.

Study Procedure

The study took place in the MyOwnMe online environment and the mobile phones of the study participants. This entailed a website where users had personal profiles as well as receiving text messages on their mobile phones from the web platform. The intervention was hosted by Wordpress and the mobile phone text messages were delivered by the Twilio messaging service linked to Wordpress. Data was collected at baseline and week 4 post-intervention through online and e-mailed forms and was stored and analysed on a password protected computer located at the University of Cambridge.

Consent from participants:

Written informed consent was obtained from all participants. Participants were given a choice of receiving consent forms and information sheets via post or e-mail. The information sheet explained the aims and methods of the study and highlighted that participation was entirely voluntary and could be stopped at any time. E-mailed consent forms were electronically signed by the participants with their Estonian ID cards, which encrypt the signed file so that only the individual signing and the person they give viewing permission to are able to view the contents of the file. Only individuals with Estonian ID cards can be given viewing permissions. As an Estonian national, I was able to view the consent forms. Consent forms sent via post included a prepaid envelope. Participants signed the consent form manually and were able to post it using the prepaid envelope. Participants in the age range 12-17 were sent a consent form and information sheet adjusted to their reading level and consent was also required from their parent or legal guardian. According to Estonian law, individuals under the age of 18 need parental consent in addition to their own consent and parents have to be notified of any substance use that their child might be engaging in.

Parental consent for participants under the age of 18:

Parental consent was obtained for participants under the age of 18. Parents and legal guardians were also given a choice of indicating consent using their Estonian ID cards or with a manually signed form sent back to the investigator using a prepaid envelope via post. Parents and legal guardians were supplied with a study information sheet similar to that of the participants. Participants under the age of 18 were not able to join the study before receiving parental consent.

The participants were debriefed at the end of the study, and the debrief information was sent to participants via e-mail. Debriefing information included contact details of smoking cessation and alcohol use counselling services for young people in Estonia as well as school counsellors the participants could turn to, should they have any negative experiences arising as a result of taking part in the study. The contact details of me and my supervisors were also repeated on the debrief form.

During the study, the data were collected and stored on the Wordpress admin panel, from which it was exported into Excel files and saved onto a University of Cambridge server. Once the study had finished the data was only accessed by me and my supervisors. According to the Medical Research Council data management requirements, the anonymised and computerised data will be retained for 10 years following the completion of the study. Parts of the data were shared with my supervisors when data analysis required specific datapoints to be discussed.

Randomisation and blinding

A random sequence was generated by me using the RAND function in the Microsoft Excel programme. I also enrolled participants and assigned them to study groups. Neither participants nor researchers could be blinded to study group assignment due to lack of Estonian-speaking people in the research team. An explanation of the study procedure, hyperlinks to online intervention content and online usual care content were sent to participants via e-mail.

Data analysis

All analyses were conducted using an intention-to-treat approach, where data were included from all participants. Missing data at the 1-month follow-up were imputed from the baseline data by carrying the last observation forward (Julious & Mullee, 2008). For the feasibility and acceptability outcomes, percentages and 95% confidence intervals were calculated based on intervention program usage data derived from usage statistics provided by Wordpress and rates of replies received for follow-up questionnaires from participants. Acceptability data from the follow-up self-report questionnaire were used to calculate percentages and 95% confidence intervals. The continuous outcomes of refusal self-efficacy, autonomous motivation, self-theories, outcome expectations and number of drinking occasions in the past 30 days was analysed with analysis of covariance (ANCOVA) with the baseline data as the covariates. Statistics of means and standard deviations were calculated for these continuous measures. Before the ANCOVA was conducted, tests to check that the data meets the linearity, homogeneity of regression slopes, normal distribution, homoscedasticity and no significant

outlier assumptions were conducted. Outliers were defined as standardised residuals, where the score is greater than ±3 standard deviations. The data was shown to meet these assumptions.

The dichotomous tobacco consumption outcome of smoking/abstinent was analysed with intention-to-treat analyses and using a relative risk analysis in 2x2 tables, recommended to determine the effect size of dichotomous variables in randomised controlled trials (Laerd Statistics, 2013). The data was tested and found to meet the necessary assumptions of having a dichotomous independent variable and a dichotomous dependent variable, independence of observations and a randomised controlled trial study design.

SPSS Statistics version 24 was used for all analyses (IBM).

Ethical concerns

Participation in this pilot study was not expected to be a negative experience for participants. Participants were able to withdraw from the study at any point if they wished to do so. Participants were given a thorough explanation that their participation was entirely voluntary. They were told that the personal information collected, such as participant names and mobile phone numbers, would be kept confidential and the data collected was link-anonymised. The participants were informed of this in the participant information sheet. For participants under the age of 18, a concern might be confidentiality about their alcohol consumption and/or cigarette smoking behaviours from their parent or legal guardian, who approved them to participate in the study. According to Estonian law, parents or legal guardians of individuals under the age of 18 must be notified of any substance use identified. Participants under the age of 18 were notified of this confidentiality concern in their information sheet before they consented to participation as well as in the debrief sheet if they chose to participate anyway. As this is usual procedure in Estonia for minors who consume alcohol and/or smoke cigarettes, I did not expect this law to be a major barrier to participation for younger adolescents.

Funding

This research was funded by the Medical Research Council (UK) and Sihtasutus Archimedes (Estonia).

RESULTS

Participant characteristics

From 22 study participants, 7 were allocated to the control and 15 to the intervention group. The baseline characteristics of the participants in each group are displayed in Table 12. No participants were identified as having an AUDIT score of 8 or more, thus no participants were referred on to specialist alcohol disorder treatment services.

	Control group (n=7)	Intervention group (n=15)
Female, n (%)	6, 85%	7, 47%
Age, M (SD)	20 (2.8)	20 (2.4)
Age, range	15-24	16-24
Number of alcohol consumers	7	14
Number of cigarette smokers	2	5
Motivation to quit alcohol (M, SD)*	4.1 (1.6)	3.3 (2.4)
Motivation to reduce alcohol (M, SD)**	4.3 (2.8)	4.8 (2.9)
Motivation to quit smoking (M, SD)***	3.9 (2.9)	3.1 (2.6)
Number of drinking occasions in past month (M, SD)****	3.4 (1.3)	3.1 (3.6)
Number of smoking occasions in past month (M, SD)*****	3.3 (3.9)	1.7 (2.0)

Table 12. Pilot study participant characteristics at baseline.

Legend:

*** In response to the statement 'Quitting alcohol consumption is a choice I would like to make for myself.' Measured on a Likert-type scale, where 1 = not true at all and 7 = very true.**
**** In response to the statement 'Reducing my alcohol consumption is a choice I would like to make for myself'. Measured on a Likert-type scale, where 1 = not true at all and 7 = very true.**
*****In response to the statement 'Quitting smoking is a choice I would like to make for myself'. Measured on a Likert-type scale, where 1 = not true at all and 7 = very true.**
****** In response to the question 'On how many occasions in the past 30 days, did you consume alcohol?'. Measured on a Likert-type scale, where 1 = not once and 7 = every day or almost every day.**
******* In response to the question 'On how many occasions in the past 30 days, did you consume tobacco?'. Measured on a Likert-type scale, where 1 = not once and 7 = every day or almost every day.**

Participants in both intervention and control groups were of similar average age (20 years old), but there were many more females in the control than the intervention group (85% versus 47%). Most participants in both groups were only alcohol consumers, the second most common behaviour was to consume both alcohol and tobacco and the least common behaviour was only

consuming tobacco, with just one participant across groups who was a cigarette smoker but not an alcohol consumer.

Participation and program use

The flow of participants is illustrated in Figure 13. Recruitment of participants started in March 2016 and ended in August 2016. Study participation took place from August 2016 to October 2016. Of the forty participants assessed for eligibility, fourteen who were eligible did not consent to participating. Four participants were excluded due to not fitting the eligibility criteria. Of the fifteen participants who received the intervention, six discontinued use of the website by not completing the goal-setting exercises or by not opening some of the web pages without giving an explanation. They continued to receive mobile phone text messages until the end of the study period. In the second week of the program, there was a technical error, which delayed the delivery of the mobile phone text messages for three days. This was promptly attended to and the message schedule was continued from where it was disrupted, ensuring that all participants still received the messages they were scheduled to receive. None of the participants in the intervention group responded to the goal-setting text messages or the text messages asking about alcohol and tobacco consumption status in the past week.

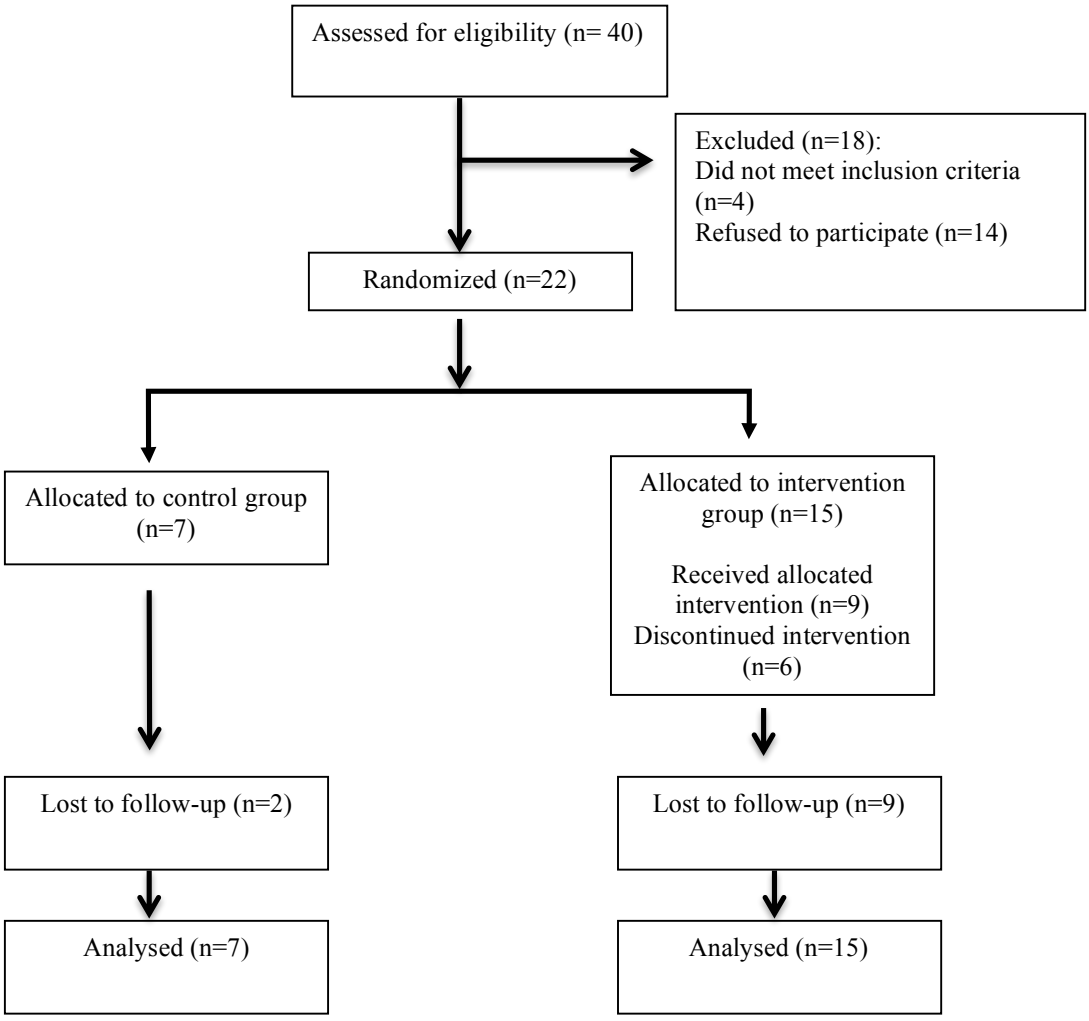

Figure 13. Flow of pilot study participants.

Feasibility

Feasibility measures indicated that 55% (95% CI (40, 69)) of eligible participats agreed to take part, all of the intervention group participants created a user profile in the MyOwnMe web environment, 100% (95% CI (80, 100)) of the intervention group participants used the programme in week 1, 40% (95% CI (20, 64)) in week 3 and 13% (95% CI (4, 38)) in week 5. At follow-up, 40% (95% CI (20, 64)) of intervention group and 60% (95% CI (23, 88)) of control group participants provided complete follow-up questionnaires. The only reason participants gave for not completing follow-up measures was lack of time.

Acceptability

Acceptability measures indicated that of the intervention group participants who were followed up, 100% (95% CI (61, 100)) found the web content of the MyOwnMe program easy to understand, 100% (95% CI (61, 100)) reported that there were too few interactive exercises in the web modules, 50% (95% CI 19, 81) reported that the web content was too long, 33% (95% CI (9, 70)) reported that there was too much text in the web content, 50% (95% CI (19, 81)) reported that the web content gave exact instructions in changing habits. One intervention group participant who filled in the follow-up questionnaire did not answer the acceptability questions. In reference to the aesthetic of the program, 50% (95% CI (19, 81)) of those who responded reported liking the design of the web environment. In reference to the web content, 50% (95% CI (19, 81)) reported that they intended to use what they had learnt from it. It was not possible to determine acceptability of the mobile phone text-messaging component of the intervention as all of those who completed the acceptability questions reported that they did not read the text messages they received.

Results of statistical analyses for behavioural and cognitive outcomes are shown in Table 13.

Alcohol consumption (N = 21)									
	Baseline Mean (SD)		Follow-up Mean (SD)		Effect				
Measure	**Intervention**	**Control**	**Intervention**	**Control**	**F**	**df**	**partial η^2**	**Mean difference (95% CI)**	**p Value**
Number of drinking occasions in past 30 days	2.0 (3.6)	2.2 (2.0)	2.2 (1.5)	3.2 (1.6)	0.25	1, 18	0.014	-0.2 (-0.9, 0.6)	0.62
Autonomous motivation[1]	2.1 (2.3)	4.1 (2.8)	3.1 (3.0)	5.7 (2.1)	0.12	1,18	0.07	-0.4 (-2.9, 2.1)	0.73
Negative outcome expectancies[2]	33.8 (39.2)	72 (23.9)	34.6 (41.2)	66.6 (31.3)	1.58	1, 18	0.081	6.723 (-4.5, 17.9)	0.23
Positive outcome expectancies[2]	28.0 (40.0)	39.5 (28.2)	28.8 (41.5)	41.7 (32.1)	0.265	1, 18	0.015	-1.6 (-7.9, 4.8)	0.61
Refusal self-efficacy[3]	4.3 (1.7)	4.9 (1.1)	4.3 (1.8)	4.7 (1.2)	0.00	1, 18	0.00	0.008 (-1.1, 1.1)	0.99
Tobacco consumption (N = 7)									
	% Quit		**% Quit**		**RR**	**95% CI Lower**		**95% CI Upper**	
	Intervention	**Control**	**Intervention**	**Control**					
30-day abstinence	0.0	0.0	14.3	0.0	1.25	0.81		1.94	
7-day abstinence	0.0	0.0	14.3	0.0	1.25	0.81		1.94	
	Baseline Mean (SD)		**Follow-up Mean (SD)**		**Effect**				
	Intervention	**Control**	**Intervention**	**Control**	**F**	**df**	**partial η^2**	**Mean difference (95% CI)**	**p Value**
Autonomous motivation[1]	2.1 (2.3)	2.0 (3.1)	6.0 (2.2)	0.5 (0.7)	4.68	1,4	0.54	4.14 (-1.2, 9.5)	0.09
Negative outcome expectancies[2]	79.4 (19.8)	76.0 (11.4)	78.6 (22.4)	75.5 (20.5)	0.085	1,6	0.014	-0.49 (-4.6, 3.6)	0.78
Positive outcome expectancies[2]	47.1 (29.7)	38.5 (34.5)	48.1 (31.9)	33.0 (41.0)	5.4	1,6	0.472	6.9 (-0.4, 14.2)	0.06
Refusal self-efficacy[3]	4.4 (2.2)	4.6 (2.4)	5.4 (1.34)	3.5 (3.5)	2.19	1,6	0.104	0.1 (-0.6, 0.3)	0.16
All participants (N = 22)									
	Intervention	**Control**	**Intervention**	**Control**	**F**	**df**	**partial η^2**	**Mean difference (95% CI)**	**p Value**
Self-theory[4]	3.4 (1.9)	4.3 (0.8)	3.5 (2.0)	4.3 (0.8)	0.53	1,19	0.027	0.076 (-0.142, 0.295)	0.47

Table 13. Effect estimates of intervention and control groups for cognitive and behavioural outcomes.

Legend:
1 = In response to the statements: 'Reducing my alcohol consumption is a choice I would like to make for myself' or 'Quitting tobacco consumption is a choice I would like to make for myself.' Measured on a Likert-type scale, where 1 = not true at all and 7 = very true.
2 = In response to 43 statements on the outcomes of alcohol and/or tobacco consumption listed in Appendix 11. Measured on a Likert-type scale, where 0 = Completely unlikely (that this outcome will occur) and 9 = Completely likely.
3 = In response to the questions: 'When someone offers me a drink, it is difficult for me to say no.' or 'When someone offers me a cigarette, it is difficult for me to say no.' Measured on a 6-point Likert-type scale where 1 = Never true and 6 = Always true.
4 = In response to the question: 'To what extent do you think you could change your own personality?'. Measured on a 6-point Likert-type scale, where 1 = I definitely cannot and 6 = I definitely can. Any score above 3 is categorised as an incremental self-theory.

Cognitive outcomes

No significant differences were found between the intervention and control group for any of the cognitive outcomes: autonomous motivation, refusal self-efficacy, self-theory or outcome expectancies. At baseline, intervention group participants had a low level of autonomous motivation to reduce/quit their alcohol consumption (mean = 2.1, SD = 2.3), or quit their tobacco consumption (mean = 2.1, SD = 2.3) whereas the control group had a slightly higher level of autonomous motivation to reduce/quit their alcohol consumption (mean = 4.1, SD = 2.8) but their motivation to quit tobacco consumption was similarly low (mean = 2.0, SD = 3.1). Refusal self-efficacy was relatively low at baseline in both the intervention (mean = 4.3, SD = 1.7) and the control group (mean = 4.9, SD =1.1) for saying no to offers of alcohol and similarly low for saying no to offers of cigarettes (intervention (mean = 4.4, SD = 2.2), control (mean = 4.6, SD = 2.2)). The intervention group had less negative (mean = 33.8, SD = 39.2) and positive (mean = 28.0, SD = 40.0) alcohol-related outcome expectations at baseline, than the negative (mean = 72, SD = 23.9) and positive (mean = 39.5, SD = 28.2) alcohol-related outcome expectations in the control group. The intervetion group had more positive (mean = 47.1, SD = 29.7) and negative (mean = 79.4, SD = 19.8) tobacco-related outcome expectations at baseline, than the negative (mean = 76.0, SD = 11.4) and positive (mean = 38.5, SD = 34.5) tobacco-related outcome expectations in the control group. Both the intervention (mean = 3.4, SD = 1.9) and the control group (mean = 4.3, SD = 0.8) participants could be categorised as having an incremental self-theory at baseline.

Behavioural outcomes

Using intention-to-treat analyses, a one-way ANCOVA was conducted on the number of drinking occasions in past 30 days' outcome with baseline alcohol consumption as the covariate. There were no outliers in the dataset, defined as standardised residuals, where the score is greater than ±3 standard deviations. After adjustment for baseline alcohol consumption, there was no statistically significant difference in post-intervention alcohol consumption, with 0.2 fewer alcohol consumption occasions in the intervention than the control group in the past 30 days.

Using intention-to-treat analyses, risk ratios were calculated for 30-day and 7-day point prevalence abstinence from cigarette smoking. For both outcomes, one participant (14.3%) of the intervention had not smoked in the past 30 days and the past 7 days compared to 0% of the control group.

DISCUSSION

This study investigated the acceptability, feasibility and short-term efficacy of a web and mobile phone intervention aiming to reduce Estonian adolescent and young adult alcohol and tobacco consumption. The feasibility of this progam is questionable for various reasons. The attrition rate at 50% was higher than most of the studies covered in the systematic review in Chapter 2 of this thesis. Two of the studies in the systematic review had similar attrition rates to this study, at 41% (Ybarra et al., 2013) and 48.9% (Bertholet et al., 2015). Whilst only 55% of eligible participants agreed to take part, all of those who did created a profile in the intervention web environment, indicating a reasonable uptake rate of the program. This is also similar to previous studies testing digital interventions in reducing adolescent and young adult alcohol and tobacco consumption covered in the systematic review in Chapter 2 of this thesis (Andersson et al., 2015; Bertholet et al., 2015; Kypri et al., 2004; Palfai et al., 2014). The user experience of the program might have influenced the uptake as well as exposure rates, with six of the fifteen participants in the intervention group discontinuing the program, potentially indicating a negative user experience. Any future trials with the MyOwnMe intervention would need to ensure a pleasant user experience and limit technical errors. Web-based intervention content was acceptable to participants, easy to understand and interactive, but there was too much text in the program so a future version might benefit from shorter web-based content. Only half of the intervention group participants found there to be clear instruction on how to change their consumption habits in the web content, thus future versions of the program should aim to provide clearer information on this.

The text-messaging component was not used by the participants: all of those who answered the program acceptability questions indicated that they had not read the text messages. This is an unusual finding, as the systematic review in Chapter 2 identified several mobile phone text message interventions, which effectively reduced adolescent and young adult alcohol consumption and increased smoking cessation (Mason et al., 2014; Suffoletto et al., 2012; Suffoletto et al., 2015; An et al., 2008; Mussener et al., 2016). Mason et al. (2014) reported a 100% recruitment rate and 0% attrition rate for a mobile phone text message intervention targeting young adult alcohol consumption, which is in stark contrast to the findings of the

current study. It remains unclear, why the mobile phone text message component of the MyOwnMe intervention program was unappealing to Estonian adolescents and young adults. It does, however, have implications on the association of this intervention with effectively reducing Estonian adolescent and young adult alcohol and tobacco consumption, as the individually-tailored behaviour change support was largely delivered through the mobile phone text messages, rather than the web content. This indicates that none of the intervention group participants actually received the behaviour change support they were meant to, which is likely to have limited the effectiveness of the intervention. Future development of the MyOwnMe intervention should investigate why the text messaging component was not engaged with by Estonian adolescents and young adults and either deliver the individually-tailored behaviour change support through the web content or identify an alternative more appealing mechanism than mobile phone text messages. It is unlikely that a larger cost-effectiveness trial of the current version of the program would result in reductions in Estonian adolescent and young adult alcohol consumption or increases in smoking cessation.

The short-term efficacy analysis of the MyOwnMe intervention program indicates no significant differences in alcohol or tobacco consumption between the intervention and control groups, however given the small number of participants, the test is underpowered to draw reliable conclusions on short-term efficacy. The intervention was also not significantly associated with changes in the cognitive outcomes of refusal self-efficacy, autonomous motivation, self-theory and outcome expectancies, which have been indicated as determinants of adolescent and young adult alcohol and tobacco consumption in previous studies (Urban, 2010; Vilenne & Quertemont, 2015; Connor et al., 2011; Kear, 2002; Williams et al., 2000; Johan et al., 2012), but again, the small sample size likely rendered the analysis impercise.

The findings from this study are comparable to the study by Norman and Skinner (2007), which also used participatory design to develop a digital intervention to reduce adolescent cigarette smoking. They also engaged adolescents in the intervention development process and focused on autonomy-supportive content. The difference between this study and the Norman and Skinner (2007) study is their process of involving adolescents into the research. They allowed more responsibility and decision-making power to the adolescents involved in the research than was

the case in this study, as the research problem, strategy to solve the problem, implementation of this strategy and evaluation of the effectiveness of the intervention developed was all led by the adolescents involved in the study rather than the researchers. In the current study, adolescents and young adults involved in the research process were encouraged to assist in the development of intervention content, and they had decision-making power in some of the content and practical exercises included in the final program, but the research problem, the strategy to solve this problem and the evaluation of the developed intervention were chosen and led by me as the main researcher. Despite this difference, Norman and Skinner (2007), similarly to the current study, found no significant effects on their primary outcomes of resistance to smoking initiation, or change in behavioural intentions of cigarette use.

Strengths

This was the first autonomy-supportive digital intervention tailored to the Estonian sociocultural context, thus giving important insight into the feasibility and acceptability of such interventions in Estonia. MyOwnMe provided interactive exercises for the participants in the web environment, which aimed to create a feeling of collaboration with the program in the users, a key tenet of effective health communication (Smith, 1989). Participants indicated that there could be even more interactive exercises and that this might improve the efficacy of the intervention. Web content of MyOwnMe was easy to understand, confirming that the intervention achieved the correct level of health literacy (Kreps & Neuhauser, 2010). The web content also included the use of narratives directed by the adolescents and young adult involved in the project to illustrate scenarios of Estonian adolescent and young adult alcohol and tobacco consumption, which might have increased the ease of understanding by participants in the study and added to the development of interpreting alcohol and tobacco consumption in a new way, rooted in the social context (Kreps & Neuhauser, 2010; Neuhauser & Kreps, 2010).

Limitations

There were several limitations to this pilot study. The recruitment approach did not yield enough potential participants. The recruitment and baseline data collection period coincided with the summer holidays from school and university in Estonia, meaning that potential participants were less likely to be in the institutions where the study posters and flyers were available and less likely to be online or on Facebook, which was the biggest recruitment channel. Many adolescents were away in summer camps and the young adults either working or on holiday and less likely to check their e-mails and messages regularly. Recruiting during the academic school year would be a better strategy. This had been the original recruitment plan for this study, to start recruitment in October 2015 and carry it through until the end of that academic year, in June 2016. Unforeseen delays in the intervention software development process and the obtainment of ethics approval from the University of Tartu Ethics Committee in Estonia caused the main recruitment period to fall on the summer holidays. Recruitment was initially started in March 2016, in a high school in Tartu, Estonia. However, due to miscommunications in the intervention software development portion of the project, the participants recruited during this recruitment period were lost, as the intervention was not ready and there was several months still to wait which meant that the participants lost interest in taking part. This was a huge setback in the success of recruitment efforts for this study, as this school where recruitment was started in Tartu, Estonia, had some of the most active support for this study from the teachers, who invested their time in finding participants. The other recruitment locations did not have as much support for this study, meaning that recruitment was likely to be lower than in this school in Tartu, which proved to be the case during the summer recruitment period.

In addition to the miscommunication in the timeline of the intervention software development process, the ethics approval to be obtained from the University of Tartu Ethics Committee took much longer than expected and that had been the case for a previous study in this research project, namely the focus group study reportin in Chapter 3 of this thesis. For the focus group study, obtaining ethics approval from the same University of Tartu Ethics Committee took four weeks. For the pilot study, it took six months to obtain final approval, which was in March 2016. Due to the intervention not being ready at this time and the recruitment being postponed until the

summer holidays, which required the recruitment efforts to change to online channels. This change required an update for the ethics application for this study as well, which took another two months to be approved. In total, then, the ethics approval for this study took eight months to obtain. This was completely unforeseen to the research team, given the short turnaround on the focus group study ethics application with the same ethics board. The potential of such a long ethics approval process should be taken into account in plans for future studies of digital interventions aimed at reducing adolescent and young adult alcohol and tobacco consumption.

A possible limitation to the recruitment and intervention uptake process might have been the requirements to obtain parental consent for all potential participants under the age of 18. As alcohol and tobacco consumption is illegal in Estonia before the age of 18, potential participants might not have wanted to let their parents know about their consumption habits and might not have agreed to participate because of it. This might be a reason why most participants in this study were over the age of 18. This requirement for parental consent for adolescents under the age of 18 to participate in research is an important barrier in developing interventions to target alcohol and tobacco use in adolescents in Estonia. However, as a legal requirement, there was no way to overcome this barrier in the case of this study. As a result of the summer recruitment and the parental consent requirement, the study provided poor precision. A larger sample size would be needed to provide a more precise estimate of effect.

In the running of this study, some technical issues were encountered with the functioning of the intervention program. For a period of three days, the text messages were not sent correctly, which might have influenced the user experience of the program. However, given that many participants did not read the text messages anyway and did not find them to be an important part of the intervention, the technical difficulties might not have changed the users' opinions of the program.

In the development of this program, the technical specification fulfillment was also challenged by the lack of user interface design expertise in the development team, which reduced the extent that the intervention content could be made appealing and pleasurable to use. There was also not enough multidisciplinary software development expertise in the research team to foresee these

issues or the delays and miscommunications in the intervention development process. Although the text-based content was written to reflect experiential information on Estonian adolescent and young adult alcohol and tobacco consumption, the static nature of the website and mobile phone text messages may not have been the best format to represent this, and video- or animation-based delivery might have been a closer representation and provided more appealing content for the study participants. Engagement is often dependent on adding real value to the user's life in terms of the content the intervention delivers and the aesthetic and ease of use of the technical interface (O'Brien & Toms, 2008; Kim et al., 2013). Developing digital interventions requires a multidisciplinary team, which should include a strong user interface design focus (van Gemert-Pijnen et al., 2011).

There were no indications in the web environment or any related messages on the fact that the program content had been developed together with Estonian adolescents and young adults. Had this been made clear to participants in the pilot study, the source credibility of the information shared might have been increased and might thus have also increased participants' motivation in changing their behaviour (Eysenbach, 2008). MyOwnMe was introduced to participants in the context of a University of Cambridge research study, which may have been identified as the source of the information and any linguistic relevance to their own experiences and peer-sourced information which the program was aiming to emulate may not have stood out clearly enough to overcome the authority of the University of Cambridge. This might also explain the lack of younger adolescent participants in this pilot study, as they are more likely to veer away from traditional authority figures such as educational establishments than older adolescents or young adults (Eysenbach, 2008).

There were no objective measures of alcohol and tobacco consumption outcomes, thus adding the usual bias attached to self-report measures to the results (Schillington & Clapp, 2000). There might be specific concern with self-report in adolescent and young adult populations as they might regard it as a sensitive topic and feel guilt or shame about admitting to having consumed alcohol and tobacco and thus underreport their consumption (Nepusz et al., 2014). Another limitation was the length of the baseline and follow-up questionnaires used for both the control and intervention group, especially the tailoring questionnaire in the intervention group, which

also included baseline measurements. Multiple item questionnaires were used, to provide a more robust measurement of items of interest, however, these also placed more burden on the participants than a shorter questionnaire would have done.

The use of the last observation carried forward statistical technique might have introduced bias into the analysis in this study. This method is primarily used in longitudinal studies and assumes, very likely incorrectly, that a data point does not change in value from one observation to the next in the case of attrition (Haukoos & Newgard, 2007). If this assumption was not met in the data of this study, bias is likely to have been produced. Alcohol and tobacco consumption behaviours are likely to be more dynamic in real life than is assumed by the last observation carried forward method and results of this method should be examined from a variety of angles in addition to the conclusion that a missing value at follow-up indicates the same behaviour as at baseline (Hedeker et al., 2007). In this study, the results should have been examined using sensitivity analyses in addition to the last observation carried forward method, or multiple imputation should have been used as the method of dealing with missing data instead (Hedeker et al., 2007; Sterne et al., 2009). As this was not done, the conclusions which can be drawn based on this data are limited.

The generalisability of the MyOwnMe intervention might be limited due to the current Estonian sociocultural context specificity and language use. However, adapting the intervention to other populations of adolescents and young adults might be feasible, as the developmental process of adolescence and young adulthood is universal, only the sociocultural and linguistic nuances specific to each sub-population would need to be added.

Implications for future research

This pilot study has indicated that the delivery of a digital intervention aiming to reduce Estonian adolescent and young adult alcohol and tobacco consumption might benefit from high-level user interface design expertise to provide a program that is easy and enjoyable to use and that is in line with the experiences adolescents and young adults have when using other digital programs.

The development of such interventions might also benefit from a multidisciplinary research management team, where expertise on leading software development projects is at hand (van Gemert-Pijnen et al., 2011). In the case of this study, the behaviour change potential of a tailored digital intervention was not met due to the lack of timely and accurate delivery of the intervention software and the technical errors during the pilot study.

Recruitment of future research studies with Estonian adolescents and young adults should aim for the recruitment period to fall on an academic school year semester rather than the summer or any other school holiday to increase the chances of reaching adolescents and young adults. Recruitment via Facebook appears to be an efficient channel, more so than posters, leaflets or e-mails. In the case of underage adolescent participants, family- or parent-based interventions might result in more exposure to intervention content, as the adolescents would not have to overcome the barrier of exposing their consumption habits to their parents or legal guardians.

It is difficult to capture the social and cultural context of an autonomy-supportive content for the intervention users even with representatives involved in the development and design of the program and further research in this area is warranted to truly provide insightful and relevant health behaviour change content for adolescents and young adults in digital interventions (Neuhauser & Kreps, 2008). There is no real guidance on how to do this from intervention development frameworks or behaviour change theory, thus steps towards providing such guidance might be useful to take for the development of future interventions (Norman & Skinner, 2007).

It is still unclear what kind of intervention content might be engaging and persuasive for reducing adolescent and young adult alcohol and tobacco consumption (Crutzen et al., 2011). More research with a focus on implementing the expertise and knowledge of adolescents and young adults themselves is warranted (Mandel & Qazilbash, 2005). In Estonian adolescents and young adults, the use of mobile phone text messages as an intervention delivery mechanism should be further investigated. For the MyOwnMe intervention to be tested in a larger, cost-effectiveness trial, the technical flaws should be corrected, the reason behind the lack of

engagement with mobile phone text messaging investigated and the tailoring/baseline questionnaire shortened to lessen the assessment burden on participants.

Conclusions

This pilot study of the MyOwnMe intervention program targeting alcohol and tobacco consumption in Estonian adolescents and young adults suggests that although there is interest in such a program and the content developed so far is interesting and easy to understand for potential participants, the design of the program needs further improvement. The program should include more interactive elements and potentially be delivered via a digital channel used more often by adolescents and young adults than static websites and mobile phone text messages.

CHAPTER 6
DISCUSSION

Main Aims and Findings

This thesis had the following aims and main findings:

Chapter 2 aimed to investigate the effectiveness of digital interventions in reducing adolescent and young adult alcohol and tobacco consumption. A meta-analysis of 26-alcohol consumption and 6 tobacco consumption studies was conducted. Digital interventions were found to reduce alcohol and tobacco consumption in adolescents and young adults. The first analysis of behaviour change techniques present in digital interventions aimed at adolescents and young adults was conducted. None of the tested behaviour change techniques were found to have significant associations with weekly alcohol consumption or monthly binge drinking outcomes. No behaviour change techniques associated with significant intervention effects on tobacco consumption were identified either. Notably, no studies targeting both alcohol and tobacco consumption in adolescents and young adults were found either, despite the frequent co-occurrence of these behaviours and the negative health consequences of co-consumption (Falk, 2004). Better study quality, more digital interventions targeting both alcohol and tobacco consumption in adolescents and young adults and additional examination of behaviour change techniques associated with intervention effectiveness were identified as potential future research directions.

Chapter 3 aimed to explore the sociocultural context of Estonian adolescent and young adult alcohol and tobacco consumption and gather information on the appeal and potential content of an individually tailored digital intervention aimed at reducing Estonian adolescent and young adult alcohol and tobacco consumption. Findings indicate that Estonian adolescents and young adults have easy access to both alcohol and tobacco, often initiate consumption habits in their home environments in the presence of adults and are more likely to consume tobacco when they are also consuming alcohol. Estonian adolescents and young adults also expressed the view that alcohol and tobacco consumption is a normal part of the Estonian socialising culture and it is more likely that people will be consumers than nonconsumers. The participants thought that an individually tailored digital intervention would be appealing to them, especially in the light of the current school curriculum on alcohol and tobacco consumption not being interesting or

memorable to them. Existing web-based resources on alcohol and tobacco consumption were seen as too generic and so an individually tailored intervention was seen as appealing. Participants suggested using goal-setting, personalised message content and a supportive tone as appealing elements of a potential digital intervention. Participants found the idea of a website and mobile phone text messaging based intervention appealing.

Chapter 4 aimed to outline the development of an autonomy-supportive digital intervention program to reduce Estonian adolescent and young adult alcohol and tobacco consumption using participatory design. This involved recruiting two adolescents and one young adult from Estonia to participate in the entire intervention development and content writing process. I identified the theoretical evidence base for adolescent and young adult alcohol and tobacco consumption. Social Cognitive Theory, Self-Determination Theory and implicit self-theories were chosen as the theoretical basis for this intervention. Outcome expectancies, refusal self-efficacy, perception of social norms, implicit self-theories and autonomous motivation were determinants of adolescent and young adult alcohol and tobacco consumption that were chosen to be targeted in this intervention. Based on this information, I worked together with the intervention development group to decide on the structure of the website, content and goal-setting exercises to be included on the website, tone of communication and examples of situations where an Estonian adolescent or young adult might be consuming alcohol to be used as a part of a narrative approach to the website content. Mobile phone text messages were added to the website to provide individually tailored motivational and behaviour change support. I wrote text messages, with consultations from the intervention development group on the wording. An Estonian language specialist was also involved in the process, advising on the translation of English-language behaviour change theory and techniques into Estonian-language health communication messages and ensuring a consistent tone and style of the intervention content across the web and mobile phone components. A website linked to a mobile phone text messaging program was developed, named MyOwnMe. The website had four modules to be completed over four weeks and the mobile phone text message component involved twice-daily text messages sent to the mobile phones of program users. Participatory design was found to be a useful methodology for developing autonomy-supportive health communication targeting adolescents and young adults and providing insight into potentially appealing intervention content for these age groups.

Chapters 5 aimed to pilot test the MyOwnMe intervention program to investigate its feasibility, acceptability and short-term efficacy in reducing Estonian adolescent and young adult alcohol and tobacco consumption. A randomised controlled pilot trial comparing existing web-based health information on the risks of alcohol consumption and cigarette smoking (Control) with existing web-based information plus the MyOwnMe program (Intervention) was conducted. Participants were 12-25-year-old adolescents and young adults recruited from Estonia through school- and social media-based recruitment efforts. Of the 40 participants assessed for eligibility, 22 were randomised into the intervention (15 participants) and control (7 participants) groups. Findings show that 55% of eligible participants agreed to take part, 100% of those who did created a profile in the intervention web environment, indicating a reasonable uptake rate of the program. Of the participants who created a profile in the intervention's web environment, 40% completed follow-up measures. The static design of the website might have influenced uptake and exposure rates, with a more interactive program potentially being more appealing to adolescent and young adult users. The text-messaging component of the intervention was not used by participants, the reason for which is unclear, but contrasts the findings from Chapter 3, where participants felt that text messaging would be a useful component in a digital intervention directed at them. Further research is required to understand the appeal or usage of mobile phone text messaging in Estonian adolescents and young adults. Short-term efficacy analysis of the MyOwnMe intervention program indicated no significant differences in alcohol or tobacco consumption or their determinants between the intervention and control groups, but due to the small sample size in this study more data is needed to draw reliable conclusions on the short-term efficacy of the program. Further development of the MyOwnMe intervention is required before a larger cost-effectiveness trial can be conducted.

Comparison to existing evidence

This research project adds several new findings to the cumulative science of reducing adolescent and young adult alcohol and tobacco consumption. Our systematic review highlights the lack of quality of digital alcohol and tobacco consumption interventions targeting adolescents and young

adults. Although in this project, alcohol consumption studies reviewed were generally of high quality, the risk of attrition bias could be improved in this research area. Low attrition rates might be influenced by factors such as inconsistent reporting and lack of controlled testing of singular intervention components to determine effectiveness (Crutzen et al., 2011). This research project has highlighted also the lack of knowledge into which intervention features might increase participant engagement, and it has also been found in previous studies that intervention content chosen by experts might not been the expectations or preferences of adolescent and young adult intervention users (Crutzen et al., 2011). This research project also identified the common use of self-report measures in this type of research and the intervention evaluation in this case was also conducted using self-report measures. However, use of self-report measures increases the risk of performance and deterction bias, as indicated by the systematic review in Chapter 2 of this thesis, thus more objective measurements of adolescent and young adult alcohol and tobacco consumption might reduce such bias and therefore increase overall study quality in this area.

A notable finding in this research project was the dearth of technological diversity found in intervention design. This research project attempted to engage more users by delivering the intervention via two digital channels, namely mobile phone text messages and a website. In the studies reviewed in Chapter 2 of this thesis, only three of the alcohol consumption studies employed mobile phone text messaging technology; the others used either a website or a computer program. The tobacco consumption interventions reviewed included more diverse technological features, including mobile phone text messaging, websites and video technology. This is an important consideration for the development of future digital interventions in order for interventions to stay relevant to the rapidly developing technology landscape that adolescents and young adults especially are accustomed to using (Pew Research Centre, 2015).

This research project was the first to review the use of behaviour change techniques in both alcohol and tobacco interventions targeting adolescents and young adults. Notably, we found most interventions to use very similar combinations of BCTs, most commonly ‘providing normative information’. This meant that it was not possible to identify the unique contribution of this common BCT to intervention effectiveness. Although building on existing use of BCTs in complex interventions allows for the development of a cumulative science of behaviour change

(Michie & Johnston, 2012), it also makes it difficult to identify the active ingredients of complex interventions, when commonly used BCT are not systematically combined with additional intervention ingredients. The lack of significant associations found between the presence of BCTs and digital intervention effectiveness in this research might be explained by poor reporting of BCTs, thus introducing error into BCT coding and analyses (Hawkins et al., 2008). Improved reporting of the use of BCTs in interventions might aid in the examination of their association with effectiveness. BCT coding produces observational data and relies on the description of intervention content reported in publications, which leaves room for misinterpretation or lack of insight into the intervention. These issues with the execution, reporting and coding of BCTs might be improved by the ongoing research into the use of ontologies in behaviour change (Larsen et al., 2016).

The feasibility of the intervention evaluated in this research project is questionable. The technical errors experienced during the pilot study and the inability to fulfil the technical specifications of the intervention design due to lack of adequate software development expertise on the research team meant that the users of the intervention might have disengaged from the intervention due to the lack of usability, rather than not liking the intervention content. Any future trials with this intervention would need to ensure a pleasant user experience and limit technical errors. We also had the curious finding that the text messaging component was not used by the participants of the intervention, which is in contrast with the existing evidence on the use of text messaging in adolescent and young adult populations, as it has successfully been used before (e.g. Mussener et al., 2016). Further research into the use of text messages in the adolescent and young adult populations in Estonia might be warranted.

Similarly to existing multiple change interventions targeting health behaviours, this thesis chose one of three approaches to the development of such interventions: (1) behaviour change principles approach, (2) global health/behavioral category approach or (3) multiple behavioural approach (Noar et al., 2008). This thesis followed the behaviour change principles approach, identifying common determinants of adolescent and young adult alcohol and tobacco consumption and focusing intervention content on these. The behaviour change principles approach has been used in the development of existing multiple behaviour change interventions (Godin & Kok, 1996; Prochaska et al., 1994). The use of this approach made the information to

be delivered by the intervention more manageable.

Participatory design for digital intervention development in adolescents and young adults has been used by one other study (Norman & Skinner, 2007), which similarly to the current research, opted for an autonomy-supportive intervention development and intervention content. They also opted for delivering smoking cessation advice over a website, but did not include mobile phone text messaging as was the case in the current research project. Norman and Skinner (2007) also found no significant effects of their intervention on adolescents' smoking behaviour in current smokers, but they did find that resistance to smoking increased in nonsmoking adolescents after exposure to the intervention. Resistance to smoking was not included in the current research, as only current alcohol and tobacco consumers were recruited into the pilot study.

This intervention differed from other digital multiple behaviour change interventions targeting adolescents and young adults in tailoring to sociocultural context and using an autonomy-supportive health communication style, suggested to be more appealing to adolescent and young adult populations than a more traditional, instructional communication style (Miller et al., 2007; Fetterman, 2001). Although the pilot study did not show significant changes in adolescent and young adult alcohol and tobacco consumption, given the small sample size of the study, the barriers to recruitment and the technical difficulties experienced during the study, these results cannot be taken as conclusive. Additionally, given the lack of research on the use of participatory design in the development of digital interventions for adolescents and young adults, the process followed in this thesis research would benefit from further development and practice. Considering the lack of success with school-based interventions (Steinberg, 2015) and digital intervention having high rates of disengagement (Eysenbach, 2005; 2008), new methods of developing intervention content should be examined, and this thesis adds to the effort of finding more engaging and effective digital interventions to reduce adolescent and young adult substance use.

Strengths

This current research has many strengths. It involved the first meta-analysis to examine the associations between behaviour change techniques and digital intervention effectiveness in reducing adolescent and young adult alcohol and tobacco consumption. MyOwnMe is the first digital intervention aiming to reduce adolescent and young adult alcohol and tobacco consumption to be developed using participatory design. It is the first digital intervention targeting adolescents and young adults to explicitly tailor to the sociocultural context of alcohol and tobacco consumption for the target population. It is also the first digital intervention to be developed with and for Estonian adolescents and young adults, which is frequently highlighted as being a problem region of youth alcohol and tobacco consumption (WHO, 2016[2]). This thesis research also involves the first digital intervention aimed at reducing adolescent and young adult alcohol and tobacco consumption to utilise autonomy-supportive health communication, an important direction of research in the field of adolescent and young adult health. The intervention developed for this thesis is theory-based, involves the use of evidence-based behaviour change techniques and focuses on increasing engagement with and appeal of the intervention for adolescent and young adult users. The result that all intervention group participants in the pilot study for this intervention found the intervention content interesting and easy to understand support the use of participatory design and autonomy-supportive health communication to engage adolescent and young adult intervention users. Another strength of this research project was the use of both qualitative and quantitative research methods, which has been associated with greater intervention effectiveness (Shaw et al., 2014). Overall, this project has added to the development of a cumulative science of behaviour change (Michie & Johnston, 2012) by employing behaviour change theory and techniques in a systematic manner in order to build on the existing evidence base on the effective prevention and intervention of adolescent and young adult alcohol and tobacco consumption.

Limitations

This research project also involves several limitations. There is a lack of intervention development frameworks to guide the development of multiple health behaviour change interventions, which might limit the comparability of the MyOwnMe intervention with other

digital interventions targeting adolescent and young adult alcohol and tobacco consumption. The area of alcohol and tobacco consumption in adolescents and young adults primarily uses self-report measures, which was also the case in this thesis. This introduces bias into the data collected and might be especially concerning in the case of adolescent and young adult participants (Williams & Nowatzki, 2005). Underage adolescents specifically are more likely to feel uncomfortable with revealing their alcohol and tobacco consumption habits, as use of such substances is illegal in the EU context (Dolcini et al., 1996). This remains to be an area of improvement in the field of e-health interventions and testing. Interactive devices such as pedometers in the case of physical activity increase user engagement and reliability of behaviour measurement (Kreps & Neuhauser, 2010) but currently, there are no such devices to noninvasively measure alcohol and tobacco consumption.

The issue of underage alcohol and tobacco consumption was also a limitation in terms of recruitment success in this research project. Underage adolescents who were interested in participating in the pilot study may have changed their minds once they found out that participation would require consent from their parent or legal guardian as well. As this is a legal requirement in Estonia, it was not possible to overcome this barrier to recruitment. There was less concern expressed by the focus group study participants about this requirement to inform their parents, possibly because the recruitment into the focus group study included closer collaboration with teachers and youth centre workers who the potential participants already trusted. Such close collaboration with existing educators in the lives of underage Estonian adolescents might be a way to reduce the impact of the legal requirement on recruitment success. In addition to the Estonian ethics approval, this research project also required approval from the Psychology Ethics Committee at the University of Cambridge. This meant that four different rounds of ethics approval had to be sought altogether, two from Estonia and two from Cambridge for the focus group and pilot studies conducted in the scope of this project. Not only was this time-consuming, it was also difficult to produce different ethics applications for the same study to two ethics boards with varying levels of familiarity and expertise in this type of research. The ethics board in Cambridge had seen projects like this before, which might have been one of the reasons why they could process the ethics applications for the focus group and pilot studies

quicker than the Estonian board. Future research should consider this in planning the timeline for such projects.

A limitation that might have influenced the exposure of participants to the whole intervention content in the pilot study was the lack of technical and user interface design expertise in the intervention development team. Although a programmer was attached to the project, he had not been involved in the development of such a tailored program before and was also not a designer, thus resulting in a rather static technical solution for the website component of the intervention. This might have been more cumbersome to navigate than the websites Estonian adolescents and young adults are used to using and thus resulted in participants not completing the web modules and not being exposed to the full intervention content, thus also limiting its effectiveness (Eysenbach, 2005).

Another limitation was the lack of guidance on leading the participatory design process, which again might make the research presented in this thesis less comparable to other similarly developed interventions. There was only one existing study, which was identified as having involved adolescents in the intervention development process (Norman & Skinner, 2007). Introducing participants from different backgrounds into the research process inevitably involves some communication issues between researchers and participants as well as power differentials to overcome to produce intervention content reflective of the diversity of opinions involved (Clemensen et al., 2007). The relationship between the participants and the researchers should be carefully managed and the participants should be prepared before the process starts for how much of their opinions and input will be used in the end product in order to avoid conflict or disappointment (Clemensen et al., 2007). Although I, as the intervention development group manager, was aware of such potential issues, there was little guidance on how to prevent them or solve them and could have led to the adolescents and young adult recruited into the research not feeling entirely autonomous in their role or ownership of the intervention. This in turn could have led to fewer ideas being put forward by the adolescents and young adult involved in the research than what they thought of or not feeling empowered to disagree with the suggestions I was making.

Another unexpectedly time-consuming and problematic element of the intervention development process was the translation of study materials and intervention content from English to Estonian and back to English again for every iteration and draft being produced. Although I had a very experienced translator working on the English to Estonian translations, I myself translated from Estonian to English when presenting new drafts of study materials and intervention content to the rest of the research team. I am bilingual in English and Estonian, but am not a translator which is a skill that would have been required to accurately also translate the materials from Estonian back into English. Therefore, the materials presented to the rest of the research team were direct translations from the Estonian version, which might not have accurately conveyed meaning in English. The need to translate back and forth between drafts also meant that there were less iterations of the intervention content which was eventually delivered to users than would have been the case, had there only been one language to work with. Future research involving populations with languages other than English should take this into account.

The scope of this project was slightly beyond the resources available in the research team. I travelled back and forth between Estonia throughout the project to collect data, liaise with local schools, youth centres, universities and the ethics board. In addition to this, the recruitment efforts, development of the intervention and preparation of study materials and processes were also all completed by me. With more resources and a more multidisciplinary research team, the project might have been completed more successfully and in a timely manner.

Implications for future research

Although behaviour change theory can guide intervention developers in what kind of intervention content might predict change in health behaviour, there is little guidance on how to translate theory into health communication messages. There is even less guidance on examining what the users of interventions value and how this might make for a more engaging intervention content, except for the Yardley et al. (2015) person-based approach to digital intervention development. However, this approach does not suggest the use of intervention participants as involved in the whole process or the process itself being directed by potential participants as participatory design does. Further research into the participatory design method is warranted.

Autonomy-supportive health communication should be further investigated in the realm of digital interventions for adolescents and young adults. It is a promising area of research for overcoming the often alienating or unappealing effects of the traditional instructional health communication model, deemed too paternalistic for use with young people (Fetterman, 2001; Miller et al., 2007).

Developing a systematic approach to designing digital interventions aimed at multiple behaviour change and guidance on how to translate behaviour change theory into health communication targeting multiple behaviours might be a useful future research direction. This thesis found there to be a lack of such guidance and the reporting on the development process of current digital interventions for adolescents and young adults to also be scarce. This was especially the case for the use of the participatory design method with adolescents and young adults. Further research into the use of this methodology with young people would provide insight into best practices of applying it and might provide the basis for developing systematic guidance on translating behaviour change theory into health communication messages as well.

This thesis found a dearth of different technological tools being tested as intervention delivery mechanisms for adolescents and young adults. Whilst technological innovation should not overshadow the focus on or importance of health communication, it needs to be a larger consideration than perhaps exists in the digital health community today (Kreps & Neuhauser, 2010). This is especially the case with a generation who uses their phones as much as the current adolescents and young adults (Pew Internet & American Life Project, 2012; 2013). The use of other digital platforms could achieve the user control, interactivity, information customization and social networking important for intervention effectiveness (Kreps & Neuhauser, 2010). Further research with a wider range of technological tools would therefore be warranted.

The World Health Organization (Kiaer et al., 2016) has mandated that interventions targeting young people should not treat them as a homogeneous group, but rather tailor content to the gender, social and culture environments that young people's health behaviour occurs in. The need for further research into the sociocultural context of health behaviours has also been highlighted in the digital intervention arena (Neuhauser & Kreps, 2010; Eysenbach, 2008). Tailoring to

sociocultural context could be the necessary next step to increase digital intervention effectiveness in reducing youth substance use (Clar et al., 2014). More research into the use of participatory design in digital intervention development would add to the understanding of the sociocultural context of youth substance use and enable tailoring to sociocultural context (Mason et al., 2013).

Difficulties in undertaking digital behavior change intervention research

Several challenges were faced when undertaking this research project in terms of recruitment, fulfilling the technical specifications of the intervention and involving user feedback into the intervention content as it developed. These might be challenges which other researchers in this area are facing as well and I would like to share a few thoughts here on how such issues might be mitigated in future projects.

There is a lack of emphasis on involving multidisciplinary expertise in the teams developing digital interventions (van Gemert-Pijnen et al., 2011). This also leads to lower usability of digital interventions and risks participant disengagement (Krug, 2014). Developing digital interventions does not just concern the realm of public health or health psychology, but also of user interface design, organisational psychology and management science (Gorla & Lam 2004). The components of digital interventions might include: behaviour change theory (Glanz & Bishop, 2010) and techniques (Michie et al., 2013), the technical solution, the user interface design and the implementation and communication strategy (Glasgow, 2008). A priority of digital intervention programmes is to be engaging for the user in order to increase user retention rates (Eysenbach, 2005). Engagement is often dependent on adding real value to the user's life in terms of the content the intervention delivers and the aesthetic and ease of use of the technical interface (O'Brien et al., 2008; Kim et al., 2013). In the process of developing effective digital health behaviour interventions, it might be beneficial to look beyond the frameworks of health behaviour change intervention development, to frameworks developed by computer scientists. A wider perspective may add to the understanding of the effective components that a digital health behaviour change intervention might require and the necessary skillset of the development team to realise these requirements.

The development and testing of digital interventions by following traditional program evaluation approaches might benefit from adding slightly more flexible and rapid development and testing cycles (Anderson, 2008). Specifically, methods which involve more than one round of development and feedback from users before the intervention is tested might be beneficial in successfully developing effective interventions (Mummah et al., 2016). This is also important to increase the usability and participant retention of digital interventions (Mummah et al., 2016). Technology develops rapidly and traditional methods of developing, testing and evaluating each individual version of interventions might not be useful in the case of digital interventions (Mummah et al., 2016). A more organic process of development, which involves several rounds of prototyping and gathering user feedback throughout each iteration of intervention content might be more conducive to the dynamic environment that digital technology users are accustomed to and would keep academically developed digital interventions on par with commercially developed programs in terms of user friendliness (Mummah et al., 2016). This is another area of digital intervention research where more input from the computer sciences might be beneficial, especially the emphasis of real-time user feedback throughout the development process, which has been shown to result in better user retention and satisfaction (Constantinides & Fountain, 2007). Thorough usability testing of digital interventions might also increase user retention rates (Krug, 2013). As mentioned above, the use of multi-disciplinary teams in the development of digital interventions might allow for more inclusion of findings from the area of computer science, which might benefit digital behavior change interventions in effectively changing health behavior.

Improvements to the objective measurement of behaviour is another area of potential improvement in digital behaviour change research, which might improve digital intervention accuracy and user retention (Benvenuto et al., 2009). Digital technologies allow for increasingly measuring behaviour in real-time and associations can be found with the user's data on their social media and search sites to understand user preferences in real-time, rather than relying on traditional methods of data collection to provide insights into active ingredients of digital programs (Benevenuto et al., 2009; Anderson, 2008). The plethora of user data available through digital technologies, often termed 'Big Data', has promising potential to be used for the objective

measurement of health behaviour and the improvement of digital health behaviour change interventions, however, a systematic approach to understanding the uses and appropriate analyses for Big Data in the field of public health are needed before this potential can be realised (Khoury & Ioannidis, 2014; Barrett et al., 2013).

Implications for practice

Various websites provide health risk information and several research efforts are dedicated to making some parts of these websites relevant to individuals as well as whole populations. The field of eHealth might need to add to such efforts with more skill-based information and web environments for smaller homogeneous social and cultural groups to allow for the user to use a network approach of finding a complete and comprehensive set of information about the health issue they are searching across multiple sites (Eysenbach, 2008).

In terms of testing digital interventions with adolescents and young adults, the expertise and skillsets of the intervention development team should be carefully considered (Faraj & Sproull, 2000). Researchers working with the participatory design approach should have appropriate training to manage the power dynamics between them and adolescent or young adult participants. There should also be increased emphasis on user interface design in testing digital interventions with adolescents and young adults, as they are used to a higher-level user experience than simple programming can provide.

The development of digital interventions aimed at adolescents and young adults is an iterative process and requires several rounds of development (Bock et al., 2015). To engage adolescents and young adults in the development process, collaborations with schools, youth centres or youth sports clubs might be beneficial to ensure long-term commitment to the project and involve a potential implementation context from the beginning of the intervention development process, shown to positively impact intervention effectiveness (Bennett & Glasgow, 2009).

Conclusions

This research project undertook the development of a tailored digital intervention aimed at reducing adolescent and young adult alcohol and tobacco consumption. Digital interventions were found to effectively reduce alcohol and tobacco consumption when targeted separately, but more research is needed into interventions targeting both behaviours simultaneously. The sociocultural context of Estonian adolescent and young adult alcohol and tobacco consumption was investigated using qualitative research methods, and a participatory design was used to develop autonomy-supportive intervention content tailored to the Estonian sociocultural context. The intervention was found to be acceptable to Estonian adolescents and young adults and feasible to implement, although short-term efficacy of behaviour change was not shown. Further research into multiple behaviour change in adolescents and young adults and the development of autonomy-supportive health communication using participatory design with adolescents and young adults is needed to fully realise the potential of these methods and of digital interventions.

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APPENDIX 1

Systematic review PRISMA checklist

Section	#	Checklist item	Reported on page
Title Title	**1**	Identify the report as a systematic review, meta-analysis or both	**42**
Abstract Structured summary	**2**	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	**43**
Introduction Rationale	**3**	Describe the rationale for the review in the context of what is already known.	**44-45**
Objectives	**4**	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes and study design (PICOS).	**46**
Method Protocol and registration	**5**	Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address), and, if available, provide registration information including registration number.	**47**
Eligibility criteria	**6**	Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	**47-49**
Information sources	**7**	Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	**49**
Search	**8**	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	**225**
Study selection	**9**	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis.	**49**
Data collection process		Describe the method of data extraction from	

Data items	**10**	reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	**50**
	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	**49**
Risk of bias in individual studies	**12**	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	**52**
Summary measures		State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	**13**	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	**50**
Risk of bias across studies	**14**		**50**
Additional analyses	**15**	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	**52**
	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating, which were pre-specified.	**51**
Results			
Study selection	**17**	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusion at each stage, ideally in a flow diagram.	**53**
Study characteristics	**18**	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide citations.	**54-63**
Risk of bias within studies	**19**	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12).	**54-57**
Results of individual studies	**20**	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.	**58-63**
Synthesis of results			
Risk of bias across studies	**21**	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	**68-72**

Additional analysis	**22** **23**	Present results of any assessment of risk of bias across studies (see Item 15). Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression) (see Item 16).	**54-57** **73-74**
Discussion Summary of evidence Limitations Conclusions	**24** **25** **26**	Summarise the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. health care providers, users, and policy makers). Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias). Provide a general interpretation of the results in the context of other evidence, and implications for future research.	**75** **75-79** **80**
Funding Funding	**27**	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	**NA**

APPENDIX 2

Systematic Review Search strategy

Five bibliographic databases were searched in February 2015: MEDLINE, PsychInfo, ASSIA, EMBASE and CINAHL. In EMBASE, the search was limited to studies published between 1996 and 2015. A combination of the keywords adolescent, young adult, student, university, alcohol, drinking, smoking, tobacco, Internet, mobile, text message and other variations of these words was used. A highly sensitive search strategy was created for MEDLINE. The search strategies for every database can be viewed below.

PsychInfo

1. (clinical trials OR treatment outcomes OR randomised controlled trial OR randomized controlled trial OR quasi-randomised OR quasi-randomized OR pseudo-randomised OR pseudo-randomized OR RCT OR randomized control trial OR randomised control trial)
2. (Adolescen* OR teenag* OR young adults OR youth OR student* OR college OR university)
3. (Alcohol* OR binge drinking OR drink* OR smok* OR tobacco)
4. (Internet OR online OR email OR web* OR virtual OR phone OR cell phone OR mobile OR text message OR text OR texting OR short message service OR SMS OR video message OR picture message OR multi-media OR video OR recording OR digital OR social network OR social media)
5. #1 AND #2 AND #3 AND #4

MEDLINE
The revised Cochrane highly sensitive search strategy (2008 revision, PubMed format).

1. (randomized controlled trial [pt] OR controlled clinical trial [pt] OR randomized [tiab] OR placebo [tiab] OR drug therapy [sh] OR randomly [tiab] OR trial [tiab] OR groups [tiab]) NOT (Animals [mh] NOT humans [mh])

2. (Adolescence [tw] OR adolescent [tw] OR adolescents [tw] OR teenager [tw] OR teenagers [tw] OR young adults [tw] OR youth [tw] OR student [tw] OR college [tw] OR university [tw])

3. (alcohol [tw] OR alcohols [tw] OR binge drinking [tw] OR drinking [tw] OR smoking [tw] Or drink [tw] OR smoke [tw] OR tobacco [tw] OR nicotine [tw])

4. (Internet [tw] OR online [tw] OR email [tw] OR web [tw] OR virtual [tw] OR phone [tw] OR cell phone [tw] OR mobile [tw] OR text message [tw] OR text [tw] OR texting [tw] OR short message service [tw] OR SMS [tw] OR video message [tw] OR picture message [tw] OR multi-media [tw] OR video [tw] OR DVD [tw] OR recording [tw] OR digital [tw] OR social network [tw] OR social media [tw])

5. #1 AND #2 AND #3 AND #4

ASSIA
1. (clinical trials OR treatment outcomes OR randomised controlled trial OR randomized controlled trial OR quasi-randomised OR quasi-randomized OR pseudo-randomised OR pseudo-randomized OR RCT OR randomized control trial OR randomised control trial)

2. (Adolescen* OR teenag* OR young adults OR youth OR student* OR college OR university)

3. (Alcohol* OR binge drinking OR drink* OR smok* OR tobacco)

4. (Internet OR online OR email OR web* OR virtual OR phone OR cell phone OR mobile OR text message OR text OR texting OR short message service OR SMS OR video message OR picture message OR multi-media OR video OR recording OR digital OR social network OR social media)

5. #1 AND #2 AND #3 AND #4

EMBASE (1996-2015)

1. (clinical trials OR treatment outcomes OR randomised controlled trial OR randomized controlled trial OR quasi-randomised OR quasi-randomized OR pseudo-randomised OR pseudo-randomized OR RCT OR randomized control trial OR randomised control trial).af.

2. (Adolescen$ OR teenag$ OR young adults OR youth OR student$ OR college OR university).af.

3. (Alcohol$ OR binge drinking OR drink$ OR smok$ OR tobacco).af.

4. (Internet OR online OR email OR web* OR virtual OR phone OR cell phone OR mobile OR text message OR text OR texting OR short message service OR SMS OR video message OR picture message OR multi-media OR video OR recording OR digital OR social network OR social media).af.

5. #1 AND #2 AND #3 AND #4

CINAHL

1. ("clinical trials" OR "treatment outcomes" OR "randomised controlled trial" OR "randomized controlled trial" OR "quasi-randomised" OR "quasi-randomized" OR "pseudo-randomised" OR "pseudo-randomized" OR "RCT" OR "randomized control trial" OR "randomised control trial")

2. (Adolescen* OR teenag* OR "young adults" OR youth OR student* OR college OR university)

3. (Alcohol* OR "binge drinking" OR drink* OR smok* OR tobacco)

4. (Internet OR online OR email OR web* OR virtual OR phone OR "cell phone" OR mobile OR "text message" OR text OR texting OR "short message service" OR "SMS" OR "video message" OR "picture message" OR "multi-media" OR video OR recording OR digital OR "social network" OR "social media")

5. #1 AND #2 AND #3 AND #4

APPENDIX 3

List of behaviour change techniques coded in the systematic review

BCT name	BCT description	Present in Alcohol specific taxonomy?	Present in smoking specific taxonomy?	Present in V1 taxonomy?
Provide information on consequences of excessive alcohol consumption and reducing excessive alcohol consumption	Give, or make more salient, information about the harm caused by excessive drinking and the benefits of reducing excessive alcohol consumption	**Yes**	**Yes**	Health consequences 5.1, salience of consequences 5.2, Social and environmental consequences 5.3, Emotional consequences 5.6
Identify reasons for wanting and not wanting to reduce excessive alcohol consumption	Help the client to arrive at a clear understanding of his or her feelings about reducing excessive alcohol use, why it is important to reduce and any conflicting motivations	**Yes**	**Yes**	X (Closest to pros and cons 9.2)
Boost motivation and self-efficacy	Give encouragement and bolster confidence in ability to reduce excessive alcohol use	**Yes**	**Yes**	Boost self-efficacy 15.1, nothing on general motivation
Provide normative information about others' behaviour and experiences	Give information about how the client's experience compares with other people's experiences	**Yes**	**Yes**	Social comparison 6.2
Provide feedback on performance	Give information on progress towards reducing excessive alcohol use	**Yes**	**Yes**	Feedback on behavior 2.2
Provide information on withdrawal symptoms	Describe to drinkers what are, and are not, alcohol withdrawal symptoms, how common they are, how long they typically last, what causes them and what can be done to alleviate them	**Yes**	**Yes**	X (Closest to Emotional consequences 5.6, specific to addiction)
Provide rewards contingent on effort or progress	Give praise or other rewards for the effort the drinker is making	**Yes**	**Yes**	Social reward 10.4, Material reward 10.2, Non-specific reward 10.3(?)
Prompt commitment from the client there and then	Encourage the client to affirm or reaffirm a strong commitment to start, continue or restart the attempt to reduce excessive alcohol use	**Yes**	**Yes**	Commitment 1.9
Conduct motivational interviewing	This is a specific set of techniques involving prompting the client to provide self-motivating statements and evaluations of own behaviour to	**Yes**	**No**	**No**

	minimise resistance to change (includes motivational counselling). Normally this technique will be mentioned by name. Only rate this technique if explicitly referred to by name, not if one identifies specific elements of it.			
Provide rewards contingent on successfully reducing excessive alcohol consumption	Give praise or other rewards if the client has cut down on their drinking	**Yes**	**Yes**	Social reward 10.4, Material reward 10.2
Prompt use of imagery	Teach the person to imagine successfully performing the behaviour or to imagine finding it easy to perform the behaviour, including component or easy versions of the behaviour	**Yes**	**No**	Comparative imagining of future outcomes 9.3
Model/ demonstrate the behaviour	Involves *showing* the person how to correctly perform a behaviour e.g., through physical or visual demonstrations of behavioural performance, in person or remotely	**Yes**	**No**	Modeling the behavior 6.1
Explain the importance of abrupt cessation	Explain why it is better to stop abruptly rather than cut down gradually if at all possible	**Yes**	**Yes**	Addiction specific
Facilitate goal setting	Help the client to set goals that support the aim of reducing their drinking	**Yes**	**Yes**	Goal setting outcome 1.3, Goal setting behavior 1.1
Facilitate action planning/help identify relapse triggers	Help the client identify specific triggers that generate urge/want/need to drink and develop and reinforce plans for avoiding these or coping with the motivation to drink when it occurs	**Yes**	**Yes**	Action planning 1.4
Advise on avoidance of social cues for drinking	Give specific advice on how to avoid being exposed to social cues for drinking (e.g. explaining to friends that you have stopped)	**Yes**	**Yes**	Avoidance/changing exposure to cues for the behavior 12.3, Restructuring the social environment, 12.2
Behaviour substitution	Substituting the undesired behaviour or its associated activities with a behaviour that does not promote excessive alcohol use e.g. substituting going to the pub with going to the cinema	**Yes**	**No**	Behaviour substitution 8.2
Prompt review of goals	Review how far the client has achieved the main goal of reducing excessive consumption/abstinence and any other goals that are	**Yes**	**Yes**	Review outcome goals 1.5, Review behavior goals 1.7

	supportive of it (e.g. putting in place plans to avoid triggers)			
Facilitate relapse prevention and coping	Help the client understand how lapses occur and how they lead to relapse and to develop general strategies for preventing lapses or avoiding lapses turning into relapse	**Yes**	**Yes**	Problem solving/coping planning 1.2
Prompt self-recording	Establish a routine of recording potentially useful information (e.g. situations or times when urges to drink are strong and less strong)	**Yes**	**Yes**	Self-monitoring of outcome of behavior 2.4, Self-monitoring of behavior 2.3
Facilitate barrier identification and problem solving	Help the client to identify general barriers (e.g. susceptibility to stress) that might make it harder to reduce excessive consumption/abstain and develop ways of addressing these	**Yes**	**Yes**	Problem solving/coping planning 1.2
Advise on environmental restructuring	Advise on ways of changing the physical environment to minimise exposure to drinking cues (e.g. removing bottles from the house)	**Yes**	**Yes**	Restructuring the physical environment 12.1
Set graded tasks	Set small achievable goals where appropriate (e.g. take one day at time)	**Yes**	**Yes**	Grade tasks 8.7
Advise on conserving mental resources	Advise on ways of minimising stress and other demands on mental resources (activities that require mental effort)	**Yes**	**Yes**	Conserving mental resources 11.3
Change routine	Advise on ways of changing daily or weekly routines to minimise exposure to drinking cues	**Yes**	**Yes**	Habit reversal 8.4, Habit formation 8.3, Avoidance/changing exposure to cues for the behaviour 12.3
Advise on/facilitate use of social support	Advise on or facilitate development of social support from friends, relatives, colleagues or 'buddies'	**Yes**	**Yes**	Social support practical 3.2, general 3.1, emotional 3.3
Give options for additional and later support	Give information about options for additional and later support where these are available (e.g. websites, self-help groups, telephone helpline)	**Yes**	**Yes**	**No**
Emphasise choice	Emphasise client choice within the bounds of evidence based practice	**Yes**	**Yes**	**No**
Assess current readiness and ability to reduce excessive alcohol consumption	Assess current level of motivation to reduce excessive alcohol use and confidence in success	**Yes**	**Yes**	**No**

Offer/direct towards appropriate written materials	Distinguish what are and are not, appropriate written materials and offer/direct clients to these in ways that promotes their effective use	**Yes**	**Yes**	**No**
Assess current and past drinking behaviour	Assess amount drunk, age when started, pattern of drinking behaviour	**Yes**	**Yes**	**No**
Assess past history of attempts to reduce excessive alcohol consumption	Assess number and duration of past attempts and experiences related to these, including factors that led to drinking	**Yes**	**Yes**	**No**
Assess withdrawal symptoms	Assess the presence and severity of alcohol withdrawal signs and symptoms	**Yes**	**Yes**	**No**
Explain expectations regarding treatment programme	Explain to the client the treatment programme, what it involves, the active ingredients and what it requires of the drinker	**Yes**	**Yes**	**No**
Tailor interactions appropriately	Use relevant information from the client to tailor the behavioural support provided	**Yes**	**Yes**	**No**
Build general rapport	Establish a positive, friendly but professional relationship with the client and foster a sense that the client's experiences are understood	**Yes**	**Yes**	**No**
Use reflective listening	Adopt a style of interaction that involves listening carefully to the client and where appropriate reflecting back to the client key elements of what s/he is saying	**Yes**	**Yes**	**No**
Provide reassurance	Give general reassurance to the client that his/her experiences are normal and time limited, and provide positive expectations of success based on experience with other drinkers in the same situation.	**Yes**	**Yes**	**No**
Summarise information/confirm client decisions	Provide a summary of information exchanged and establish a clear confirmation of decisions made and commitments entered into	**Yes**	**Yes**	**No**
Elicit and answer questions	Prompt questions from the client and answer clearly and accurately	**Yes**	**Yes**	**No**
Elicit client views	Prompt the client to give views on drinking, reducing excessive alcohol use/abstaining and any aspect of the behavioural support programme	**Yes**	**Yes**	**No**

General communication skills training	This includes any technique directed at general communication skills but not directed towards a particular behaviour change. Often this may include role play and group work focusing on listening skills or assertive skills	**Yes**	**No**	**No**
Strengthen ex-smoker identity	Explain the importance of regarding smoking as something that is 'not an option', including the 'not a puff' rule, encourage the smoker to re-evaluate the attraction to smoking, and construct a new identity as someone who 'used to smoke'.	**No**	**Yes**	**No**
Advise on stop smoking medication	Explain the benefits of medication safety, potential side effects, contraindications, how to use them most effectively, and how to get them; advise on the most appropriate medication for the smoker and promote effective use.	**No**	**Yes**	**No**
Adopt appropriate local procedures to enable clients to obtain free medication	Enact the necessary procedures to ensure that the smoker gets his/her medication easily and without charge where appropriate	**No**	**Yes**	**No**
Ask about experiences of stop smoking medication that the smoker is using	Assess usage, side effects and benefits experienced of medication(s) that the smoker is currently using	**No**	**Yes**	**No**
BCTs only present in V1				
Scheduled consequences				
Punishment	Arrange for aversive consequence contingent on the performance of the unwanted behaviour			
Response cost	Arrange for withdrawal of something valued if and only if an unwanted behavior is performed (includes '**Response cost'**). Note if withdrawal of contingent reward code, ***14.3, Remove reward***			
Chaining	Build up behavior by arranging reward following final component of the behavior; gradually add the components of the behavior that occur earlier in the behavioral sequence (includes **'Backward chaining'**)			
Extinction	Arrange for discontinuation of contingent reward following performance of the unwanted behavior (includes **'Extinction'**)			
Discrimination training	Arrange for reward following the behavior in one situation but not in another (includes **'Discrimination training'**)			
Shaping	Arrange for reward following any approximation to the target behavior, gradually rewarding only performance closer to the wanted behavior (includes **'Shaping'**)			
Negative reinforcement	Arrange for removal of an unpleasant consequence contingent on performance of the wanted behavior (includes **'Negative reinforcement'**)			
Counter-conditioning	Arrange reward for responding in a manner that is incompatible with a previous response to that situation (includes **'Counter-conditioning'**)			
Thinning	Arrange for rewards to be made contingent on increasing duration or frequency of the behavior (includes **'Thinning'**)			

Differential reinforcement	Arrange reward for performance of an alternative to the unwanted behavior (includes **'Differential reinforcement'**)
Reward and threat	
Self-reward	Prompt self-praise or self-reward if and only if there ***has been*** effort and/or progress in performing the behavior
Non-specific reward	Arrange delivery of a reward if and only if there ***has been*** effort and/or progress in performing the behavior (includes '**Positive reinforcement'**)
Threat	Inform that future punishment or removal of reward will be a consequence of performance of an unwanted behavior (may include fear arousal) (includes **'Threat'**)
Anticipation of future rewards or removal of punishment	Arrange for removal of an unpleasant consequence contingent on performance of the wanted behavior (includes **'Negative reinforcement'**)
Incentive	Inform that money, vouchers or other valued objects ***will be*** delivered if and only if there has been effort and/or progress in performing the behavior (includes **'Positive reinforcement'**)
Repetition and substitution	
Overcorrection	Ask to repeat the wanted behavior in an exaggerated way following an unwanted behaviour
Behavioural rehearsal/practice	Prompt practice or rehearsal of the performance of the behavior one or more times in a context or at a time when the performance may not be necessary, in order to increase habit and skill
Generalization of a target behaviour	Advise to perform the wanted behaviour, which is already performed in a particular situation, in another situation
Antecedents	
Distraction	Advise or arrange to use an alternative focus for attention to avoid triggers for unwanted behaviour
Associations	
Discriminative (learned) cue	Identify an environmental stimulus that reliably predicts that reward will follow the behavior (includes **'Discriminative cue'**)
Time out	Advise or arrange for the person to be separated from situations in which unwanted behavior can be rewarded in order to reduce the behavior (includes **'Time out'**)
Escape learning	Advise or arrange for the removal of an aversive stimulus to facilitate behavior change (includes **'Escape learning'**)
Satiation	Advise or arrange repeated exposure to a stimulus that reduces or extinguishes a drive for the unwanted behavior
Exposure	Provide systematic confrontation with a feared stimulus to reduce the response to a later encounter
Classical conditioning	Present a neutral stimulus jointly with a stimulus that already elicits the behavior repeatedly until the neutral stimulus elicits that behavior (includes **'Classical/Pavlovian Conditioning'**)
Fading	Withdraw gradually prompts to perform the behavior (includes **'Fading'**)
Prompts/cues	Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behavior. The prompt or cue would normally occur at the time or place of performance
Covert learning	
Vicarious reinforcement	Prompt observation of the consequences (including rewards and punishments) for others when they perform the behavior
Covert sensitization	Advise to imagine performing the **unwanted** behavior in a real-life situation followed by imagining an unpleasant consequence (includes **'Covert sensitisation'**)
Covert conditioning	Advise to imagine performing the **wanted** behavior in a real-life situation followed by imagining a pleasant consequence (includes **'Covert conditioning'**)
Natural consequences	
Social and environmental consequences	Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behavior
Emotional consequences	Provide information (e.g. written, verbal, visual) about emotional consequences of performing the behavior
Self-assessment of affective consequences	Prompt assessment of **feelings** after attempts at performing the behavior
Anticipated regret	Induce or raise awareness of expectations of future regret about performance of the unwanted behavior

Feedback and monitoring	
Biofeedback	Provide feedback about the body *(e.g. physiological or biochemical state)* using an external monitoring device as part of a behavior change strategy
Other(s) monitoring with awareness	Observe or record behavior with the person's knowledge as part of a behavior change strategy. Observe or record outcomes of behavior with the person's knowledge as part of a behavior change strategy.
Self-monitoring of outcome behaviour	Establish a method for the person to monitor and record the **outcome(s)** of their behavior as part of a behavior change strategy
Goals and planning	
Behavioural contract	Create a written specification of the behavior to be performed, agreed on by the person, and witnessed by another
Discrepancy between current behaviour and gold standard	Draw attention to discrepancies between a person's current behavior (in terms of the *form, frequency, duration, or intensity* of that behavior) and the person's previously set outcome goals, behavioral goals or action plans (goes beyond self-monitoring of behavior)
Comparison of behaviour	
Information about others' approval	Provide information about what other people think about the behavior. The information clarifies whether others will like, approve or disapprove of what the person is doing or will do
Self-belief	
Mental rehearsal of successful performance	Advise to practise imagining performing the behavior successfully in relevant contexts
Self-talk	Prompt positive self-talk (aloud or silently) before and during the behavior
Focus on past success	Advise to think about or list previous successes in performing the behavior (or parts of it)
Comparison of outcomes	
Persuasive argument	Present verbal or visual communication from a credible source **in favour of or against the behavior**
Pros and cons	Advise the person to identify and compare reasons for wanting (pros) and not wanting to (cons) change the behavior (includes '**Decisional balance')**
Identity	
Identification of self as a role model	Inform that one's own behavior may be an example to others
Self-affirmation	Advise the person to write or complete rating scales about a cherished value or personal strength as a means of affirming the person's identity as part of a behavior change strategy (includes **'Self-affirmation'**)
Reframing	Suggest the deliberate adoption of a perspective or new perspective on behavior (e.g. its purpose) in order to change cognitions or emotions about performing the behavior (includes '**Cognitive structuring**')
Cognitive dissonance	Draw attention to discrepancies between current or past behavior and self-image, in order to create discomfort (includes **'Cognitive dissonance'**)
Shaping knowledge	
Reattribution	Elicit perceived causes of behavior and suggest alternative explanations *(e.g. external or internal and stable or unstable)*
Antecedents	Provide information about antecedents (e.g. social and environmental situations and events, emotions, cognitions) that reliably predict performance of the behaviour
Behavioural experiments	Advise on how to identify and test hypotheses about the behavior, its causes and consequences, by collecting and interpreting data
Instruction on how to perform a behaviour	Advise or agree on how to perform the behavior (includes '**Skills training**')
Regulation	
Regulate negative emotions	Advise on ways of reducing negative emotions to facilitate performance of the behavior (includes '**Stress Management**')
Paradoxical instructions	Advise to engage in some form of the unwanted behavior with the aim of reducing motivation to engage in that behaviour

APPENDIX 4

Focus group participant consent form

Date of Birth: _____day _____month _____year

Gender: Male ☐ Female ☐

Please answer the following questions:

Tobacco Consumption

Question 1

In your life, have you EVER used ANY tobacco products?	NO	YES
Cigarettes, chewing tobacco, cigars etc but *NOT e-cigarettes)*		

Question 2

In the past month, how often have you used the substances mentioned	Never	Once or twice	Three or four times	Weekly	Once or twice a week	Three or four times a week	Four or five times a week	Daily or almost daily
Cigarettes, chewing tobacco, cigars, etc but *NOT e-cigarettes*								

Question 3

How many times a day do you typically use ANY tobacco products?	0	1 or 2	3 or 4	5 or 6	7, 8 or 9	10 or more
Cigarettes, chewing tobacco, cigars, etc but *NOT e-cigarettes*						

Alcohol consumption

Question 1

In your life, have you EVER consumed ANY alcoholic drinks?	NO	YES
Beer, wine, spirits, etc		

Question 2

In the past month, how often have you consumed ANY alcoholic drinks?	Never	Once or twice	Three or four times	Weekly	Once or twice a week	Three or four times a week	Four or five times a week	Daily or almost daily
Beer, wine, spirits, etc								

Question 3

How many alcoholic drinks do you usually consume on a typical drinking day?	0	1 or 2	3 or 4	5 or 6	7, 8 or 9	10 or more
Beer, wine, spirits, etc						

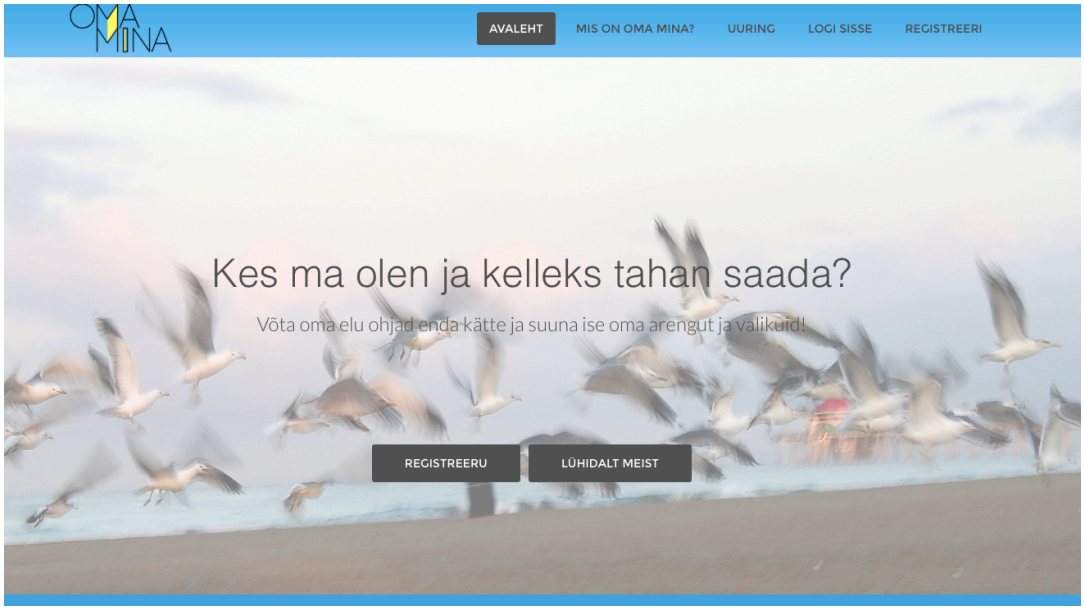
APPENDIX 5

Focus Group Interview Schedule

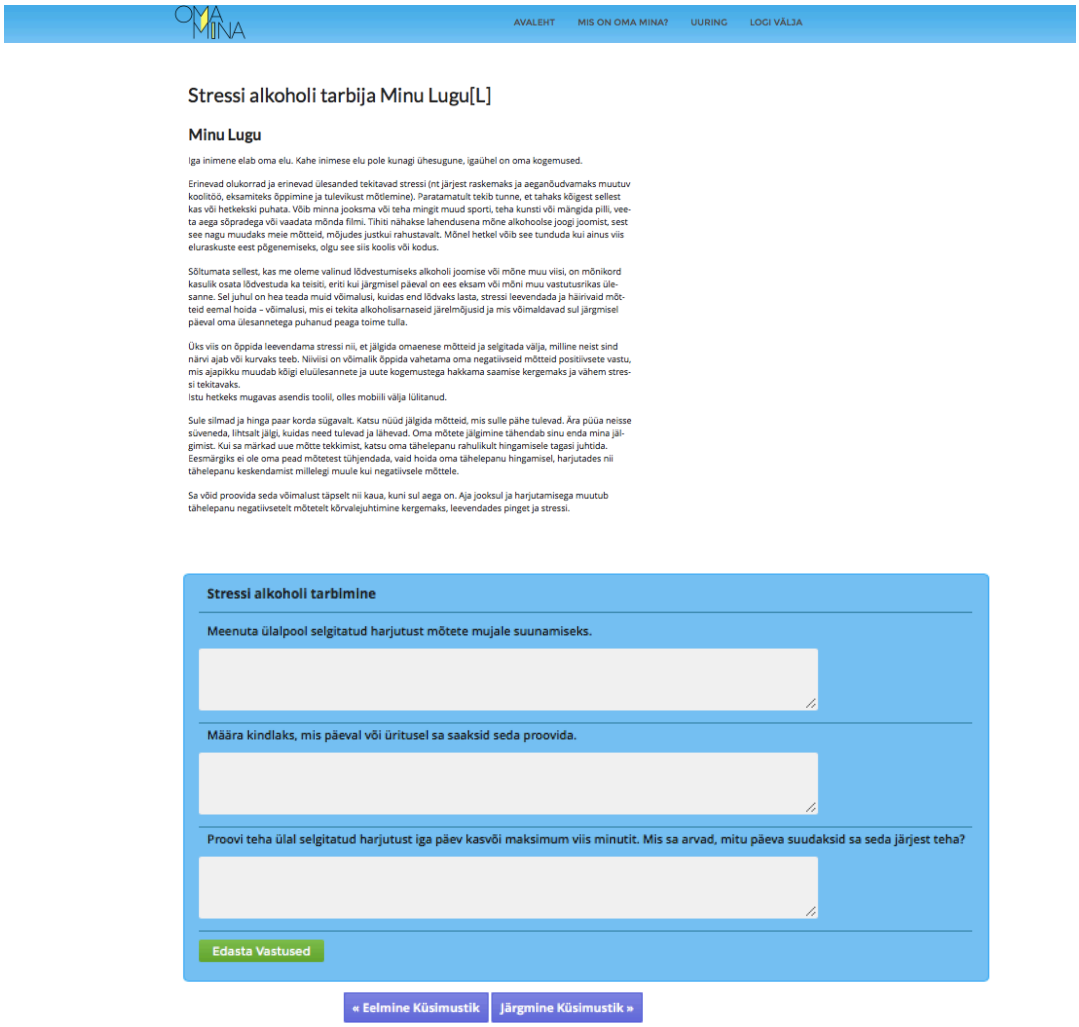
1. Why do young people drink and smoke or try drinking and smoking?
2. How common is it for young people to drink and smoke?
3. What do you think makes young people more likely to drink and smoke?
4. What makes them less likely to drink and smoke?
5. Do you think young people are interested in information about drinking and smoking?
6. Do you think young people who smoke are interested in getting help to quit?
7. Do you think young people who drink are interested in getting help to reduce their drinking?
8. Let's take a look at a couple of examples of websites that currently exist on tobacco and alcohol, can you describe to me what your thoughts are on these websites? Which parts do you like or dislike?
9. If you would change, add or take away anything on these websites what would it be and why?
10. Imagine you were given the task of creating a website on alcohol and tobacco consumption – what do you think you would want it to look like and what kind of features would you like it to include?

Appendix 6

Examples of web page design in the MyOwnMe intervention



Cover page of the MyOwnMe web platform.



Stressed alcohol drinker page, focusing on independent decision making and practical exercises on stress management.

APPENDIX 7

Examples of web page content in the MyOwnMe intervention

NOTE: these pages have been translated from Estonian and are not tailored to the English language or the language and context of adolescents and young adults in the UK. For this text to be used in the UK context, it would have to be edited together with representatives of adolescents and young adults from the UK.

Web page examples for 19-25-year-old smokers

WELCOME!

The magic of being a teenager

Everything in our lives is changing very quickly right now. Our bodies develop, we gain new knowledge, have different relations and roles in family, school and in the whole society. We try out new things that we have not experienced before, communicate with new people, become more and more independent – start making our own decisions and depending less and less on our parents, teachers and other adults.

Changes are natural

The teenage years are full of energy, creativity and motivation. We go to school, discover new music, learn to drive, do sports, make new friends, decide, where to go to university, experience first romantic thoughts and relationships, form our own opinions of the world. All of this can be intimidating at times and cause stress because everything changes so quickly and we get the feeling that we might feel overwhelmed. The challenges of managing so many changes during the teenage years is not talked about much and adults who otherwise try to support us might add to the stress by criticising our choices without meaning to.

The effect of society

Amidst the changes we are going through and the lack of discussion and information about them we try to find ways of expressing ourselves and of finding ways to relax. However, we might not pay attention to whether our choices are truly independent and right for each of us or whether we are choosing based on what the people around us seem to be doing. Our environment can influence us a lot and during times of change it is useful to think about how

our habits and choices are shaped by those around us and whether we want to be shaped in this way.

My Own Me

Our program offers new ideas and practical options how to express our needs and at the same time to decide personally what direction we want to take.

MY HABITS

What are habits?

Habits are behaviour patterns that we carry out regularly and often without thinking. Initially, we of course learn or choose an action but the more often we do something, the more automatic it gets. A good example of a habit that you might carry out automatically is brushing your teeth.

Smoking is also a habit. The first time that someone offered you a cigarette, it was a decision that you were faced with: to accept the cigarette and smoke it or not. The next time it was offered, especially if the person offering was the same, you might have thought a little less about it, it might have become a bit more automatic to accept the cigarette. And so on until accepting cigarettes from others turned into buying them yourself and not needing to make the decision of whether to smoke. You might no longer think that with every cigarette, there is still a choice to *not* smoke it that you can make, regardless of which decision you have taken so far.

Or for example, you meet someone who you like or who impresses you. You would like to know him or her better. You are at a party and he or she offers you a cigarette. You accept and you spend time together, chatting cheerfully, smoking. When you have smoked your cigarette then your new friend asks you smiling if you would like another one and starts to offer you a new cigarette. Saying '*no*' does not make you *less* interesting companion. Or if you feel that you dare not to refuse then it is possible to say that '*no*', not right now, but perhaps later. And later it is already easier to say 'no' again.

It is your own choice what habits you choose to develop.

You might want to weigh the advantages and disadvantages of each of your habits to ensure you are filling your time with behaviours which help you achieve the future you dream of. For example, it might be more useful to read two books a month than use the same amount of time for partying on Fridays and Saturdays.

Habits and the teenage brain

The brain develops the quickest between the ages of 12-25. During this time, permanent connections between brain cells are created which means that we learn very quickly and create habits that can remain for the rest of our lives. Our ability to develop the skills so valued in today's workforce, such as complex thinking and creativity are also developed during this time. It is also a time where the brain become better at making independent decisions and being less influenced by the opinions of others.

Brain development is damaged by nicotine. Nicotine significantly reduces the brain's development capacity because during the teenage years, the brain is especially sensitive to such substances. Smoking is likely to become a long-term habit, if started between the ages of 12 and 25.

Protecting the brain's development during these years is important for making sure that we can achieve our goals in the future. You can do this by reducing your cigarette smoking and finding alternative activities which support rather than reduce your brain's development potential.

Goals

Let's set a goal for how you can start supporting the development of your brain. As everywhere in this program we use smoking as an example.

Write down a new and exciting experience that <u>is not</u> connected to smoking and which you would be interested in trying.

.....

Write down the time and place when you will be trying this new activity for the first time.

.....

We will see next week if you have met your goal or whether we need to set something more manageable. Either way, you have already started to support the full potential of your brain!

Stress smoker user profile

MY STORY

Times of stress
Every person has a unique experience of life. This means that every person also experiences stress differently. For example, the extent to which working too much, managing university assignments or making plans for the future causes stress is different for each person. It is natural to occasionally feel overwhelmed with commitments and responsibilities. So, it is also natural to need a rest from the stress. Sometimes smoking a cigarette might seem like the easiest, quickest way to find a relief from stress. But there are many more efficient ways of relaxing, for example exercising, make art, play a musical instrument or spend time with friends.

Stress relief
If you tend to use smoking to relieve stress, it is useful to have a different method for relaxing as well, especially if you are taking exams at university or have important deadlines and meetings at work. In such situations, you might not always be able to step outside for a cigarette so having another tool for relaxing is beneficial. It is also useful because the nicotine in cigarettes actually increases anxiety and tension in your body, rather than reducing it so smoking is a rather inefficient way to reduce stress.

Practical exercise

One way to relieve stress is to learn to observe your thoughts and identify which topics cause you most distress. It is then possible to learn to replace your negative thoughts with positive ones which in the long term makes coping with your responsibilities less stressful. Try this exercise:

1. *Switch off your mobile and sit comfortably in a chair for a moment.*
2. *Close your eyes and take couple of deep breaths.*
3. *Now try to observe the thoughts that come into your head. Don`t try to delve into them, just observe how they come and go. Observing your thoughts means observing yourself.*
4. *If you notice a new thought coming then try to move your attention calmly back to your breath. The aim is not to empty your head from thoughts but to keep your attention on breathing, practicing focusing your attention on something else.*

You can continue this for as little or as long as you have time, with practice it becomes easier to immediately calm your mind and continue with your tasks.

To ensure your success in learning to manage your stress, let's set a goal:

Describe the stressful situations in your life where the above exercise could be useful:

……
.

Set the date when or choose an event where you could try it for the first time:

……
……..

Try to practise this exercise every day at least for 5 minutes. What do you think, how many consecutive days could do it? Try to substitute one cigarette per day with this exercise.

Social smoker user profile

MY STORY

Socialising is important!

It is important for our wellbeing to be able to communicate honestly and openly about our experiences. It is also exciting to learn about other's experiences through old and new friendships. At the same time, it is not always easy to find a conversation topic with new people, especially if you are in a company where you do not know anyone. Socialising can be awkward sometimes and include lots of empty silences where no one seems to know what to say. Sometimes it might feel safer to have a cigarette in hand when approaching new people or to socialise the most when going out for smoke breaks with a group. That way you already have something to fill the silences with, namely your cigarettes. It might also seem like a good conversation starter, as you already know you have smoking in common with other smokers.

Having fulfilling relationships and easy communication with others is an important skill to develop for now and the future. Honest communication is a great way to relieve stress, and maintain long-term relationships. Yet, if we communicate with the support of a cigarette, you might not express yourself as you would without being under the influence of nicotine so some of the honesty might be lost.

Developing communication skills

Creating and maintaining relationships is one of the main skills of an adult, which helps to fulfil our potential in our personal and professional lives. You might currently feel that it is easier to start conversations with other smokers with the aid of having a cigarette in your hand, but this might not be possible in every environment. For example, if you need to go to a job interview, you need to show to your possible future employer your communication skills without smoking a cigarette. Or if you are offered an opportunity to lead a project at university or work, then you have to find mutual common ground with many different people, link different viewpoints and find ways to collaborate – all of which requires very good communication skills and flexibility. If you can communicate well only with the support of a cigarette, then you are not able to show your leadership when it is not appropriate to smoke.

Practical Exercise 1

Think of situations where you have been a bit hesitant, especially while talking to new people. Write shortly, what happened, what did you think, how did you feel, what did you say and how other people present affected your thoughts and actions.

.....
.....
.....

My new social identity

To have an authentic conversation with your existing friends or new people who you meet, try to spend time with them without smoking. First try to talk to your best friend about something important to you so that you do not smoke a cigarette but both still say what you think. If it makes you feel good then try it next for example with some other friends, and then with someone new who you meet etc.

Practical Exercise 2

Write down what would you like to talk about with your best friend next week.

.....
.....

Write down some sentences how you could explain him/her why you would like to be with him/her without smoking cigarettes.

.....
.....

Saying 'no'

It is easy to make a plan to discuss something important with your friend or make conversation with someone new without the help of a cigarette, but still when you are actually socialising, you might face a situation where you feel pressured to smoke cigarettes. Write below how would you overcome such situations.

Practical Exercise 3

If someone asks why I do not smoke, then I can say that……

If……., then……..

If ……., then ……..

If ……., then ……..

Pressured smoker user profile

MY STORY

Independent choices

We all have different experiences in life and we understand similar situations differently. For example, at a family celebration, we might be together with several different family members, but how we feel in that situations is different for everyone involved. In some social situations, we feel relaxed and confident whereas in others we feel slightly uncomfortable and perhaps not completely ourselves. This might be because in some social groups, the people who we spend time with are more or less familiar to us or treat us in different ways.

For example, if you are at a party and a cigarette is offered to you by someone you don't know very well or someone who you don't feel completely comfortable with, you might feel less confident in saying no than if your best friend offered it to you. You might feel that you should take the cigarette because you don't want to leave a bad impression for this new person.

Have you ever been in that situation? What did you think? What did you feel?

The good news is that regardless of who you are spending time with, learning to feel confident and relaxed in social situations is a skill like any other. Therefore, all you need to do is practice! For example, saying no to cigarettes offered by a person you don't know very well or maybe don't like very much is a part of this skill. You might keep saying yes to cigarettes you don't want for a little while still because building a new skill takes time. But now that you are starting to practice saying no, eventually you will be able to say it easily and without stress.

Practical Exercise 1

Think about where and when you and your friends usually smoke cigarettes. Recall the last time someone offered you a cigarette in such a situation. Write shortly what happened, what did you think and what did you say and how did the presence of your friend affect your thoughts.

.....
.....
.....

My new me and cigarettes

Let's think about how could you say 'no' if a cigarette is offered to you so that it would not leave a negative impression of you to the other person?

For example

- No, I better not, I have a training tomorrow.
- No, I have not eaten, I would not like to drink or smoke with an empty stomach.
- Maybe later, I do not fancy it now.
- No, I have promised to X that I will not smoke today.
- No, I feel sick in my stomach, I`m going to pass.

Practical Exercise 2

Write down five sentences that you could use to refuse cigarettes without causing tension in your friendships or relationships with new people.

1. .....

2. .....

3. .....

4. .....

5. .....

I just like it smoker user profile

MY STORY

Newness and excitement

What do you normally do after work or university? What do you do at weekends, during holidays? If you have free time after doing your duties, what do like to do? Do you sometimes feel bored because you feel as if there is nothing exciting for you to do? Do you feel as if it is more exciting to go somewhere with your companions and have a drink or two than just stay at home?

New skills, tastes and feelings that we learn and experience in youth are very important because they form the basis for our understanding about the world and our habits. The experiences we have during these years also form our social circle or community. We do not often discuss the importance of our interests as youth being natural and normal. Our cravings for newness and excitement is a normal part of our development and should be nurtured to ensure we develop the necessary skills to succeed later in life. However, how we nurture these cravings is even more important. Finding newness and excitement can be experienced in many ways and situations and it might not be in ways that you would expect.

New experiences

Trying new things and gaining new exciting experiences is completely natural. However, we often find this excitement in ways that we see others finding it. For example, we might choose to try cigarette smoking because we see others doing it and it seems like a new and exciting experience. However, once you do it enough times, the newness and excitement might be gone but the habit remains. So, you might not have the same kind of motivation for continuing to smoke cigarettes as you did at the beginning.

Practical Exercise 1
Write what you normally do in your free time after work or university.

.....
.....
.....

Write down a few reasons why you enjoy smoking cigarettes.

.....
.....
.....

Write down which activities would help you feel less bored or restless.

.....
.....
.....

Doing it differently

There are several other activities which might provide the newness and excitement youa re looking for but which continue to be challenging and less likely to become boring than cigarette smoking. For example, travelling, studying a new language, trying on leadership roles are all activities which you might be interested in trying to have a longer-term source of excitement. Getting involved in one of these activities might mean finding someone else who is interested in them and trying them together which would be an opportunity to make new friends as well. Some ways to find others interested in the same activities as you might be to join a student club at your university or ask around your workplace. Another way might be to find people who already know how to get involved in the activities you are interested in and learning from them.

Practical Exercise 2

Write down some activities that you would like to master.

.....
.....
.....

Practical Exercise 3
Write down what are the possibilities to study these new skills, considering affordability, availability and people who could teach you or learn with you.

.....
.....
.....

Appendix 8

Text message schedules in the MyOwnMe intervention

Substance	Day	Time	Message block
Cigarettes	1	am	Introduction
		pm	Dependence
	2	am	Outcome expectancy
		pm	Outcome expectancy
	3	am	Refusal SE
		pm	Refusal SE
	4	am	Self-theory
		pm	Self-theory
	5	am	Independent decisions
		pm	Independent decisions
	6	am	Refusal SE
		pm	Refusal SE
	7	am	Motivation
		pm	Motivation
	8	am	Quit/reduction
		pm	Quit/reduction
	9	am	Outcome expectancy
		pm	Outcome expectancy
	10	am	Refusal SE
		pm	Refusal SE
	11	am	Self-theory
		pm	Self-theory
	12	am	Independent decisions
		pm	Independent decisions
	13	am	Refusal SE
		pm	Refusal SE
	14	am	Motivation
		pm	Motivation
	15	am	Quit/reduction
		pm	Quit/reduction
	16	am	Outcome expectancy
		pm	Outcome expectancy
	17	am	Refusal SE
		pm	Refusal SE
	18	am	Self-theory
		pm	Self-theory
	19	am	Independent decisions
		pm	Independent decisions
	20	am	Refusal SE
		pm	Refusal SE
	21	am	Motivation
		pm	Motivation
	22	am	Quit/reduction
		pm	Quit/reduction
	23	am	Outcome expectancy
		pm	Outcome expectancy
	24	am	Refusal SE
		pm	Refusal SE
	25	am	Self-theory
		pm	Self-theory
	26	am	Independent decisions
		pm	Independent decisions
	27	am	Refusal SE
		pm	Refusal SE
	28	am	Motivation
		pm	Motivation
	29	am	Quit/reduction
		pm	Quit/reduction
	30	am	Outcome expectancy
		pm	Outcome expectancy
	31	am	Refusal SE
		pm	Refusal SE
	32	am	Self-theory
		pm	Self-theory
	33	am	Independent decisions
		pm	Independent decisions
	34	am	Refusal SE
		pm	Refusal SE
	35	am	Motivation
		pm	Motivation

Text message schedule for alcohol.

Substance	Day	Time	Message block
Alcohol	1	am	Introduction
		pm	Dependence
	2	am	Outcome expectancy
		pm	Outcome expectancy
	3	am	Refusal SE
		pm	Refusal SE
	4	am	Self-theory
		pm	Self-theory
	5	am	Independent decisions
		pm	Independent decisions
	6	am	Refusal SE
		pm	Refusal SE
	7	am	Motivation
		pm	Motivation
	8	am	Quit/reduction
		pm	Quit/reduction
	9	am	Outcome expectancy
		pm	Outcome expectancy
	10	am	Refusal SE
		pm	Refusal SE
	11	am	Self-theory
		pm	Self-theory
	12	am	Independent decisions
		pm	Independent decisions
	13	am	Refusal SE
		pm	Refusal SE
	14	am	Motivation
		pm	Motivation
	15	am	Quit/reduction
		pm	Quit/reduction
	16	am	Outcome expectancy
		pm	Outcome expectancy
	17	am	Refusal SE
		pm	Refusal SE
	18	am	Self-theory
		pm	Self-theory
	19	am	Independent decisions
		pm	Independent decisions
	20	am	Refusal SE
		pm	Refusal SE
	21	am	Motivation
		pm	Motivation
	22	am	Quit/reduction
		pm	Quit/reduction
	23	am	Outcome expectancy
		pm	Outcome expectancy
	24	am	Refusal SE
		pm	Refusal SE
	25	am	Self-theory
		pm	Self-theory
	26	am	Independent decisions
		pm	Independent decisions
	27	am	Refusal SE
		pm	Refusal SE
	28	am	Motivation
		pm	Motivation
	29	am	Quit/reduction
		pm	Quit/reduction
	30	am	Outcome expectancy
		pm	Outcome expectancy
	31	am	Refusal SE
		pm	Refusal SE
	32	am	Self-theory
		pm	Self-theory
	33	am	Independent decisions
		pm	Independent decisions
	34	am	Refusal SE
		pm	Refusal SE
	35	am	Motivation
		pm	Motivation

Text message schedule for alcohol and smoking.

Substance	Day	Time	Message block
Cigarettes and Alcohol	1	am	Introduction
		pm	Dependence
	2	am	Outcome expectancy cig
		pm	Outcome expectancy cig
	3	am	Outcome expectancy alc
		pm	Outcome expectancy alc
	4	am	Refusal SE cig
		pm	Refusal SE cig
	5	am	Refusal SE alc
		pm	Refusal SE alc
	6	am	Self-theory cig
		pm	Self-Theory cig
	7	am	Self-theory alc
		pm	Self-theory alc
	8	am	Quit/reduction cig
		pm	Quit/reduction cig
	9	am	Quit/reduction alc
		pm	Quit/reduction alc
	10	am	Independent decisions cig
		pm	Independent decisions cig
	11	am	Independent decisions alc
		pm	Independent decisions alc
	12	am	Refusal SE cig
		pm	Refusal SE cig
	13	am	Refusal SE alc
		pm	Refusal SE alc
	14	am	Motivation cig
		pm	Motivation alc
	15	am	Quit/reduction cig
		pm	Quit/reduction cig
	16	am	Quit/reduction alc
		pm	Quit/reduction alc
	17	am	Outcome expectancy cig
		pm	Outcome expectancy cig
	18	am	Outcome expectancy alc
		pm	Outcome expectancy alc
	19	am	Refusal SE cig
		pm	Refusal SE cig
	20	am	Refusal SE alc
		pm	Refusal SE alc
	21	am	Self-theory cig
		pm	Self-theory alc
	22	am	Quit/reduction cig
		pm	Quit/reduction cig
	23	am	Quit/reduction alc
		pm	Quit/reduction alc
	24	am	Motivation cig
		pm	Motivation cig
	25	am	Motivation alc
		pm	Motivation alc
	26	am	Independent decisions cig
		pm	Independent decisions cig
	27	am	Independent decisions alc
		pm	Independent decisions alc
	28	am	Refusal SE cig
		pm	Refusal SE alc
	29	am	Quit/reduction cig
		pm	Quit/reduction cig
	30	am	Quit/reduction alc
		pm	Quit/reduction alc
	31	am	Outcome expectancy cig
		pm	Outcome expectancy cig
	32	am	Outcome expectancy alc
		pm	Outcome expectancy alc
	33	am	Independent decisions cig
		pm	Independent decisions alc
	34	am	Refusal SE cig
		pm	Refusal SE alc
	35	am	Motivation cig
		pm	Motivation alc

Schedule for alcohol and smoking.

Appendix 9

Example text message matrices

Dependence	Substance used	Gender	Message type	Time sent	Message code	Message content 12-18 years old	Message code	19-25 years old
Addicted	Cigarettes	Male	Nicotine addiction	am	dacmy	You mentioned that you smoke within the first hour of waking up in the morning. This might be a symptom of nicotine addiction.	dacmo	You mentioned that you smoke within the first hour of waking up in the morning. This might be a symptom of nicotine addiction.
		Female	Nicotine addiction	am	dacfy	You mentioned that you smoke within the first hour of waking up in the morning. This might be a symptom of nicotine addiction.	dacfo	You mentioned that you smoke within the first hour of waking up in the morning. This might be a symptom of nicotine addiction.
	Alcohol	Male	Referral message	am	daamy	Your alcohol consumption is higher than average. Please consult http://alkoinfo.ee/et/kust-saada-abi/kust-saada-nou-ja-abi	daamo	Your alcohol consumption is higher than average. Please consult http://alkoinfo.ee/et/kust-saada-abi/kust-saada-nou-ja-abi
		Female	Referral message	am	daafy	Your alcohol consumption is higher than average. Please consult http://alkoinfo.ee/et/kust-saada-abi/kust-saada-nou-ja-abi	daafo	Your alcohol consumption is higher than average. Please consult http://alkoinfo.ee/et/kust-saada-abi/kust-saada-nou-ja-abi

Examples of text messages sent to participants who were identified as addicted to nicotine or cigarettes.

Outcome expectancy	Substance used	Age	Message type	Time sent	Message code	Message content
Stress	Cigarettes	12-18 years old	Nicotine effect on stress; stress reduction methods	am	oescy1	Smoking increases your stress levels by increasing your heart rate and reducing the oxygen level in your brain.
				pm	oescy2	Hi #name! Try to replace at least two smoking breaks today with an alternative. Maybe go for a quick walk or jog after school?
					oescy3	Hi #name! Instead of smoking, try eating lollipops, it will replace one habit with another and take your mind off smoking!
					oescy4	School can be stressful but instead of smoking you could try to sit still in a quiet place, close your eyes and breathe deeply.
					oescy5	Hi #name! Did you know that smoking increases the feeling of anxiety in your body? Let's find another way to reduce your stress!
					oescy6	When you have a lot of homework and are feeling tired, drink some green tea. It makes you more alert than smoking!
					oescy7	Hi #name! Try exercising in the morning, It will give you lots of energy and calms the whole body to be ready for the day.

Examples of text messages sent to participants who were identified as ‘stress smokers’.

Outcome expectancy	Substance used	Age	Message type	Time sent	Message code	Message content
Social		19-25 years old	Alcohol in socialising; alternatives	am	oesocao1	It might feel like you need alcohol to be sociable at events. But it slows down your thinking and speech. so you might not be as articulate as you would like to be.
				pm	oesocao2	At the next event, take an alcoholfree cocktail. Then you won't have to explain why you are not drinking and can shine with your social skills!
					oesocao3	Your work might require attending events where alcohol is served. Choose water instead of alcohol and you will be more competent at discussing work.
					oesocao4	Hi #name! Try out an alcohol free weekend! It will help you detox and prepare for another week of university and work.
					oesocao5	Alcohol might seem obligatory at celebrations. But that is just an outdated assumption, alcohol doesn't actually make accomplishments more important or enjoyable.
					oesocao6	Hi #name! If you are worried about remaining sober this weekend, why not organise an event yourself in a venue which does not allow alcohol?

Examples of text messages sent to participants who were identified as social drinkers.

Refusal SE	Substance used	Age	Parents' consumption	Friends' consumption	Message type	Time sent	Message code	Message content
Low	Cigarettes	12-18 years old	Yes	Yes	Saying no to parents, saying no to friends,	am	reselcypf1	If your parents are smoking near you, ask them to take it outside or say that you need some fresh air and go for a short walk.
			No	No	Saying no general	am	reselcygen1	Saying no is a skill, it gets easier with practice. Ask a friend to help you if you feel you are not ready to say not to offers of cigarettes yourself yet.
			Yes	No	Saying no to parents	am	reselcyp1	If your parents are smoking near you, ask them to take it outside or say that you need some fresh air and go for a short walk.
			No	Yes	Saying no to friends	am	reselcyf1	If your friends offer you a cigarette, you could say no thank you, maybe later. Then you don't have to refuse completely but can postpone the question.

Examples of text messages sent to participants identified as having low refusal self-efficacy.

Independent decisions	Substance used	Age	Time sent	Message type	Message code	Message content
	Cigarettes	12-18 years old	am	Social norms	ipcy1	New experiences and decisions can be daunting, but it is time to change how we socialise and be more innovative! We don't need a cigarette in our hands to talk to people!
			pm	Estonian context	ipcy2	As a smoker, you are the minority amongst people your age in Estonia. Only 2.2% of people your age smoked in the last week!
			am		ipcy3	Well done for deciding to become smoke free! Last year, 69% of people your age tried to become smokefree as well, you are not alone!
			pm		ipcy4	We get a lot of messages about what we are supposed to act and be like. Let's take the lead in our lives and dare to be our unique selves!
			am		ipcy5	We often feel like people will always see us the same way. When you make your own decisions, you also show others that you can develop and grow.
			pm		ipcy6	The decision to smoke might be an influence of your environment, rather than your own choice. You might not notice how much those who surround you influence your choices.

Examples of autonomy-supportive messages sent to participants who smoke cigarettes.

Motivation	Substance used	Age	Time sent	Message type	Message code	Message content
Low	Alcohol	19-25 years old	am	Motivation	lmca1	Hi #name! You are admirably courageous for trying to reduce your alcohol consumption. Celebrate your decision and courage today!
			pm	Motivation	lmca2	Congratulations on another day of choosing your freedom and realising your potential! Change is difficult but you can do it!
			am	Motivation	lmca3	You are a special person and the world wants to get to know you. Enjoy changing your habits and others will enjoy it too!
			pm	Motivation	lmca4	Reducing alcohol consumption is difficult. But it doesn't have to be perfect on the first try. Allow yourself days where things don't go so well. It won't change the end result.
			am	Motivation	lmca5	Hi #name! You might have heard negative comments about the possibility of change from friends or family. These are more reflective of their uncertainty rather than being about you!

Examples of text messages sent to participants identified as having low motivation.

Appendix 10

Pilot Study Screening Questionnaire

Date of Birth: _____day _____month _____year

Gender: Male ☐ Female ☐

Please answer the following questions:

Tobacco Consumption

Question 1

In your life, have you EVER used ANY tobacco products?	NO	YES
Cigarettes, chewing tobacco, cigars etc but *NOT e-cigarettes)*		

Question 2

In the past month, how often have you used the substances mentioned	Never	Just a puff	Once or twice	Three or four times	Weekly	Once or twice a week	Three or four times a week	Four or five times a week	Daily or almost daily
Cigarettes, chewing tobacco, cigars, etc but *NOT e-cigarettes*									

Question 3

How many times a day do you typically use ANY tobacco products?	0	Just a puff	1 or 2	3 or 4	5 or 6	7, 8 or 9	10 or more
Cigarettes, chewing tobacco, cigars, etc but *NOT e-cigarettes*							

Alcohol consumption

Question 1

In your life, have you EVER consumed ANY alcoholic drinks?	NO	YES
Beer, wine, spirits, etc		

Question 2

In the past month, how often have you consumed ANY alcoholic drinks?	Never	Just a sip	Once or twice	Three or four times	Weekly	Once or twice a week	Three or four times a week	Four or five times a week	Daily or almost daily
Beer, wine, spirits, etc									

Question 3

How many alcoholic drinks do you usually consume on a typical drinking day?	1 or 2	3 or 4	5 or 6	7 to 9	10 or more
Beer, wine, spirits, etc					

Appendix 11

Intervention Group Baseline/Tailoring Questionnaire

Demographics

Name (you can choose an alias if you would prefer not to give your real name)	
Date of birth	
Gender (Male/Female)	

Alcohol consumption

Question 1

How often do you consume alcoholic drinks?	**Never**	**Every month or less**	**2-4 times a month**	**2-3 times a week**	**4 or more times a week**
Beer, wine, spirits etc					

Question 2

How often in the past month have you consumed alcohol?	**Never**	**Once or twice**	**Three or four time**	**Once a week**	**Once or twice a week**	**Three or four times a week**	**Four or five times a week**	**Every day or almost every day**
Beer, wine, spirits etc								

Question 3

How many drinks do you consume on a typical drinking day?	**0**	**1 or 2**	**3 or 4**	**5 or 6**	**7, 8 or 9**	**10 or rohkem**
Beer, wine, spirits etc						

Question 4

How often do you drink 6 or more alcoholic drinks at the same drinking occasion?	**Never**	**Less than once a month**	**Every month**	**Every week**	**Every day or almost every day**
Beer, wine, spirits etc					

Question 5

How often do your parents drink alcohol?	**Never**	**Less than once a month**	**Every month**	**Every week**	**Every day or almost every day**	**Don't know**
Mother						
Father						

Question 6

How many of your five closest friends drink alcohol?	**0**	**1**	**2**	**3**	**4**	**5**

Question 7

	1 Very unlikely	**2** Unlikely	**3** Somewhat unlikely	**4** Somewhat likely	**5** Likely	**6** Very likely
The next time I am offered an alcoholic drink, I am going to say 'no'.						
Next month I am going to stick to the recommended alcohol consumption limits at every event or birthday party I go to.						
I am going to stop drinking alcohol.						

Question 8.

At what age did you have your first alcoholic drink?

Question 9

What kind of alcoholic drink do you usually consume at social events?

Question 10. Which of the following statements best describes the most common reason for your alcohol consumption?

	To reduce srtess	**To be social**	**I feel that when others around me are drinking, I should too**	**I just like it**
I drink alcohol				

Tobacco consumption

Question 1

Have you ever in your life consumed tobacco?	**No**	**Yes**
Cigarettes, snus, cigars but NOT e-cigarettes		

Question 2

Have you consumed any tobacco in the past month?	Not once	Once or twice	Three or four times	Once a week	Once or twice a week	Three or four times a week	Four or five times a week	Every day or almost every day
Cigarettes, snus, cigars but NOT e-cigarettes								

Question 3

How many cigarettes do you smoke a day?	10 or less	11-20	21-30	31 or more

Question 4

How soon after waking up in the morning do you consume tobacco?	Within 5 minutes	Within 6-30 minutes	Within 31-60 minutes	After 60 minutes
Cigarettes, snus, cigars but NOT e-cigarettes				

Question 5

How often do your parents consume tobacco?	Never	Less than once a month	Every month	Every week	Every day or almost every day	Don't know
Mother						
Father						

Question 6

How many of your five closest friends consume tobacco?	0	1	2	3	4	5

Question 7. To what extent do you agree with the following statements:

	1 Very unlikely	2 Unlikely	3 Somewhat unlikely	4 Somewhat likely	5 Likely	6 Very likely
The next time I am offered a cigarette, I am going to say 'no'.						
I am going to quit smoking.						

Question 8

At what age did you first smoke a cigarette?

Question 9

How many cigarettes do you usually smoke at social events?

Question 10

What type of cigarettes do you usually smoke?

Question 11

Which of the following statements best describes the most common reason why you smoke cigarettes?

	To reduce stress	**To be social**	**I feel I should smoke when everyone around me is smoking**	**I just like it**
I smoke				

Questions about the possibility of change

1. In your opinion, are the following statements true?	**Yes**	**No**
People addicted to alcohol and/or nicotine can't change.		
Everyone is either a winner or a loser.		
People, who start drinking alcohol and smoking cigarettes before becoming adults, can't change.		
Addicts can sometimes try to give up alcohol and/or nicotine, but they will always fall back into their habits.		
There are two types of people, those who smoke/drink and those who avoid both.		

2.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change
To what extent do you think that a person's personality can change?					

3.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change
To what extent do you think that people can change their own personality?					

4.	1 Definitely cannot change	2 Almost definitely cannot change	3 Probably cannot change	4 Probably can change	5 Definitely can change
To what extent do you think that your personality could change?					

5.	1 Definitely cannot change	2 Almost definitely cannot change	3 Probably cannot change	4 Probably can change	5 Definitely can change
To what extent do you think that you could change your personality?					

Questions about refusal self-efficacy

Drinking refusal self-efficacy

How confident are you that you can say no when an alcoholic drink is offered to you in the following situations?	**1** I am completely sure that I CANNOT say no	**2** I very likely CANNOT say no	**3** I probably CANNOT say no	**4** I probably CAN say no	**5** I very likely CAN say no	**6** I am completely sure that I CAN say no.
1. If my girlfriend/boyfriend offers me alcohol.						
2. If my friends offer me alcohol.						
3. If someone in a club/bar offer me alcohol.						

To what extent are the following statements true	**1** Never true	**2** Sometimes true	**3** Not sure	**4** Usually true	**5** Always true
1. If my friends are drinking alcohol, it is very difficult for me to say no to offers of alcohol.					
2. If I wanted to quit drinking alcohol, I probably could not do it.					
3. If someone offers me alcohol, I definitely cannot say no.					

4. If my parents offer me alcohol, I definitely cannot say no.					
5. It is very difficult for me to become/stay completely sober.					
6. If people call me a coward for not wanting to consume alcohol, I have no idea what to say.					
7. It is very difficult for me to explain to others that I do not want to drink alcohol.					

Smoking Refusal Self-Efficacy

How confident are you that you can say no when a cigarette is offered to you in the following situations?	**1** I am completely sure that I CANNOT say no	**2** I very likely CANNOT say no	**3** I probably CANNOT say no	**4** I probably CAN say no	**5** I very likely CAN say no	**6** I am completely sure that I CAN say no.
1. If my girlfriend/boyfriend offers me a cigarette.						
2. If my friends offer me a cigarette.						
3. If someone in a club/bar offer me a cigarette.						

To what extent are the following statements true	**1** Never true	**2** Sometimes true	**3** Not sure	**4** Usually true	**5** Always true
1. If my friends are smoking cigarettes, it is very difficult for me to say no to offers of cigarettes.					
2. If I wanted to quit smoking cigarettes, I probably could not do it.					
3. If someone offers me a cigarette, I definitely cannot say no.					

4. If my parents offer me a cigarette, I definitely cannot say no.					
5. It is very difficult for me to quit smoking cigarettes completely.					
6. If people call me a coward for not wanting to smoke cigarettes, I have no idea what to day.					
7. It is very difficult for me to explain to others that I do not want to smoke cigarettes.					

Questions about autonomy

Quitting smoking

You mentioned earlier that you have smoked at least one cigarette in the past month. There are several reasons why people might want to quit smoking. Please consider the following statements and think about to what extent these are true about you.

I would quit smoking because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
1. Not smoking is a choice I would like to make for myself.							
2. Others would be annoyed with me if I did not quit smoking.							
3. I think quitting smoking would be good for my health.							
4. I do not want others to be disappointed in me.							
5. It would be a personal challenge for me to quit smoking.							

Reducing alcohol consumption

You mentioned earlier that you have consumed at least one alcoholic drink in the past month. There are several reasons why people might want to reduce their alcohol consumption. Please consider the following statements and think about to what extent these are true about you.

I would reduce my alcohol consumption because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
1. Reducing alcohol consumption is a choice I would like to make for myself.							
2. Others would be annoyed with me if I did not reduce my alcohol consumption.							
3. I think reducing alcohol consumption would be good for my health.							
4. I do not want others to be disappointed in me.							
5. It would be a personal challenge for me to reduce alcohol consumption.							

Quitting alcohol consumption (for participants under the age of 18)

You mentioned earlier that you have consumed at least one alcoholic drink in the past month. There are several reasons why people might want to quit consuming alcohol. Please consider the following statements and think about to what extent these are true about you.

I would quit consuming alcohol because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
1. Quitting alcohol consumption is a choice I would like to make for myself.							
2. Others would be annoyed with me if I did not quit alcohol consumption.							
3. I think quitting alcohol consumption would be good for my health.							
4. I do not want others to be disappointed in me.							
5. It would be a personal challenge for me to quit consuming alcohol.							

Questions about outcome expectations

Expected outcomes of cigarette smoking

How likely is it that the following will happen, if you smoke cigarettes?

	0 Completely unlikely	**1** Extremely unlikely	**2** Very unlikely	**3** Somewhat unlikely	**4** Slightly unlikely	**5** Slightly likely	**6** Somewhat likely	**7** Very likely	**8** Extremely likely	**9** Completely likely

I will become addicted to nicotine										
I will feel calm										
I will lose the respect of my friends if I smoke.										
Smoking relieves my negative feelings.										
Smoking makes me feel good.										
Smoking reduces my anger.										
I feel less tired when I smoke.										
Smoking gives me bad breath.										
I get a bad taste in my mouth when I smoke.										
Smoking makes me cool.										
I am severely harming my health if I smoke.										
Smoking keeps my body weight under control.										
Smoking keeps me from eating more than I need to.										
Smoking gives me a better opportunity to get a girl/boyfriend.										
Smoking relieves my stress.										
I feel less bored when I smoke.										
Smoking harms my lungs.										
Smoking relaxes me.										
Smoking reduces my popularity.										
I will get heart disease if I smoke.										
Smoking makes my life more interesting.										
Smoking helps me win the respect of my friends.										
If I smoke, I might lose the respect of my sibling(s).										
Smoking helps me pass the time.										
Smoking stains my teeth and fingers.										
Smoking makes me feel like an outsider.										

Cigarettes have power over me.										
When I smoke I feel listless or tired.										
I spend less money when I smoke.										
Smoking makes me less good at sports.										
Smoking helps me keep my appetite in check.										
I might die prematurely if I smoke.										
I might win the respect of my sibling(s) if I smoke.										
It is hard for me to quit smoking.										
I fit better with my friends if I smoke.										
I am more attractive if I smoke.										
I improve my position if I smoke.										
I avoid putting on weight if I smoke.										
I will get lung cancer if I smoke.										

Expected outcomes of alcohol consumption

How likely is it that the following will happen if you drink alcohol?

	0 Completely unlikely	**1** Extremely unlikely	**2** Very unlikely	**3** Somewhat unlikely	**4** Slightly unlikely	**5** Slightly likely	**6** Somewhat likely	**7** Very likely	**8** Extremely likely	**9** Completely likely
I will become addicted to alcohol										
I will feel calm										
I will lose the respect of my friends if I drink alcoho.										
Drinking alcohol relieves my negative feelings.										
Drinking makes me feel good.										
Drinking reduces my anger.										
I feel less tired when I drinking alcohol.										
Drinking alcohol gives me bad breath.										
I get a bad taste in my mouth when I drink alcohol.										
Drinking alcohol makes me cool.										

I am severaly harming my health if I drink alcohol.										
Drinking alcohol keeps my body weight under control.										
Drinking alcohol keeps me from eating more than I need to.										
Drinking alcohol gives me a better opportunity to get a girl/boyfriend.										
Drinking alcohol relieves my stress.										
I feel less bored when I drink alcohol.										
Drinking alcohol harms my liver.										
Drinking alcohol relaxes me.										
Drinking alcohol reduces my popularity.										
I will get heart disease if I drink alcohol.										
Drink alcohol makes my life more interesting.										
Drinking alcohol helps me win the respect of my friends.										
If I drink alcohol, I might lose the respect of my sibling(s).										
Drinking alcohol helps me pass the time.										
Drinking alcohol makes me feel like an outsider.										
Alcohol has power over me.										
When I drink alcohol I feel listless or tired.										
I spend less money when I drink alcohol.										
Drinking alcohol makes me less good at sports.										
Drinking alcohol helps me keep my appetite in check.										
I might die prematurely if I drink alcohol.										
I might win the respect of my sibling(s) if I drink alcohol.										
It is hard for me to reduce alcohol consumption.										
I fit better with my friends if I drink alcohol.										
I am more attractive if I drink alcohol.										
I improve my position if I drink alcohol.										
I avoid putting on weight if I drink alcohol.										
Drinking alcohol will damage my brain cells.										

Appendix 12

Control group baseline questionnaire

Demographics

Name (you can choose an alias if you would prefer not to give your real name)	
Date of birth	
Gender (Male/Female)	

Alcohol consumption

Question 1

How often do you consume alcoholic drinks?	**Never**	**Every month or less**	**2-4 times a month**	**2-3 times a week**	**4 or more times a week**
Beer, wine, spirits etc					

Question 2

How often in the past month have you consumed alcohol?	**Never**	**Once or twice**	**Three or four time**	**Once a week**	**Once or twice a week**	**Three or four times a week**	**Four or five times a week**	**Every day or almost every day**
Beer, wine, spirits etc								

Question 3

How many drinks do you consume on a typical drinking day?	**0**	**1 or 2**	**3 or 4**	**5 or 6**	**7, 8 or 9**	**10 or rohkem**
Beer, wine, spirits etc						

Question 4

How often do you drink 6 or more alcoholic drinks at the same drinking occasion?	**Never**	**Less than once a month**	**Every month**	**Every week**	**Every day or almost every day**
Beer, wine, spirits etc					

Question 4

	1 Very unlikely	**2** Unlikely	**3** Somewhat unlikely	**4** Somewhat likely	**5** Likely	**6** Very likely
The next time I am offered an alcoholic drink, I am going to say 'no'.						
Next month I am going to stick to the recommended alcohol consumption limits at every event or birthday party I go to.						
I am going to stop drinking alcohol.						

Question 5.

At what age did you have your first alcoholic drink?

Question 6.

What kind of alcoholic drink do you usually consume at social events?

Tobacco consumption

Question 1

Have you ever in your life consumed tobacco?	**No**	**Yes**
Cigarettes, snus, cigars but NOT e-cigarettes		

Question 2

Have you consumed any tobacco in the past month?	**Not once**	**Once or twice**	**Three or four times**	**Once a week**	**Once or twice a week**	**Three or four times a week**	**Four or five times a week**	**Every day or almost every day**
Cigarettes, snus, cigars but NOT e-cigarettes								

Question 3

How many cigarettes do you smoke a day?	**10 or less**	**11-20**	**21-30**	**31 or more**

Question 4

How soon after waking up in the morning do you consume tobacco?	**Within 5 minutes**	**Within 6-30 minutes**	**Within 31-60 minutes**	**After 60 minutes**

Cigarettes, snus, cigars but NOT e-cigarettes				

Question 5. To what extent do you agree with the following statements:

	1 Very unlikely	**2** Unlikely	**3** Somewhat unlikely	**4** Somewhat likely	**5** Likely	**6** Very likely
The next time I am offered a cigarette, I am going to say 'no'.						
I am going to quit smoking.						

Question 6.

At what age did you first smoke a cigarette?

Question 7.

How many cigarettes do you usually smoke at social events?

Question 8.

What type of cigarettes do you usually smoke?

Questions about the possibility of change

1. In your opinion, are the following statements true?	**Yes**	**No**
People addicted to alcohol and/or nicotine can't change.		
Everyone is either a winner or a loser.		
People, who start drinking alcohol and smoking cigarettes before becoming adults, can't change.		
Addicts can sometimes try to give up alcohol and/or nicotine, but they will always fall back into their habits.		
There are two types of people: those who consume alcohol and/or tobacco and those who avoid both.		

2.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change

To what extent do you think that a person's personality can change?					

3.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change
To what extent do you think that people can change their own personality?					

4.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change
To what extent do you think that your personality could change?					

5.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change
To what extent do you think that you could change your personality?					

Questions about refusal self-efficacy

Drinking refusal self-efficacy

How confident are you that you can say no when an alcoholic drink is offered to you in the following situations?	**1** I am completely sure that I CANNOT say no	**2** I very likely CANNOT say no	**3** I probably CANNOT say no	**4** I probably CAN say no	**5** I very likely CAN say no	**6** I am completely sure that I CAN say no.
1. If my girlfriend/boyfriend offers me alcohol.						
2. If my friends offer me alcohol.						
3. If someone in a club/bar offer me alcohol.						

To what extent are the following statements true	**1** Never true	**2** Sometimes true	**3** Not sure	**4** Usually true	**5** Always true

1. If my friends are drinking alcohol, it is very difficult for me to say no to offers of alcohol.					
2. If I wanted to quit drinking alcohol, I probably could not do it.					
3. If someone offers me alcohol, I definitely cannot say no.					
4. If my parents offer me alcohol, I definitely cannot say no.					
5. It is very difficult for me to become/stay completely sober.					
6. If people call me a coward for not wanting to consume alcohol, I have no idea what to day.					
7. It is very difficult for me to explain to others that I do not want to drink alcohol.					

Smoking Refusal Self-Efficacy

How confident are you that you can say no when a cigarette is offered to you in the following situations?	**1** I am completely sure that I CANNOT say no	**2** I very likely CANNOT say no	**3** I probably CANNOT say no	**4** I probably CAN say no	**5** I very likely CAN say no	**6** I am completely sure that I CAN say no.
1. If my girlfriend/boyfriend offers me a cigarette.						
2. If my friends offer me a cigarette.						
3. If someone in a club/bar offer me a cigarette.						

To what extent are the following statements true	**1** Never true	**2** Sometimes true	**3** Not sure	**4** Usually true	**5** Always true
1. If my friends are smoking cigarettes, it is very difficult for me to say no to offers of cigarettes.					

2. If I wanted to quit smoking cigarettes, I probably could not do it.					
3. If someone offers me a cigarette, I definitely cannot say no.					
4. If my parents offer me a cigarette, I definitely cannot say no.					
5. It is very difficult for me to quit smoking cigarettes completely.					
6. If people call me a coward for not wanting to smoke cigarettes, I have no idea what to day.					
7. It is very difficult for me to explain to others that I do not want to smoke cigarettes.					

Questions about autonomy

Quitting smoking

You mentioned earlier that you have smoked at least one cigarette in the past month. There are several reasons why people might want to quit smoking. Please consider the following statements and think about to what extent these are true about you.

I would quit smoking because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
6. Not smoking is a choice I would like to make for myself.							
7. Others would be annoyed with me if I did not quit smoking.							
8. I think quitting smoking would be good for my health.							
9. I do not want others to be disappointed in me.							
10. It would be a personal challenge for me to quit smoking.							

Reducing alcohol consumption

You mentioned earlier that you have consumed at least one alcoholic drink in the past month. There are several reasons why people might want to reduce their alcohol consumption. Please consider the following statements and think about to what extent these are true about you.

I would reduce my alcohol consumption because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
6. Reducing alcohol consumption is a choice I would like to make for myself.							
7. Others would be annoyed with me if I did not reduce my alcohol consumption.							
8. I think reducing alcohol consumption would be good for my health.							
9. I do not want others to be disappointed in me.							
10. It would be a personal challenge for me to reduce alcohol consumption.							

Quitting alcohol consumption (for participants under the age of 18)

You mentioned earlier that you have consumed at least one alcoholic drink in the past month. There are several reasons why people might want to quit consuming alcohol. Please consider the following statements and think about to what extent these are true about you.

I would quit consuming alcohol because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
6. Quitting alcohol consumption is a choice I would like to make for myself.							
7. Others would be annoyed with me if I did not quit alcohol consumption.							
8. I think quitting alcohol consumption would be good for my health.							
9. I do not want others to be disappointed in me.							

10. It would be a personal challenge for me to quit consuming alcohol.								

Questions about outcome expectations

Expected outcomes of cigarette smoking

How likely is it that the following will happen, if you smoke cigarettes?

	0 Completely unlikely	**1** Extremely unlikely	**2** Very unlikely	**3** Somewhat unlikely	**4** Slightly unlikely	**5** Slightly likely	**6** Somewhat likely	**7** Very likely	**8** Extremely likely	**9** Completely likely
I will become addicted to nicotine										
I will feel calm										
I will lose the respect of my friends if I smoke.										
Smoking relieves my negative feelings.										
Smoking makes me feel good.										
Smoking reduces my anger.										
I feel less tired when I smoke.										
Smoking gives me bad breath.										
I get a bad taste in my mouth when I smoke.										
Smoking makes me cool.										
I am severely harming my health if I smoke.										
Smoking keeps my body weight under control.										
Smoking keeps me from eating more than I need to.										
Smoking gives me a better opportunity to get a girl/boyfriend.										
Smoking relieves my stress.										
I feel less bored when I smoke.										
Smoking harms my lungs.										
Smoking relaxes me.										
Smoking reduces my popularity.										

I will get heart disease if I smoke.										
Smoking makes my life more interesting.										
Smoking helps me win the respect of my friends.										
If I smoke, I might lose the respect of my sibling(s).										
Smoking helps me pass the time.										
Smoking stains my teeth and fingers.										
Smoking makes me feel like an outsider.										
Cigarettes have power over me.										
When I smoke I feel listless or tired.										
I spend less money when I smoke.										
Smoking makes me less good at sports.										
Smoking helps me keep my appetite in check.										
I might die prematurely if I smoke.										
I might win the respect of my sibling(s) if I smoke.										
It is hard for me to quit smoking.										
I fit better with my friends if I smoke.										
I am more attractive if I smoke.										
I improve my position if I smoke.										
I avoid putting on weight if I smoke.										
I will get lung cancer if I smoke.										

Expected outcomes of alcohol consumption

How likely is it that the following will happen if you drink alcohol?

	0 Completely unlikely	**1** Extremely unlikely	**2** Very unlikely	**3** Somewhat unlikely	**4** Slightly unlikely	**5** Slightly likely	**6** Somewhat likely	**7** Very likely	**8** Extremely likely	**9** Completely likely
I will become addicted to alcohol										

I will feel calm										
I will lose the respect of my friends if I drink alcoho.										
Drinking alcohol relieves my negative feelings.										
Drinking makes me feel good.										
Drinking reduces my anger.										
I feel less tired when I drinking alcohol.										
Drinking alcohol gives me bad breath.										
I get a bad taste in my mouth when I drink alcohol.										
Drinking alcohol makes me cool.										
I am severaly harming my health if I drink alcohol.										
Drinking alcohol keeps my body weight under control.										
Drinking alcohol keeps me from eating more than I need to.										
Drinking alcohol gives me a better opportunity to get a girl/boyfriend.										
Drinking alcohol relieves my stress.										
I feel less bored when I drink alcohol.										
Drinking alcohol harms my liver.										
Drinking alcohol relaxes me.										
Drinking alcohol reduces my popularity.										
I will get heart disease if I drink alcohol.										
Drink alcohol makes my life more interesting.										
Drinking alcohol helps me win the respect of my friends.										
If I drink alcohol, I might lose the respect of my sibling(s).										
Drinking alcohol helps me pass the time.										
Drinking alcohol makes me feel like an outsider.										
Alcohol has power over me.										
When I drink alcohol I feel listless or tired.										
I spend less money when I drink alcohol.										
Drinking alcohol makes me less good at sports.										
Drinking alcohol helps me keep my appetite in check.										
I might die prematurely if I drink alcohol.										

I might win the respect of my sibling(s) if I drink alcohol.										
It is hard for me to reduce alcohol consumption.										
I fit better with my friends if I drink alcohol.										
I am more attractive if I drink alcohol.										
I improve my position if I drink alcohol.										
I avoid putting on weight if I drink alcohol.										
Drinking alcohol will damage my brain cells.										

Appendix 13

Intervention group follow-up questionnaire

Program Acceptability

Question	**Multiple choice answers**				
	Yes			**No**	
Did you find the content of MyOwnMe easy to understand?					
Did you find exact instructions on how to create and change habits in the MyOwnMe program?					
Did you find the text in the MyOwnMe website too long?					
Did you find there to be too much text in the MyOwnMe website?					
Did you find there to be too many practical exercises in the MyOwnMe program?					
	I read all messages, some more than once	**I read most of the messages**	**I read all messages in one go**	**I didn't read any messages**	**I didn't receive messages**
Did you read the text messages?					
	Very important	**Somewhat important**	**Not very important**	**Not important at all**	**I don't know if they were important**
To what extent were the text messages important for understanding the content of the MyOwnMe program?					
	Very interesting	**Somewhat interesting**	**Not very interesting**	**Not interesting at all**	**I don't know if they were interesting**
To what extent where the text messages interesting to you?					
	Very easily understandable	**Somewhat understandable**	**Not very understandable**	**Not at all understandable**	**I don't know if they were understandable**
To what extent were the text messages understandable to you?					

	Very believable	Somewhat believable	Not very believable	Not at all believable	I don't know if they were believable
To what extent were the text messages believable to you?					
	Very logically	**Somewhat logically**	**Not very logically**	**Not at all logically**	**I don't know if they were logical or not**
To what extent where the text messages presented to you in a logical order?					
	Definitely too few messages	**Somewhat too few messages**	**About the right number of messages**	**Somewhat too many messages**	**Definitely too many messages**
How did you find the number of text messages sent to you?					
	Yes			**No**	
Are you planning to use what you learned in the program?					
	Yes			**No**	
Did you like the design of the program?					

Alcohol consumption

Question 1

How often in the past month have you consumed alcohol?	Never	Once or twice	Three or four time	Once a week	Once or twice a week	Three or four times a week	Four or five times a week	Every day or almost every day
Beer, wine, spirits etc								

Question 2

How many drinks do you consume on a typical drinking day?	0	1 or 2	3 or 4	5 or 6	7, 8 or 9	10 or rohkem
Beer, wine, spirits etc						

Question 3

How often do you drink 6 or more alcoholic drinks at the same drinking occasion?	Never	Less than once a month	Every month	Every week	Every day or almost every day
Beer, wine, spirits etc					

Question 4

	1 Very unlikely	**2** Unlikely	**3** Somewhat unlikely	**4** Somewhat likely	**5** Likely	**6** Very likely
The next time I am offered an alcoholic drink, I am going to say 'no'.						
Next month I am going to stick to the recommended alcohol consumption limits at every event or birthday party I go to.						
I am going to stop drinking alcohol.						

Tobacco consumption

Question 1.

Have you consumed any tobacco in the past month?	**Not once**	**Once or twice**	**Three or four times**	**Once a week**	**Once or twice a week**	**Three or four times a week**	**Four or five times a week**	**Every day or almost every day**
Cigarettes, snus, cigars but NOT e-cigarettes								

Question 2.

How many cigarettes do you smoke a day?	**10 or less**	**11-20**	**21-30**	**31 or more**

Question 3.

How soon after waking up in the morning do you consume tobacco?	**Within 5 minutes**	**Within 6-30 minutes**	**Within 31-60 minutes**	**After 60 minutes**
Cigarettes, snus, cigars but NOT e-cigarettes				

Question 4. To what extent do you agree with the following statements:

	1 Very unlikely	**2** Unlikely	**3** Somewhat unlikely	**4** Somewhat likely	**5** Likely	**6** Very likely

The next time I am offered a cigarette, I am going to say 'no'.						
I am going to quit smoking.						

Questions about the possibility of change

1. In your opinion, are the following statements true?	Yes	No
People addicted to alcohol and/or nicotine can't change.		
Everyone is either a winner or a loser.		
People, who start drinking alcohol and smoking cigarettes before becoming adults, can't change.		
Addicts can sometimes try to give up alcohol and/or nicotine, but they will always fall back into their habits.		
There are two types of people: those who consume alcohol and/or tobacco and those who avoid both.		

2.	1 Definitely cannot change	2 Almost definitely cannot change	3 Probably cannot change	4 Probably can change	5 Definitely can change
To what extent do you think that a person's personality can change?					

3.	1 Definitely cannot change	2 Almost definitely cannot change	3 Probably cannot change	4 Probably can change	5 Definitely can change
To what extent do you think that people can change their own personality?					

4.	1 Definitely cannot change	2 Almost definitely cannot change	3 Probably cannot change	4 Probably can change	5 Definitely can change
To what extent do you think that your personality could change?					

5.	1 Definitely cannot change	2 Almost definitely cannot change	3 Probably cannot change	4 Probably can change	5 Definitely can change

To what extent do you think that you could change your personality?					

Questions about refusal self-efficacy

Drinking refusal self-efficacy

How confident are you that you can say no when an alcoholic drink is offered to you in the following situations?	**1** I am completely sure that I CANNOT say no	**2** I very likely CANNOT say no	**3** I probably CANNOT say no	**4** I probably CAN say no	**5** I very likely CAN say no	**6** I am completely sure that I CAN say no.
1. If my girlfriend/boyfriend offers me alcohol.						
2. If my friends offer me alcohol.						
3. If someone in a club/bar offer me alcohol.						

To what extent are the following statements true	**1** Never true	**2** Sometimes true	**3** Not sure	**4** Usually true	**5** Always true
1. If my friends are drinking alcohol, it is very difficult for me to say no to offers of alcohol.					
2. If I wanted to quit drinking alcohol, I probably could not do it.					
3. If someone offers me alcohol, I definitely cannot say no.					
4. If my parents offer me alcohol, I definitely cannot say no.					
5. It is very difficult for me to become/stay completely sober.					
6. If people call me a coward for not wanting to consume alcohol, I have no idea what to day.					
7. It is very difficult for me to explain to others that I do not want to drink alcohol.					

Smoking Refusal Self-Efficacy

How confident are you that you can say no when a cigarette is offered to you in the following situations?	**1** I am completely sure that I CANNOT say no	**2** I very likely CANNOT say no	**3** I probably CANNOT say no	**4** I probably CAN say no	**5** I very likely CAN say no	**6** I am completely sure that I CAN say no.
1. If my girlfriend/boyfriend offers me a cigarette.						
2. If my friends offer me a cigarette.						
3. If someone in a club/bar offer me a cigarette.						

To what extent are the following statements true	**1** Never true	**2** Sometimes true	**3** Not sure	**4** Usually true	**5** Always true
1. If my friends are smoking cigarettes, it is very difficult for me to say no to offers of cigarettes.					
2. If I wanted to quit smoking cigarettes, I probably could not do it.					
3. If someone offers me a cigarette, I definitely cannot say no.					
4. If my parents offer me a cigarette, I definitely cannot say no.					
5. It is very difficult for me to quit smoking cigarettes completely.					
6. If people call me a coward for not wanting to smoke cigarettes, I have no idea what to day.					
7. It is very difficult for me to explain to others that I do not want to smoke cigarettes.					

Questions about autonomy

Quitting smoking

You mentioned earlier that you have smoked at least one cigarette in the past month. There are several reasons why people might want to quit smoking. Please consider the following statements and think about to what extent these are true about you.

I would quit smoking because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
11. Not smoking is a choice I would like to make for myself.							
12. Others would be annoyed with me if I did not quit smoking.							
13. I think quitting smoking would be good for my health.							
14. I do not want others to be disappointed in me.							
15. It would be a personal challenge for me to quit smoking.							

Reducing alcohol consumption

You mentioned earlier that you have consumed at least one alcoholic drink in the past month. There are several reasons why people might want to reduce their alcohol consumption. Please consider the following statements and think about to what extent these are true about you.

I would reduce my alcohol consumption because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
11. Reducing alcohol consumption is a choice I would like to make for myself.							
12. Others would be annoyed with me if I did not reduce my alcohol consumption.							
13. I think reducing alcohol consumption would be good for my health.							
14. I do not want others to be disappointed in me.							
15. It would be a personal challenge for me to reduce alcohol consumption.							

Quitting alcohol consumption (for participants under the age of 18)

You mentioned earlier that you have consumed at least one alcoholic drink in the past month. There are several reasons why people might want to quit consuming alcohol. Please consider the following statements and think about to what extent these are true about you.

I would quit consuming alcohol because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
11. Quitting alcohol consumption is a choice I would like to make for myself.							
12. Others would be annoyed with me if I did not quit alcohol consumption.							
13. I think quitting alcohol consumption would be good for my health.							
14. I do not want others to be disappointed in me.							
15. It would be a personal challenge for me to quit consuming alcohol.							

Questions about outcome expectations

Expected outcomes of cigarette smoking

How likely is it that the following will happen, if you smoke cigarettes?

	0 Completely unlikely	**1** Extremely unlikely	**2** Very unlikely	**3** Somewhat unlikely	**4** Slightly unlikely	**5** Slightly likely	**6** Somewhat likely	**7** Very likely	**8** Extremely likely	**9** Completely likely
I will become addicted to nicotine										
I will feel calm										
I will lose the respect of my friends if I smoke.										
Smoking relieves my negative feelings.										
Smoking makes me feel good.										
Smoking reduces my anger.										

I feel less tired when I smoke.										
Smoking gives me bad breath.										
I get a bad taste in my mouth when I smoke.										
Smoking makes me cool.										
I am severely harming my health if I smoke.										
Smoking keeps my body weight under control.										
Smoking keeps me from eating more than I need to.										
Smoking gives me a better opportunity to get a girl/boyfriend.										
Smoking relieves my stress.										
I feel less bored when I smoke.										
Smoking harms my lungs.										
Smoking relaxes me.										
Smoking reduces my popularity.										
I will get heart disease if I smoke.										
Smoking makes my life more interesting.										
Smoking helps me win the respect of my friends.										
If I smoke, I might lose the respect of my sibling(s).										
Smoking helps me pass the time.										
Smoking stains my teeth and fingers.										
Smoking makes me feel like an outsider.										
Cigarettes have power over me.										
When I smoke I feel listless or tired.										
I spend less money when I smoke.										
Smoking makes me less good at sports.										
Smoking helps me keep my appetite in check.										
I might die prematurely if I smoke.										

I might win the respect of my sibling(s) if I smoke.										
It is hard for me to quit smoking.										
I fit better with my friends if I smoke.										
I am more attractive if I smoke.										
I improve my position if I smoke.										
I avoid putting on weight if I smoke.										
I will get lung cancer if I smoke.										

Expected outcomes of alcohol consumption

How likely is it that the following will happen if you drink alcohol?

	0 Completely unlikely	**1** Extremely unlikely	**2** Very unlikely	**3** Somewhat unlikely	**4** Slightly unlikely	**5** Slightly likely	**6** Somewhat likely	**7** Very likely	**8** Extremely likely	**9** Completely likely
I will become addicted to alcohol										
I will feel calm										
I will lose the respect of my friends if I drink alcoho.										
Drinking alcohol relieves my negative feelings.										
Drinking makes me feel good.										
Drinking reduces my anger.										
I feel less tired when I drinking alcohol.										
Drinking alcohol gives me bad breath.										
I get a bad taste in my mouth when I drink alcohol.										
Drinking alcohol makes me cool.										
I am severaly harming my health if I drink alcohol.										
Drinking alcohol keeps my body weight under control.										
Drinking alcohol keeps me from eating more than I need to.										
Drinking alcohol gives me a better opportunity to get a girl/boyfriend.										
Drinking alcohol relieves my stress.										
I feel less bored when I drink alcohol.										
Drinking alcohol harms my liver.										

Drinking alcohol relaxes me.										
Drinking alcohol reduces my popularity.										
I will get heart disease if I drink alcohol.										
Drink alcohol makes my life more interesting.										
Drinking alcohol helps me win the respect of my friends.										
If I drink alcohol, I might lose the respect of my sibling(s).										
Drinking alcohol helps me pass the time.										
Drinking alcohol makes me feel like an outsider.										
Alcohol has power over me.										
When I drink alcohol I feel listless or tired.										
I spend less money when I drink alcohol.										
Drinking alcohol makes me less good at sports.										
Drinking alcohol helps me keep my appetite in check.										
I might die prematurely if I drink alcohol.										
I might win the respect of my sibling(s) if I drink alcohol.										
It is hard for me to reduce alcohol consumption.										
I fit better with my friends if I drink alcohol.										
I am more attractive if I drink alcohol.										
I improve my position if I drink alcohol.										
I avoid putting on weight if I drink alcohol.										
Drinking alcohol will damage my brain cells.										

Appendix 14

Control group follow-up questionnaire

Alcohol consumption

Question 1.

How often in the past month have you consumed alcohol?	**Never**	**Once or twice**	**Three or four time**	**Once a week**	**Once or twice a week**	**Three or four times a week**	**Four or five times a week**	**Every day or almost every day**
Beer, wine, spirits etc								

Question 2.

How many drinks do you consume on a typical drinking day?	**0**	**1 or 2**	**3 or 4**	**5 or 6**	**7, 8 or 9**	**10 or rohkem**
Beer, wine, spirits etc						

Question 3.

How often do you drink 6 or more alcoholic drinks at the same drinking occasion?	**Never**	**Less than once a month**	**Every month**	**Every week**	**Every day or almost every day**
Beer, wine, spirits etc					

Question 4.

	1 Very unlikely	**2** Unlikely	**3** Somewhat unlikely	**4** Somewhat likely	**5** Likely	**6** Very likely
The next time I am offered an alcoholic drink, I am going to say 'no'.						
Next month I am going to stick to the recommended alcohol consumption limits at every event or birthday party I go to.						
I am going to stop drinking alcohol.						

Tobacco consumption

Question 1.

Have you consumed any tobacco in the past month?	**Not once**	**Once or twice**	**Three or four times**	**Once a week**	**Once or twice a week**	**Three or four times a week**	**Four or five times a week**	**Every day or almost every day**
Cigarettes, snus, cigars but NOT e-cigarettes								

Question 2.

How many cigarettes do you smoke a day?	**10 or less**	**11-20**	**21-30**	**31 or more**

Question 3.

How soon after waking up in the morning do you consume tobacco?	**Within 5 minutes**	**Within 6-30 minutes**	**Within 31-60 minutes**	**After 60 minutes**
Cigarettes, snus, cigars but NOT e-cigarettes				

Question 4. To what extent do you agree with the following statements:

	1 Very unlikely	**2** Unlikely	**3** Somewhat unlikely	**4** Somewhat likely	**5** Likely	**6** Very likely
The next time I am offered a cigarette, I am going to say 'no'.						
I am going to quit smoking.						

Questions about the possibility of change

1. In your opinion, are the following statements true?	**Yes**	**No**
People addicted to alcohol and/or nicotine can't change.		
Everyone is either a winner or a loser.		
People, who start drinking alcohol and smoking cigarettes before becoming adults, can't change.		
Addicts can sometimes try to give up alcohol and/or nicotine, but they will always fall back into their habits.		
There are two types of people: those who consume alcohol and/or tobacco and those who avoid both.		

2.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change

To what extent do you think that a person's personality can change?					

3.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change
To what extent do you think that people can change their own personality?					

4.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change
To what extent do you think that your personality could change?					

5.	**1** Definitely cannot change	**2** Almost definitely cannot change	**3** Probably cannot change	**4** Probably can change	**5** Definitely can change
To what extent do you think that you could change your personality?					

Questions about refusal self-efficacy

Drinking refusal self-efficacy

How confident are you that you can say no when an alcoholic drink is offered to you in the following situations?	**1** I am completely sure that I CANNOT say no	**2** I very likely CANNOT say no	**3** I probably CANNOT say no	**4** I probably CAN say no	**5** I very likely CAN say no	**6** I am completely sure that I CAN say no.
1. If my girlfriend/boyfriend offers me alcohol.						
2. If my friends offer me alcohol.						
3. If someone in a club/bar offer me alcohol.						

To what extent are the following statements true	**1** Never true	**2** Sometimes true	**3** Not sure	**4** Usually true	**5** Always true
1. If my friends are drinking alcohol, it is very difficult for me to say no to offers of alcohol.					
2. If I wanted to quit drinking alcohol, I probably could not do it.					
3. If someone offers me alcohol, I definitely cannot say no.					
4. If my parents offer me alcohol, I definitely cannot say no.					
5. It is very difficult for me to become/stay completely sober.					
6. If people call me a coward for not wanting to consume alcohol, I have no idea what to day.					
7. It is very difficult for me to explain to others that I do not want to drink alcohol.					

Smoking Refusal Self-Efficacy

How confident are you that you can say no when a cigarette is offered to you in the following situations?	**1** I am completely sure that I CANNOT say no	**2** I very likely CANNOT say no	**3** I probably CANNOT say no	**4** I probably CAN say no	**5** I very likely CAN say no	**6** I am completely sure that I CAN say no.
1. If my girlfriend/boyfriend offers me a cigarette.						
2. If my friends offer me a cigarette.						
3. If someone in a club/bar offer me a cigarette.						

To what extent are the following statements true	**1** Never true	**2** Sometimes true	**3** Not sure	**4** Usually true	**5** Always true
1. If my friends are smoking cigarettes, it is very difficult for me to					

say no to offers of cigarettes.					
2. If I wanted to quit smoking cigarettes, I probably could not do it.					
3. If someone offers me a cigarette, I definitely cannot say no.					
4. If my parents offer me a cigarette, I definitely cannot say no.					
5. It is very difficult for me to quit smoking cigarettes completely.					
6. If people call me a coward for not wanting to smoke cigarettes, I have no idea what to day.					
7. It is very difficult for me to explain to others that I do not want to smoke cigarettes.					

Questions about autonomy

Quitting smoking

You mentioned earlier that you have smoked at least one cigarette in the past month. There are several reasons why people might want to quit smoking. Please consider the following statements and think about to what extent these are true about you.

I would quit smoking because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
16. Not smoking is a choice I would like to make for myself.							
17. Others would be annoyed with me if I did not quit smoking.							
18. I think quitting smoking would be good for my health.							
19. I do not want others to be disappointed in me.							
20. It would be a personal challenge for me to quit smoking.							

Reducing alcohol consumption

You mentioned earlier that you have consumed at least one alcoholic drink in the past month. There are several reasons why people might want to reduce their alcohol consumption. Please consider the following statements and think about to what extent these are true about you.

I would reduce my alcohol consumption because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
16. Reducing alcohol consumption is a choice I would like to make for myself.							
17. Others would be annoyed with me if I did not reduce my alcohol consumption.							
18. I think reducing alcohol consumption would be good for my health.							
19. I do not want others to be disappointed in me.							
20. It would be a personal challenge for me to reduce alcohol consumption.							

Quitting alcohol consumption (for participants under the age of 18)

You mentioned earlier that you have consumed at least one alcoholic drink in the past month. There are several reasons why people might want to quit consuming alcohol. Please consider the following statements and think about to what extent these are true about you.

I would quit consuming alcohol because:	**1** Not true at all	**2** Mostly not true	**3** Seldom true	**4** Sometimes true	**5** Usually true	**6** Mostly true	**7** Very true
16. Quitting alcohol consumption is a choice I would like to make for myself.							
17. Others would be annoyed with me if I did not quit alcohol consumption.							
18. I think quitting alcohol consumption would be good for my health.							
19. I do not want others to be disappointed in me.							
20. It would be a personal challenge for me to quit							

consuming alcohol.							

Questions about outcome expectations

Expected outcomes of cigarette smoking

How likely is it that the following will happen, if you smoke cigarettes?

	0 Completely unlikely	**1** Extremely unlikely	**2** Very unlikely	**3** Somewhat unlikely	**4** Slightly unlikely	**5** Slightly likely	**6** Some what likely	**7** Very likely	**8** Extremely likely	**9** Completely likely
I will become addicted to nicotine										
I will feel calm										
I will lose the respect of my friends if I smoke.										
Smoking relieves my negative feelings.										
Smoking makes me feel good.										
Smoking reduces my anger.										
I feel less tired when I smoke.										
Smoking gives me bad breath.										
I get a bad taste in my mouth when I smoke.										
Smoking makes me cool.										
I am severely harming my health if I smoke.										
Smoking keeps my body weight under control.										
Smoking keeps me from eating more than I need to.										
Smoking gives me a better opportunity to get a girl/boyfriend.										
Smoking relieves my stress.										
I feel less bored when I smoke.										
Smoking harms my lungs.										
Smoking relaxes me.										
Smoking reduces my popularity.										
I will get heart disease if I smoke.										

Smoking makes my life more interesting.										
Smoking helps me win the respect of my friends.										
If I smoke, I might lose the respect of my sibling(s).										
Smoking helps me pass the time.										
Smoking stains my teeth and fingers.										
Smoking makes me feel like an outsider.										
Cigarettes have power over me.										
When I smoke I feel listless or tired.										
I spend less money when I smoke.										
Smoking makes me less good at sports.										
Smoking helps me keep my appetite in check.										
I might die prematurely if I smoke.										
I might win the respect of my sibling(s) if I smoke.										
It is hard for me to quit smoking.										
I fit better with my friends if I smoke.										
I am more attractive if I smoke.										
I improve my position if I smoke.										
I avoid putting on weight if I smoke.										
I will get lung cancer if I smoke.										

Expected outcomes of alcohol consumption

How likely is it that the following will happen if you drink alcohol?

	0 Completely unlikely	**1** Extremely unlikely	**2** Very unlikely	**3** Some what unlikely	**4** Slightly unlikely	**5** Slightly likely	**6** Some what likely	**7** Very likely	**8** Extremely likely	**9** Completely likely
I will become addicted to alcohol										
I will feel calm										
I will lose the respect of my friends if I drink alcoho.										
Drinking alcohol relieves my negative feelings.										
Drinking makes me feel good.										
Drinking reduces my anger.										
I feel less tired when I drinking alcohol.										
Drinking alcohol gives me bad breath.										
I get a bad taste in my mouth when I drink alcohol.										
Drinking alcohol makes me cool.										
I am severaly harming my health if I drink alcohol.										
Drinking alcohol keeps my body weight under control.										
Drinking alcohol keeps me from eating more than I need to.										
Drinking alcohol gives me a better opportunity to get a girl/boyfriend.										
Drinking alcohol relieves my stress.										
I feel less bored when I drink alcohol.										
Drinking alcohol harms my liver.										
Drinking alcohol relaxes me.										
Drinking alcohol reduces my popularity.										
I will get heart disease if I drink alcohol.										
Drink alcohol makes my life more interesting.										
Drinking alcohol helps me win the respect of my friends.										

If I drink alcohol, I might lose the respect of my sibling(s).										
Drinking alcohol helps me pass the time.										
Drinking alcohol makes me feel like an outsider.										
Alcohol has power over me.										
When I drink alcohol I feel listless or tired.										
I spend less money when I drink alcohol.										
Drinking alcohol makes me less good at sports.										
Drinking alcohol helps me keep my appetite in check.										
I might die prematurely if I drink alcohol.										
I might win the respect of my sibling(s) if I drink alcohol.										
It is hard for me to reduce alcohol consumption.										
I fit better with my friends if I drink alcohol.										
I am more attractive if I drink alcohol.										
I improve my position if I drink alcohol.										
I avoid putting on weight if I drink alcohol.										
Drinking alcohol will damage my brain cells.										

APPENDIX 15

PILOT STUDY CONSORT CHECKLIST

Section	#	Checklist item	Reported on page
Title and Abstract			
Title	**1a**	Identification as a randomised trial in the title	**155**
Abstract	**1b**	Structured summary of trial design, methods, results and conclusion.	**156**
Introduction			
Background	**2a**	Scientific background and explanation of rationale.	**157**
Objectives	**2b**	Specific objectives or hypotheses	**158**
Methods			
Trial design	**3a**	Description of trial design (such as parallel, factorial) including allocation ratio	**159**
Changes to trial design	**3b**	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	**NA**
Participants	**4a**	Eligibility criteria for participants	**159**
Study setting	**4b**	Settings and locations where the data were collected	**164**
Interventions	5	The intervention for each group with sufficient details to allow replication, including how and when they were actually administered	**161**
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	**163**
Changes to outcomes	6b	Any changes to trial outcomes after the trial commenced, with reasons	**NA**
Sample size	7a	How sample size was determined	**159**
Interim analyses and stopping guidelines	7b	When applicable, explanation of any interim analyses and stopping guidelines	**NA**
Randomisation: sequence generation	8a	Method used to generate random allocation sequence	**166**
Randomisation: type	8b	Type of randomisation: details of any restriction (such as blocking and block size)	**166**
Randomisation: allocation	9	Mechanism used to implement the random allocation sequence (such as sequentially	**166**

concealment mechanism		numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	
Randomisation: implementation	10	Who generated the allocation sequence, who enrolled participants, and who assigned participants to interventions	**166**
Blinding	11a	If done, who was blinded after first assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	**166**
Similarity of interventions	11b	If relevant, description of the similarity of interventions	**NA**
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	**166**
Additional analyses	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	**167**
Results			
Participant flow	13a	For each group, the number of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	**170**
Losses and exclusions	13b	For each group, losses and exclusions after randomisation, together with reasons	**170**
Recruitment	14a	Dates defining the periods of recruitment and follow-up	**169**
Reason for stopped trial	14b	Why the trial ended or was stopped	**NA**
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	**168**
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	**170**
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	**171, 173**
Binary outcomes	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	**172**
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	**172**
Harms	19	All important harms or unintended effects in each group	**NA**
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant,	**178**

		multiplicity of analyses	
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	**180**
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	**175**
Other information			
Registration	23	Registration number and name of trial registry	**NA**
Protocol	24	Where the full trial protocol can be accessed, if available	**NA**
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	**168**