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The Effectiveness of the Protection Motivation Theory in Reducing Vaping Behaviour in a Student Population

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A thesis submitted in partial fulfillment of the requirements for the Master of Arts degree in Kinesiology

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Abstract and Keywords

A threat appraisal model grounded in Protection Motivation Theory (PMT) determined whether providing health information regarding perceived severity (PS) and perceived vulnerability (PV) of vaping health complications, corroborates with reduced vaping-related intention and habitual behaviour. Seventy-seven regular vapers (22.21 ± 3.47 years) registered within a Canadian university were randomized into one of two groups, wherein the aforementioned threat appraisal information was present. Participants in the experimental group ($n = 41$) watched an 8-minute information video a week after baseline, following the threat appraisal components of PMT. Those in the attention control group ($n = 36$) watched an information video on nutrition and healthy lifestyle. Data were collected for PV, PS, vaping intentions, and vaping behaviour at baseline and the following 3 time points after the intervention: Day-7, Day-30, and Day-45. A complete ($n = 77$) and imputed ($n = 416$) analysis for missing data revealed a significant treatment group by time interaction effect for PV and PS. Specifically, those in the experimental group reported higher PV and PS scores, compared to their attention control counterparts. For vaping intention, the treatment group by time interaction effect was significant for imputed but not complete data. In both analyses, intentions to vape less, particularly immediately after the intervention was evident in the experimental group but not in the attention control group. For vaping behavior, the treatment group by time interact effect was significant for imputed but not complete data. In both analyses, vaping use after the intervention dropped for both groups, however the drop for those in the experimental group was more pronounced than the drop for those in the attention control group. Both PS and PV were correlated with vaping intention at all assessment time points. Specifically, higher PS and PV

scores were associated with intentions to vape less. Weak and inconsistent evidence was provided that intentions to vape less is correlated with actually vaping less. It is suggested through this study that the threat appraisal components of PMT (i.e., PS and PV) can be successfully manipulated among University vapers, which in turn can reduce their intentions to vape and to a lesser extent reduce their actual vaping use. Implications for future vaping intervention research within a public health education framework, are discussed.

Keywords: vaping, protection motivation theory, threat appraisal, intention, behaviour

Lay Summary

As a relatively new device in North America, the Lung Association of Canada has been unsuccessful in gaining stricter regulation of vaping products across the country. Since the spike in vaping-related illnesses in 2019, statistics Canada states that young adults were the main users of vaping products, attributed to the mislead understanding that vaping is not harmful to their health. The purpose of this study is to investigate if the use of an 8-minute informational video, following the threat principles of the Protection Motivation Theory (PMT), lowers vaping intention and behaviour in Canadian university students over a 6-week study period. Another goal was to see if the two factors of threat (perceived severity and perceived vulnerability) are individually linked with changes in intention and if that intention can cause actual reductions in vaping use. In this study there were two groups of participants, those who received specific information about the risks of vaping and those who received general facts about nutrition and health. Both groups were asked to complete self-report questionnaires at four separate timepoints within a 6-week study period. From this design, it was revealed that PMT health risk information does cause vaping intentions to change and both factors of threat (PS and PV) have a strong effect on intention. However, those intentions do not translate to lowered vaping use. As a result, although using health risk information can cause regular vapers in university to have intentions to vape less, there needs to be more research done on how to convert those intentions into actual behaviour change for vaping.

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Chapter 1

1 Introduction

According to Statistics Canada, more than one-third of Canadian students have tried vaping products at some point in their lives with the highest rates of trying vaping being among young adults (18-24 years). These data points reinforce the trend that vaping is becoming increasingly popular among Canadians, specifically among Canadian students. Although the levels of toxicants are lower in aerosol from vaping products compared to tobacco smoke, long-term exposure to e-cigarette vaping may lead to nicotine dependence and an increase in respiratory and cardiovascular health effects (Herbert et al., 2014). In addition, though vaping has shown to assist with smoking cessation in adult tobacco smokers (Statistics Canada, 2020), there is evidence among young adults that vaping is a “gateway” behaviour to tobacco smoking (Chatterjee et al., 2016).

The literature on the short-term health consequences of vaping behaviour continues to mount (Statistics Canada, 2020); however, the most effective means of limiting vaping behaviour, remains unclear. As the vaping market continues to evolve rapidly in North America, owed to the JUUL e-cigarettes and similar vaping products, research identifying effective health behaviour change strategies are becoming increasingly paramount.

1.1 History of Electronic Cigarettes

The first e-cigarette was invented by Herbert A. Gilbert, an engineer who came up with the idea of vaping in 1963 and brought its patent into fruition two years later in 1965. As the issues of cigarette smoking began to perpetuate itself into the narrative of healthy living the innovation by Mr. Gilbert grew in popularity and it was quickly sought out as a solution to

replace burning tobacco and paper with heated, moist, flavoured air (White, 2018). Patented a year after the U.S. Surgeon General's "Smoking and Health" report linking cigarettes to lung cancer and other diseases, Mr. Gilbert touted the device's tremendous potential in preventing disease and death from tobacco use, and even promoted it for weight loss (Dunworth, 2020). Despite Mr. Gilbert filing a patent for his invention called "smokeless non-tobacco cigarette" in 1965, it was not commercialized, and tobacco companies were not admitted introducing e-cigarettes to the market (Gilbert, 1965).

It wasn't until 2003 when a Chinese pharmacist, Hon Lik, reinvented the modern e-cigarette to aid in smoking cessation following the death of his father from lung cancer (Hammond et al., 2019). Since then, a Chinese electronic company, Ruyan, sold e-cigarettes over the Internet and has exported them internationally, receiving the e-cigarette and e-liquid patent in 2007 and introducing the modernized vaping device to North America and Europe in the same year (Bell & Keane, 2012).

1.2 Description of Electronic Cigarettes

Electronic cigarettes or e-cigarettes are a battery-powered nicotine delivery system that employs heat to vaporize a liquid nicotine solution without burning tobacco (Goniewicz et al., 2014). E-cigarettes are known by many different names, sometimes called "e-cigs," "cig-a-likes," "mods," "vape pens," "vapes," "tank systems," and "electronic nicotine delivery systems (ENDS)" (CDC, 2010). The use of e-cigarettes is also commonly referred to as the act of *vaping*, defined as "the act of smoking an e-cigarette" by the Oxford Dictionary and recognized as the word of the year in 2014 (Steinmetz, 2014).

E-cigarettes generally consist of three main components: a cartridge, an atomizer, and a battery, which may be rechargeable. The use of e-cigarettes involves inhaling at the head of the

cartridge where a sensor detects when someone is inhaling, sending a signal to a processor that switches on a heater, known as the atomizer. From there, the atomizer heats up a solution to produce a vapour that can then be inhaled. As someone draws on the e-cigarette, an LED light is also switched on by the processor, simulating a flame (Trtchounian et al., 2010). The liquid within the vape pens, also known as the “e-juice” contains a variety of substances including nicotine, flavouring chemicals like diacetyl, and certain toxic metals such as lead, chromium, and nickel (Olmedo et al., 2018).

There is a wide range of liquid flavours available for consumer purchase including fruit, chocolate, and candy amongst a variety of devices, usually made to resemble pens, USB sticks, and other everyday items (Worsley et al., 2014). Although not all vaping devices resemble other e-cigarette devices, such as the tank systems, or “mods” that are much larger devices, all these products share the common anatomy of the cartridge, atomizer, and battery system with the average device containing between 0.5 and 24 mg/ml of nicotine (Azagba, 2018).

1.3 Prevalence Among Canadian Populations

1.3.1 Canadian Adolescents

In a survey study by Statistics Canada among Canadians between grades 7 to 12 there has been an increase in the use of vaping products. In the most recent national survey on Canadian adolescents done in 2018 by Statistics Canada, 34% of students in grades 7 to 12 had reported having tried a vaping product and 20% reported using them within the last 30 days. Specifically, 28% had reported having tried an e-cigarette with nicotine and 29% had tried an e-cigarette without nicotine. Among this population sample, 18% of students had reported using an e-cigarette with nicotine and 11% had used an e-cigarette without nicotine in the past 30 days (Canada, 2021). In this survey,

most students who had reported having tried a vaping product had also tried a cigarette. The increase in vaping usage in Canada is significantly attributed to its accessibility with 54% of all students thinking it would be either “fairly easy” or “very easy” to get an e-cigarette with nicotine if they wanted one, and 58% thought it would be “fairly easy” or “very easy” to get an e-cigarette without nicotine if attempted (Canada, 2021).

Moreover, Cole et al., (2020) found that, from 2013-2019, accounting for variability across provinces, the prevalence of e-cigarette ever and current use increased over time across Canada, particularly between 2016-2019. Specifically in Ontario, the prevalence of ever and current e-cigarette use increased among all grades, genders, and ethnicities. In contrast, the prevalence of current cigarette smoking remained relatively stable over the study period. Consistent with data from the United States, the prevalence of e-cigarette use among an adolescent sample of Canadian youth has increased substantially in a short period of time (Cole et al., 2020).

Similarly, Hammond et al., (2016) assessed the prevalence of e-cigarette use among Canadian students in grades 7 to 9 in 2016 and among Canadian’s aged 15 and older in 2017, respectively (Hammond et al., 2017). Among adolescents in grades 7 to 9, 12.6% of Canadian students reported having tried an e-cigarette with 5.4% having used an e-cigarette in the past 30 days. Among this population sample, two-thirds of current smokers in grades 7 to 9 had used an e-cigarette in the past 30 days, compared to approximately 5% of non-smokers. Within this study, e-cigarette varied by province: prevalence was lowest in Ontario and highest in Nova Scotia (Hammond et al., 2016). Subsequently, among a population survey of Canadian’s aged 15 and older, 15.4%

reported having ever tried an e-cigarette with 2.9% having used one in the past 30 days (Hammond et al., 2017).

In addition, Hammond et al., (2020) surveyed a sample of 16 to 19-year old's, assessing the use of vaping and smoking devices across Canada, United States, and England. The study showed that the number of Canadians in high school, aged 16 to 19 years, who have tried vaping was up from 29.3% in 2017 to 40.6% in 2019. It also showed a 112% increase in adolescent vaping over a two-year period: from 8.4% in 2017 up to 17.8% in 2019. Hammond's study also measured youth vaping trends in the United States and England, demonstrating a similar increase to Canadian teens in America from 11.1% in 2017 up to 18.5% in 2019. Whereas in England, there was a smaller increase from 8.7% in 2017 up to 12.6% in 2019, with a lower youth vaping prevalence of 12.6% when compared with both Canada (17.8%) and the United States (18.5%) (Hammond et al., 2020).

1.3.2 Canadian Youth and Young Adults

Among Canadians between the ages of 15 to 24 there has been an increase in the use of vaping products since 2009 (Statistics Canada, 2020). In the most recent national Canadian Tobacco and Nicotine Survey done in 2020 by Statistics Canada, 14% of Canadian youth (15 to 19) have reported to having tried a vaping product and young adults (20 to 24) age groups having the highest rates of trying vaping compared to adults 25 years and older at 43%. Among Canadian youth and young adult populations who self-reported as having vaped in the past 30 days, 65% were current smokers, 20% were former smokers, and 15% had never smoked cigarettes. Of this population sample, 32%

of current or former cigarette smokers who had never used vaping products reported using it as a quit-smoking aid (Statistics Canada, 2020).

Fataar and Hammond (2019) conducted an international Youth Tobacco and Vaping Survey to account for socio-demographic, vaping and smoking, cannabis, and cannabis vaper misclassification measures in Canada, England, and the United States. Online surveys conducted over a two-month period in 2018 found that e-cigarettes have emerged as the most common mode of nicotine delivery among youth across Canada and the U.S., whereas smoking remains the dominant form of delivery for cannabis. Within the data collected in their 2018 survey, Canadian youth reported 37.3% ever vaping e-cigarettes (the highest in relation to the three countries involved in the survey study) and 14.6% reported having vaped in the past 30 days (the second highest) (Fataar & Hammond, 2019).

Moreover, Czoli et al., (2014) examined the prevalence and perceptions of e-cigarette use among Canadian youth and young adults through online self-report questionnaires. Within a sample of over 1000 youth and young adults, 16.1% reported trying an e-cigarette (5.2% non-smokers, 18.9% former smokers, and 34.5% current smokers), and 5.7% reported use in the past 30 days. Compared to non-smokers, former smokers and current smokers were more likely to have tried e-cigarettes, and current smokers were more likely to have tried e-cigarettes than former smokers. An important distinction within this 2014 study is that close to half of respondents (43.4%) had seen e-cigarettes advertised for sale, highlighting the high commercial awareness of e-cigarettes among this population age (Czoli et al., 2014).

1.3.3 Canadian Adults

According to Health Canada, there continues to be a generational difference in the use of vaping devices (Canada, 2021). As the increase in popularity of vaping devices among Canadian adolescents, youth, and young adults has grown over the past decade, the proportion of adults aged 25 and older have reported a significantly lower rate of consumption. In comparison, the 2020 Canadian Tobacco and Nicotine Survey revealed only 13% of adults indicated that they had tried vaping at some point and 3% of adults reported using a vaping product in the past 30 days. Across all age groups who reported having using a vaping product within the past 30 days, 14% reported that they vaped on a daily basis, however older Canadians continue to be more likely to report smoking cigarettes with approximately 1 in 10 Canadians having reported smoking cigarettes on a regular basis (Statistics Canada, 2020).

In relation to the high rate of Canadian adult smokers, Gravely et al., (2019) presents statistics on the prevalence estimates of awareness, ever-use, current use, and daily use of nicotine vaping products from 14 countries among a sample population of self-reported smokers and recent ex-smokers. Within this sample population, Canadian adults over the age of 25 who identified as smokers or recent ex-smokers, 99.3% of the population reported being aware of nicotine vaping products, 62.4% of the population reported ever-used nicotine vaping products, 12% reported current use of nicotine vaping products, and 4.4% reported daily use. In comparison to the 14 countries included in this survey study Canadian adults (although lower prevalence compared to younger Canadian populations) were among the top three highest percentages of vaping awareness, ever-use, and current use; only in daily use of nicotine vaping products do Canadian adults represent the fourth highest percentage. Although the prevalence of vaping products in

Canadian adults is the lowest compared to younger age groups, the corroboration between past cigarette usage and subsequent vaping behaviour in this population is significant (Gravelly et al., 2019).

1.4 Prevalence Among Global Population

As of 2018, 98 countries had national laws regulating e-cigarettes and 29 countries had banned the sale of e-cigarettes completely (Kasza et al., 2018). Currently, 41 million people around the world are estimated to use e-cigarettes or “heat-not-burn” tobacco products (WHO, 2020). Although the global market for e-cigarettes is still small relative to tobacco cigarettes, it continues to grow rapidly (WHO, 2019). In 2020, worldwide sales of tobacco reached more than \$713 billion, compared to \$15.7 billion for e-cigarettes. At this current rate of product growth, the sales of vaping products are projected to more than double to \$40 billion by 2023, while cigarette sales are expected to decline slightly (WHO, 2019). While research data are accumulating on the adverse biological effects of e-cigarette use (Tommasi et al., 2019), focus is also being shifted to the efficacy of vaping combined with behavioural therapy in helping smokers quit (Jackson et al., 2021). The existing data clearly show that vaping is not risk free and together with the growing concern that vaping may lead to nicotine addiction and smoking, especially among youth, international public health agencies are determined to investigate the health risks and profile of vaping (Besaratina & Tommasi, 2019).

1.4.1 North America and Europe

The most recent survey on the global prevalence of vaping show that the three largest markets for vaping products are the United States, the United Kingdom, and Canada, respectively (Statista, 2020). Similar to the Canadian population statistics, youth and young adult populations are the highest reported users of e-cigarettes (The New

England Journal of Medicine, 2019) with 20% of Americans aged 18 to 29 using vaping products, compared with 16% of those aged 30 to 64, and fewer than 0.5% among those 65 and older (Newport, 2021). As the second largest market in the world for e-cigarette products worth £2.3 billion (Statista, 2020), the United Kingdom has seen the highest vaping market growth in Europe where there are an estimated 2.8 million e-cigarette users. This number represents a four-fold increase from 2012, when there were only 700,000 vape users in the country (Cohen, 2017). However, in opposition to the demographic evidence correlating population age with the highest vaping prevalence, the age range reporting the highest presence of vapers is 35 to 44 years (Statista, 2019). It is important to note that among the three countries of highest reported vaping prevalence globally, the UK holds the highest prevalence of cigarette smokers (19.5%) (WHO, 2021) with the most common reason for vaping being to use e-cigarettes as an aid to quit smoking (22%) (Statista, 2019).

1.4.2 Rest of the World

The amount of e-cigarette users varies by country. Although the United States, United Kingdom, and Canada currently hold the highest prevalence of vaping, other countries around the world are continuing to see an increase in its usage (Staff, 2018). In Russia, the National Tobacco Control Law and Monitoring and Evaluation Survey found that 11.9% of the population had tried e-cigarettes and 25.8% of those self-reported as regular users (Gambaryan, 2018). In France, another European country with significant e-cigarette usage, a recent national survey conducted by France's Monitoring Center for Drugs and Drug Addiction showed about 10% of the French population use e-cigarettes regularly (Trenda, 2020). Asia is the most populous continent on the planet with 4.15

billion inhabitants: over four times the population of Africa (Cohen, 2017). As a result, although the penetration density is higher in other regions like the U.S., Asia hosts more e-cigarette users than any other continent (Cohen, 2017) with the largest vaping market being in Malaysia, currently, with an estimated one million e-cigarette users (3.1%) (Palipudi et al., 2015).

In China, where the e-cigarette devices were first commercially successful, ironically, has a very small vaping community of approximately 1% (equated to over 13 million e-cigarette users) (Zhao et al., 2020). Outside of North America, Europe, and Asia, the usage of e-cigarettes is not prominent (Cohen, 2017). According to the Australian Institute of Health and Welfare, although the number of Australians vaping has doubled since 2016, only 2.5% of Australians were currently vaping (Ven et al., 2020). The usage of e-cigarettes in Africa is relatively unknown. For most of Africa, it can be assumed that there is no major vaping presence, however, in the country of South Africa, vaping has gained some momentum with an estimated 200,000 e-cigarette users (Cohen, 2017). South America also has an extremely small vaping and e-cigarette presence (Statista, 2020). This may be in large part due to the tremendous level of restriction and regulation on vaping throughout most of South America's most populous countries. These include the banning of sale and import of e-cigarettes in Argentina (Morello et al., 2016), the banning of the manufacturing and sale of e-cigarettes in Brazil (WHO, 2014), and the banning of sale of vaping devices completely in Uruguay (Cohen, 2017).

1.4.3 Global Trend

In 2011, there were seven million e-cigarette users worldwide. By 2020, that number had increased to 41 million (WHO, 2020) and it is expected to reach 55 million by the end of 2021 (Euromonitor, 2020). With worldwide vaping sales reaching \$15.7 billion in 2019 the global e-cigarette and vape market size is expected to expand to reach \$40 billion by 2023 (Medicine, 2020) and see an increase of a revenue-based Compound Annual Growth Rate (CAGR) of 23.8% from 2020 to 2027 worldwide (Wood, 2021).

1.5 Health Effects of E-Cigarettes

In January 2018, the National Academies of Science, Engineering and Medicine (2018) released a consensus study report that reviewed over 800 different studies; that report made clear: using e-cigarettes causes health risks. This report concluded that e-cigarettes both contain and emit a number of potentially toxic substances and carcinogens. The two primary ingredients found in e-cigarettes, propylene glycol and vegetable glycerin, are both toxic to human cells and as the products have evolved in variety, the addition of possibly toxic ingredients have only increased (Sassano et al., 2018). In recent years, there have been an increasing number of studies that demonstrate that vaping has both short and medium-term effects on the heart and lungs (Vindhya et al., 2019), however, the long-term effects of vaping are still unknown as it is a relatively new activity and the development of some diseases, such as cancer, can take many years to develop (Xie et al., 2020). It is important to note however that previous literature has shown vapours from e-cigarettes can damage human DNA, which is a pathway to developing cancer (Boakye et al., 2020).

Modern e-cigarettes produce several dangerous chemicals including acetaldehyde, acrolein, and formaldehyde. These aldehydes are known chemicals leading to possible lung

disease, as well as cardiovascular disease (Ogunwale et al., 2017). E-cigarettes also contain acrolein, a herbicide primarily used to kill weeds and may potentially lead to acute lung injury, COPD, asthma, and lung cancer (Bein et al., 2011). In a recent study following a large population (N = 21,000) over a period of five years starting in 2013, comparing the development of chronic respiratory disease between people who vaped and those who never used e-cigarettes, those who vaped were 30% more likely to develop asthma and 60% more likely to develop chronic obstructive pulmonary disease (COPD) (Xie et al., 2020). It was also recognized that in humans, just five minutes of vaping can cause changes in the way the lungs work and can lead to increased inflammation, risk of lipoid pneumonia (Gay et al., 2020) and even a spontaneous pneumothorax (Skertich et al., 2019).

In a study on e-cigarettes linked to heart attacks and coronary artery disease, Napoli et al., (2019) found that compared with non-users, those who vaped were 34% more likely to have a heart attack, 25% more likely to have coronary artery disease, and 55% more likely to suffer from depression or anxiety (Napoli et al., 2019). In addition, Peruzzi et al., (2020) found that e-cigarettes usage adversely affected blood pressure management, causing tachycardia, and worsening arterial stiffness. Moreover, within this study, e-cigarette use was found to be associated with an increased risk of adverse clinical events, including atrial fibrillation and myocardial infarction (Peruzzi et al., 2020). In addition to physiological health risks, the repeated use of e-cigarettes containing nicotine increases the risk of addiction, mood disorders, and permanent lowering of impulse control, even effecting the parts of the brain that control attention and learning (U.S. Department of Health and Human Services, 2016), leaving the prominent population demographic of vapers in Canada extremely vulnerable to poor psychological development.

The existence of health risks associated with the use of e-cigarettes is unquestionable, however, the level of health risk and the health outcomes of vaping cessation associated with e-cigarettes remains contentious (McRobbie, 2016). Although we are aware of the potential short and medium-term health risks associated with vaping on pulmonary and coronary artery disease, the long-term health effects remain unclear. In addition, there is no evidence to support that vaping cessation is related to positive health outcome. Similar to tobacco and cigarettes in the past, it may take several decades for us to truly understand what the extent of harm of these products are and how reducing their behaviour can affect the individual. It is important to note, however, that the contemporary evidence suggests e-cigarette may follow the trend of cigarettes by being related to multiple long-term health risks with continued use (Callahan-Lyon, 2014).

1.6 E-Cigarettes as a Cessation Tool

E-cigarettes are successfully marketed and commonly used in attempts to stop smoking (Hajek et al., 2019), but evidence is limited regarding their effectiveness as compared with that of nicotine products approved as smoking-cessation treatments (Siegel et al., 2011). Overall, to reduce the burden of tobacco-related illness, the best solution for cigarette smoking is complete cessation (Burch & Ciapponi, 2019). Experts agree that complete tobacco cessation over the long term, rather than reducing the number of cigarettes smoked per day, is the most effective way to reduce risk for disease and premature death (Hajek et al., 2019). However, because of the highly addictive nature of nicotine-based products like cigarettes, cessation tools are recommended when attempting to quit the habit (Silagy et al., 1994). In Canada, tools like nicotine replacement therapy (NRT), quit medications/pharmaceuticals and/or counselling are recommended (Hajek et al., 2019). There is sufficient evidence to support that NRT through skin and mouth (the patch and gum) is effective to aid smokers in quitting (Prapavessis et al., 2016). NRT through vapour

may also be more effective as the nicotine delivery is more efficient than the patch or gum, and it stimulates the smoking experience (Silver et al., 2016).

As e-cigarettes grow in popularity (Zhao et al., 2020), an increasing number of smokers are using e-cigarettes as a cessation device; however, the effectiveness as a cessation tool at the population level is still relatively unknown (Maglia et al., 2017). Research is divided on whether e-cigarettes can be considered a useful smoking device. This lack of consensus is partly due to the rapidly evolving technology and lack of standardization in the e-cigarette product market, making it challenging to compare results across studies (Jackson et al., 2021). Some research shows e-cigarettes can be useful to quit smoking behaviour, while other research shows that smokers are unsatisfied with the e-cigarette devices and return to smoking cigarettes or maintain dual use of e-cigarettes and conventional cigarettes (Pechacek et al., 2016).

A recent randomized trial among 886 conventional cigarette smokers in the United Kingdom found that those who used an e-cigarette starter pack as a nicotine-replacement product compared to NRT patches and gum reported greater declines in the incidence of cough and phlegm with more frequent throat and mouth irritation, with no significant between-group differences in the incidence of wheezing or shortness of breath (Hajek et al., 2019). In another study examining the effectiveness of e-cigarettes for smoking cessation during a 2-week period using a cross-sectional online survey, the primary findings were that a large percentage of respondents reported a reduction in the number of cigarettes they smoked (66.8%) and almost half reported abstinence from smoking for a period of time (48.8%) (Siegel et al., 2011). These findings suggest that e-cigarettes may hold promise as a smoking-cessation method, however, conflicting research surrounding the risks and benefits of e-cigarettes elicit the need for further investigation to fully understand these devices and their health-impact.

1.7 Framework Underlying Intervention

1.7.1 Protection Motivation Theory

The Protection Motivation Theory (PMT) is one of a broader category of theories known as ‘social cognition models’, along with the Theory of Planned Behaviour (Ajzen, 1991) and the Health Belief Model (Rosenstock (1974). Social cognition models propose that modifiable beliefs (such as attitude, perceived risk, and personal control) function as predictors of people’s intentions to act (Webb et al., 2010). In turn, intentions are considered to determine behaviour directly (Webb & Sheeran, 2005). It is proposed through PMT that people are motivated to react in a self-protective way towards a perceived health threat based on seven factors: the perceived severity of a threatening event (PS), the perceived probability of the occurrence, or vulnerability (PV), the perceived potential intrinsic and extrinsic rewards, the perceived efficacy of the recommended preventative behaviour (RE), the perceived self-efficacy (SE), and the perceived response cost (Rogers, 1975). In the modified PMT framework, response-cost and intrinsic and extrinsic rewards are nulled, including only the PS; PV (Threat) and RE; SE (Coping) appraisals for assessment (Gaston & Prapavessis, 2009).

The modified PMT model is summarized in Figure 1, in which the four PMT constructs predict behaviour intention, which then predict behaviour.

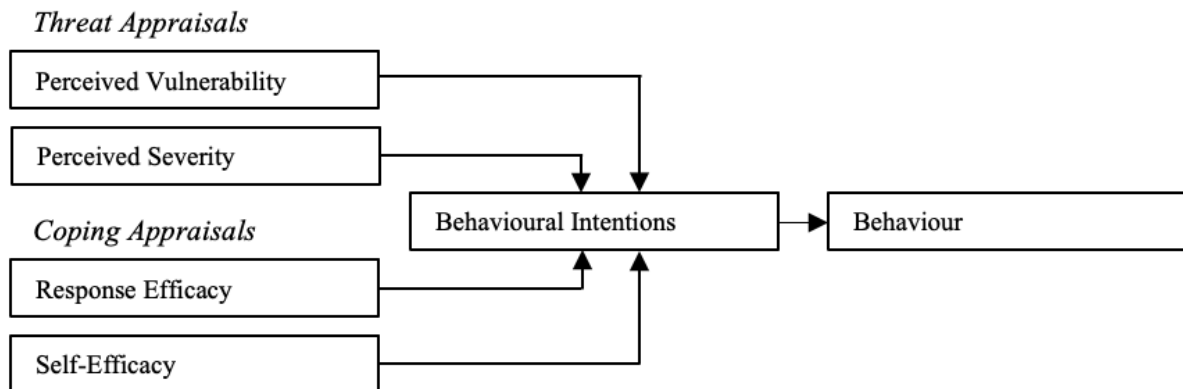


Figure 1 *Conceptual model of the Protection Motivation Theory*

1.7.2 Threat Appraisal Applications

The threat appraisal pathway involves comparing perceived rewards (intrinsic and extrinsic) of a maladaptive health-related behaviour (e.g., smoking) with perceived threats (severity and vulnerability) that the behaviour poses. For example, adolescents might weigh feelings of relaxation and better concentration (potential perceived intrinsic rewards of smoking) and beliefs that happier and more popular individuals smoke (potential perceived extrinsic rewards of smoking), against their knowledge that smoking causes cancer and other diseases (potential severity of smoking-related risk) with concerns that smoking may lead to an earlier death (potential vulnerability to smoking-related risk) (Boer & Seydel, 1996). In addition, Ben-Ahron et al., 1995) showed that high-risk drinkers perceived problems related to binge drinking to be less severe than low-risk drinkers and were less likely to intend to drink at safe limits in the future (i.e., had lower protection motivation). Similar findings have also been reported in relation to smoking (Pechmann et al., 1993). Using PMT to code the content of 194 antismoking advertisements, they found the intention to smoke was reduced with increased health risks associated with smoking, influenced by increasing the perceived severity of the

health effect (Webb et al., 2010). Supported by social cognition models, parsimonious sets of modifiable beliefs (such as attitude and perceived risk) are proven predictors of peoples' intentions to act because of the apparent threat on individual health outcome (Conner & Norman, 2005). Presently, no research has examined whether these threat appraisal components can be manipulated (enhanced) to increase goal intentions to vape less among regular vapers.

1.7.3 Coping Appraisal Applications

The coping appraisal pathway involves comparing coping efficacy (self-efficacy and response efficacy) of an adaptive variant of the health-related behavior (e.g., avoiding smoking) with perceived response costs of such adaptive behavior. For example, adolescents might consider the health benefits that non-smokers may enjoy (perceived response efficacy of not smoking) and how well they think they could decline a cigarette offered by a friend (self-efficacy for not smoking), as compared with their concerns about social isolation if they do not smoke (perceived cost of not smoking) (Yan, 2014). However, as vaping is a relatively new smoking behaviour, there is no literature to suggest that reducing/quitting vaping provides health benefits or reduces health costs. This in turn weakens the self-efficacy constructs (i.e., one can have a high degree of confidence to reduce or quit vaping, without knowing the response efficacy of such a behaviour). As a result, these coping appraisal constructs were not considered in the design of the present study.

1.8 Purpose

The aim of this two-arm randomized trial with repeated measures (i.e., baseline, post-treatment, and 6-week follow-up) was to investigate whether the use of an 8-minute

informational video, following the threat appraisal components (i.e., perceived vulnerability and perceived severity) of the Protection Motivation Theory (PMT) framework, reduces vaping intention and behaviour in Canadian university students. Another aim was to determine whether perceived vulnerability and perceived severity are associated with goal intentions to reduce vaping, and whether goal intentions to reduce vaping are associated with actual reductions in vaping use.

1.9 Study Hypotheses

1.9.1 Hypothesis I

Those exposed to the threat appraisal information grounded in the PMT components of severity and vulnerability will score higher on purpose-built questions reflecting these components than their attentional information control counterparts.

1.9.2 Hypothesis II

Those exposed to the threat appraisal information grounded in the PMT components of severity and vulnerability will show lower intentions to vape and lower vaping use compared to their attentional information (nutrition and lifestyle information group) control counterpart.

1.9.3 Hypothesis III

Increases in both severity and vulnerability of vaping usage will be associated with a reduction in intentions to vape. Furthermore, reduction in intentions to vaping will be associated with lower vaping use.

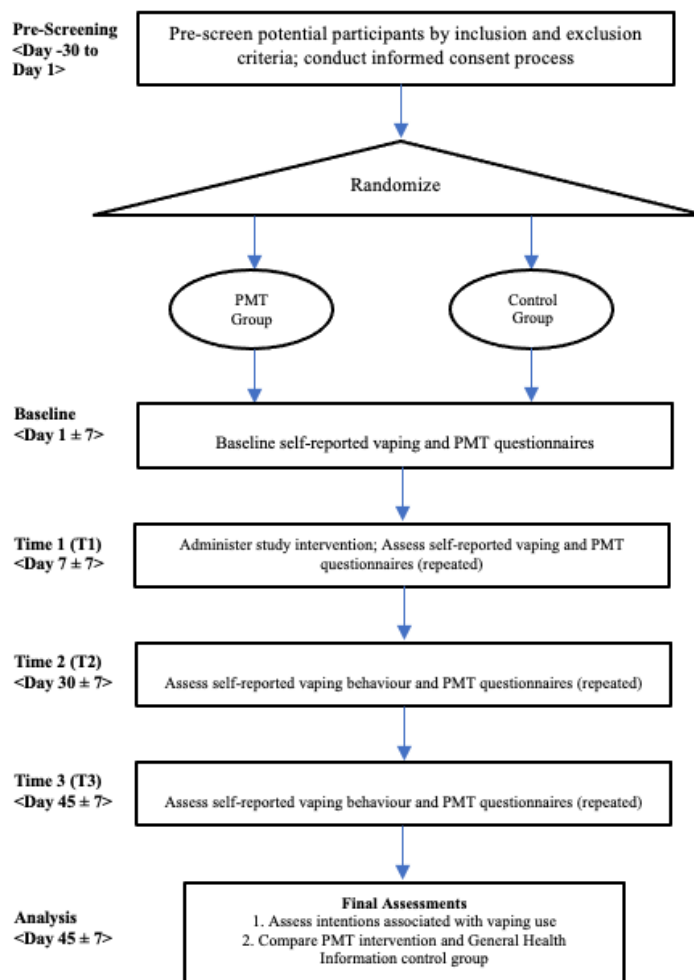


Figure 2 Flow diagram of study procedures

1.10 Significance

Understanding the specific role perceived vulnerability and perceived severity play in affecting health behaviour change will help public health educators understand how to develop specific interventions to inform this population about the negative health effects associated with e-cigarettes and affect positive change in the decision-making related to vaping.

Chapter 2

2 Literature Review

No studies have examined the effects of the threat appraisal components (PV and PS) of Protection Motivation theory on an individual's concurrent intention and vaping behaviour. Past literature surrounding PMT has largely focused on traditional tobacco smoking devices such as conventional cigarette smoking or a hookah in addition to behaviour change interventions related to physical activity and sedentary behaviour. As we are the first to incorporate the PMT threat appraisal framework with vaping, studies involving conventional cigarettes are the closest comparison of recreational behaviour.

Two studies, however, used the PMT framework to examine the effect of genetic risk information for smoking addiction (Smerecnik et al., 2011; Wright et al., 2006), one study examined the predictive factors for preventing hookah smoking in the youth of Sirjan city, Iran based on the Protection Motivation Theory (Sadeghi et al., 2019), four studies examined the application of the PMT in predicting cigarette smoking behaviour and quitting intention related outcomes (Lin & Chang, 2021; Chalermrueangrong & Preechawong, 2019; Wu et al., 2014 Yan et al., 2014; Thrul et al., 2013), and one study examined the relationship between adolescent drug use intention and protection motivation (Wu et al., 2014). Four of these studies have also focused on adolescent and young adult populations (Sadeghi et al., 2019; Wu et al., 2016; Yan et al., 2014; Thrul et al., 2013). Their results can, therefore, indicate what effects the Protection Motivation Theory may have on population intention to predict maladaptive behaviours (i.e., smoking).

As no studies have examined the effects of the threat appraisal applications of PMT alone, on vaping intention and behaviour, studies that have examined the effects of PMT on

conventional cigarette smoking and other smoking devices (i.e., tobacco hookah) may be used to indicate what effects PMT has on predicting intention and behaviour of general smoking devices, with the appraisal of the health threat and coping responses (Sadeghi et al., 2019).

2.1 PMT and Genetic Risk Information for Smoking Addiction

2.1.1 “Are Smokers Interested in Genetic Testing for Smoking Addiction? A Socio-cognitive Approach”

This study examined whether smokers are interested in undergoing a genetic test to identify their genetic susceptibility to nicotine addiction (Smerecnik et al., 2011). In addition, they aimed to identify socio-cognitive determinants of smokers’ intention to undergo genetic testing. Following the Protection Motivation Theory, they assessed the following constructs using an online survey among 587 smokers: threat appraisal (i.e., susceptibility and severity), fear, coping appraisal (i.e., response efficacy and self-efficacy, response costs and intention). In addition, knowledge, social norms, and information-seeking behaviour were measured. Susceptibility and Severity were measured using two separate sets of four items to measure susceptibility and severity factors while fear was assessed using three items combined to measure the fear factor. Response efficacy and self-efficacy were assessed using two separate sets of six items while response costs were assessed with three items. Protection motivation was operationalised to undergo a genetic test and was assessed using four items combined to form the intention factor.

Based on conventional categorisation, 372 smokers (63.4%) were classified as having a low level of addiction and the remaining 215 smokers (36.6%) were classified as having a high level of addiction to nicotine. Smokers with a high level of addiction reported higher intentions to undergo genetic testing ($M = 2.70$, $SD = 0.95$) than smokers

with a low level of addiction ($M = 42.50$, $SD = 41.00$), $F(1,585) = 5.65$, $p = 0.02$.

Women reported higher intentions to undergo genetic testing than men ($M = 2.63$, $SD = 0.91$ vs. $M = 2.52$, $SD = 1.06$, respectively), $F(1,585) = 4.13$, $p = 0.04$. Smokers between the ages of 40 and 64 reported higher intentions to undergo genetic testing ($M = 2.70$, $SD = 0.98$) compared to smokers between the ages of 20 and 39 ($M = 2.35$, $SD = 0.94$, $p < 0.001$). No difference was observed between smokers between the ages of 20 and 39, above the age of 65 ($M = 2.59$, $SD = 1.05$), between the ages of 40 and 64, and above the age of 65 (p 's > 0.26). No differences in intention were observed for level of education, $F(2, 584) = 0.16$, $p = 0.86$. Based on the correlations between the constructs and the predictions from the PMT, the study found that threat ($\beta = 0.46$, $p < 0.005$) and coping appraisal ($\beta = 0.36$, $p < 0.005$), both contributed to the intention to undergo genetic testing for smoking addiction. In addition, fear had a negative impact on this intention, suggesting that the more people fear the outcome of the genetic test, the less they intend to undergo such a test. Contrary to the predictions of the PMT, response costs did not significantly influence the intention to undergo genetic testing nor did knowledge ($\beta = 0.03$, $p > 0.05$) and social influence ($\beta = 0.01$, $p > 0.05$). The intention to undergo genetic testing significantly influenced information-seeking behaviour ($\beta = 0.18$, $p < 0.0001$). The more smokers intended to undergo genetic testing, the more likely they were to take action and click on links containing more detailed information on 'the working mechanisms of a genetic test', 'the genetic background of smoking' and 'the influence of genetic differences on smoking cessation treatments'.

Smokers with low level addiction, that are male, below the age of 39 and above the age of 65 were observed to be less interested in undergoing genetic testing,

suggesting that these groups require more attention. The result from the structural equation modelling analysis suggests that attention should focus on perceived susceptibility, severity, fear, response efficacy and self-efficacy to educate and inform smokers about the value of genetically tailored smoking cessation treatments.

2.1.2 “Can Genetic Risk Information Enhance Motivation for Smoking Cessation? An Analogue Study”

This study explored whether the impact of type of genetic risk information was moderated by smoker’s self-efficacy (SE) levels (Wright et al., 2006). Key outcomes were intention to quit and intention to attend an information session about quitting. Using a three-group, between-subjects design, the risk status manipulation was achieved using three different vignettes: gene positive, gene negative, or no testing. Participants (n = 198) were adults aged 18 to 25 that self-reported as smoking at least one cigarette every day. Consented participants were sequentially allocated to one of the three types of vignettes. Immediately after reading the vignette, the participants completed the post-manipulation questionnaire then were debriefed. Pre-message perceptions of susceptibility were assessed with a questionnaire purporting to address young adults’ concerns about different health risks, including diabetes, asthma, brittle bones, arthritis, and heart disease. Fear in response to the message was assessed with six items, “How tense/anxious/nervous/frightened/uncomfortable/worried did the information about your chances of getting heart disease make you feel?” Perceived severity of heart disease included four items (i.e., “Heart disease is a very severe illness”). Response efficacy included five items (i.e., Stopping smoking can reduce my risk of heart disease”). Self-efficacy for quitting smoking was assessed by using three items (i.e., How confident are you that you can stop smoking in the next month”). Intentions to quit smoking were

assessed by using three items (“I plan to stop smoking in the next month”) while intentions to obtain more information about quitting was assessed by telling participants that the experimenters were planning to hold information sessions and asking their intentions to attend the session with two items (i.e., How likely would you be to attend this session?). Information derogation was assessed using four items (i.e., “The information about the risks of heart disease and smoking was over the top”) and threat minimization was assessed with two items (i.e., “Although I smoke, I do many other things that lower my chances of getting heart disease”).

Following analysis, the study showed that the gene-positive group was not statistically different from zero ($\beta = 0.13, p = 0.41$). For the gene-negative group, intentions significantly decreased with increasing self-efficacy ($\beta = -.34, p = .03$). The same was true for the no-testing group ($\beta = -0.31, p = .01$). For threat minimization, the study revealed a significant interaction between risk and self-efficacy. However, instead of threat minimization decreasing as self-efficacy increased for the gene-positive group, as predicted, the slope was flat and not significant ($\beta = 0.05, p = .70$). In addition, threat minimization was affected by self-efficacy for the no-testing group, showing a positive and significant slope ($\beta = 0.45, p < 0.001$). Therefore, smokers in the no-testing group had higher threat minimization scores when they had higher self-efficacy.

These findings suggest that genetic risk information has the potential to motivate quitting but that coping appraisals, such as self-efficacy perceptions, also need to be considered. Smokers who received personalized genetic-positive risk information, had higher intentions to quit than smokers in the no-testing group, who received non-personalized risk information derived solely from their smoking status. However,

stronger intentions to quit were also associated with higher levels of self-efficacy, regardless of what type of risk information the smokers received. Self-efficacy was slightly more strongly associated with intentions to quit than was risk. Therefore, to capitalize on the motivational impact of gene-positive risk information, practitioners may also wish to consider ways of increasing smokers perceived self-efficacy. Receiving a gene-negative test result was no more or less motivating than receiving a risk estimate derived from one's status as a smoker. Although these findings did not follow the predictions of PMT, they could be explained by the notion that receiving a higher risk result from genetic testing creates a "teachable moment" (McBride, Emmons, & Lipkus, 2003) in which smokers are particularly receptive to new information. The presented implications for using genetic risk information to motivate smoking cessation is an important direction for future research on health risk and self-efficacy outcomes for maladaptive behaviours.

2.2 Effects of PMT on Hookah Smoking and Health Promotion

2.2.1 "Predictive Factors for Preventing Hookah Smoking and Health Promotion Among Young People Based on the Protection Motivation Theory"

This cross-sectional study examined the predictive factors for preventing hookah smoking in the youth of Sirjan city, based on the Protection Motivation Theory (Sadeghi et al., 2019). Data collection consisted of three parts: first, demographic information was collected, including the association of family and friend's hookah consumption and the sources of information about the harms of hookah. Second, eight multiple questions about knowledge were assessed. Third, 64 questions related to the construct of the PMT were

administered. The questions related to the PMT were based on a 5-point Likert scale and participants had to choose from 1 to 5. The structure of the PMT questionnaire included perceived sensitivity, perceived severity, internal and external rewards, self-efficacy, response efficacy, response cost, fear, and protection motivation (Sadeghi et al., 2019). To determine the internal reliability of the questionnaire, 30 individuals were asked to complete the questionnaire, and a 0.7 or higher Cronbach's alpha was considered acceptable. In addition, to examine external reliability, test-retest was done in 2-week intervals by 30 youth individuals prior to the start of this study.

Participants ($n = 280$) were predominantly female (55%), 12-24 years of age (18.06 ± 3.82), lived in Sirjan (≥ 6 months), and had no mental disorders including depression (determined by self-report and chart review) (Sadeghi et al., 2019). A regression analysis of the demographic factors on preventing hookah smoking (PHS) showed that age ($\beta = 0.30, p = 0.001$), education level ($\beta = 0.23, p = 0.002$), paternal education level ($\beta = 0.18, p = 0.04$), maternal education level ($\beta = 0.26, p = 0.003$), the individual's hookah smoking ($\beta = -0.34, p = 0.006$), father's hookah smoking ($\beta = -0.17, p = 0.006$), and friends' hookah smoking ($\beta = -0.13, p = 0.026$) were significantly related to the PMT, so that older participants, those with higher education levels, and those who had parents with higher education levels were more likely to have PHS, but the individuals who reported self-smoking of hookah, or father's or friends' smoking hookah were negatively related to PHS. The study variables were normal, and a Pearson correlation showed that there was a strong and significant correlation between perceived susceptibility, perceived severity, and fear. There were positive correlations between PHS and perceived susceptibility ($r = 0.32, p < 0.001$), perceived severity ($r = 0.34, p <$

0.001), response efficiency ($r = 0.44, p < 0.001$), self-efficacy ($r = 0.50, p = 0.001$), and fear ($r = 0.47, p = 0.001$) but negative correlations with internal and external rewards ($r = -0.12, p < 0.05$). Furthermore, the results of this study showed that the threat appraisal and coping appraisal, predicted more than 10% of PHS variability, in which the role of coping appraisal was stronger ($\beta = 0.32$).

The study findings showed that age, level of education, parental level of education, current hookah smoking of the participant, and hookah smoking status of father and friends were the most important influencing factors on PHS. The results of the Pearson correlation coefficients suggest that if people become aware of the consequences and harms of hookah smoking on the health of themselves and those around them, with an emphasis on producing fear of complications, emphasis on self-efficacy, and effectiveness of the suggested responses, the threat would have a greater chance of being alleviated. Therefore, in designing educational interventions, emphasis on the threat and coping appraisals of PMT to cause fear of hookah smoking and harms, is essential to alleviating maladaptive health threats.

2.3 Effects of PMT on Cigarette Smoking Quitting intention

2.3.1 “Factors Associated with the Quitting Intention Among Chinese Adults: Application of the Protection Motivation Theory”

This cross-sectional study examined the use of the protection motivation theory (PMT) in explaining smoker’s quitting intentions among Chinese adults with the goal of providing valuable evidence to promote theory-guided and culturally appropriate cessation interventions (Lin & Chang, 2021). Based on previous literature, they identified four psychological determinants that play an important role in influencing individuals’ threat appraisal: perceived severity, perceived susceptibility, and intrinsic and extrinsic

rewards. Considering coping appraisal, three determinants were used: response efficacy, self-efficacy, and response costs (Lin & Chang, 2021). Therefore, their first hypothesis was that severity and vulnerability to smoking-related threats are positively associated with quitting intention. Their second hypothesis is that intrinsic and extrinsic rewards and response costs would be negatively associated with the quitting intention. Their third hypothesis was that both coping and threat appraisal variables are significant predictors of the quitting intention. In addition, Lin & Chang (2021) tested the psychological determinants and the target behaviour simultaneously, predicting the effect of the quitting intention and PMT constructs on behaviour. Finally, their final hypothesis is that the smoking intention is a sound variable that can predict quitting behaviour.

Participant (n = 613) were dominantly male (91.7%), 37.94 ± 14.31 (mean \pm SD) years old, daily smokers with ≥ 1 year of smoking duration, and reported being residents (≥ 5 years) of one of 26 randomly selected provinces in Mainland China. Data was collected using questionnaires administered in the form of face-to-face interviews, lasting for approximately 15-20 minutes for each participant. The questionnaires were designed with four sections: sociodemographic information, smoking status, smoking-cessation information, and PMT constructs (Lin & Chang, 2021). Cronbach's alpha and interclass correlation coefficients (ICC) were used to assess the reliability of the individual PMT constructs and a multiple linear regression was used for multivariable analysis. Stronger quitting intentions were significantly associated with higher perceived vulnerability (Coef. = 0.13, $p < 0.01$), self-efficacy (Coef. = 0.28, $p < 0.01$), and response efficacy (Coef. = 0.23, $p < 0.01$) but inversely associated with intrinsic rewards (Coef. = -0.15 , $p < 0.01$). Greater quitting intentions were significantly associated with higher threat (Coef.

= 0.19, $p < 0.01$) and coping appraisals (Coef. = 0.25, $p < 0.01$). Regarding behaviour, longer quitting attempts were significantly associated only with self-efficacy (Coef. = 0.13, $p < 0.01$) and response cost (Coef. = -0.18, $p < 0.01$). In summary, their results confirmed the applicability of PMT for predicting the quitting intention in Chinese adults and self-efficacy was represented as the only factor that had a predictive effect on both the intention and behaviour.

The study findings confirmed the applicability of PMT for predicting the quitting intention among Chinese adults, however, the results of this study provide only partial support for their hypotheses. This finding is consistent with those reported by other researchers that not all PMT measures had the same strength in predicting behaviour (Ruiter et al., 2001). Consistent with their hypotheses, both coping and threat appraisal exhibited significant predictive values for the quitting intention, suggesting that at least some of the seven PMT constructs act as stable factors influencing quitting behaviour. Among the threat appraisal constructs, vulnerability to the health threat was confirmed as a predictor of the quitting intention, but the severity of the threat was not, even though the items related to perceived severity had the highest mean score among all the items. A possible explanation for this ineffective predictive relationship may be that people may know that smoking is harmful but are not truly motivated to quit. On the other hand, the higher vulnerability is a sign that smokers realize how they could be influenced by the negative consequences of smoking behaviour. In addition, the intrinsic rewards were one of the important predictors for the quitting intention, but extrinsic rewards and response costs may be less important in influencing behaviour. Moreover, perceived efficacy was found to be the main predictor of the quitting intention among all four perceptions,

pointing to the importance of enhancing smokers perceived self-efficacy in quitting smoking and refusing cigarettes. Overall, the results show that the quitting intention is significantly associated with quitting behaviour in all models. Self-efficacy and response cost are significantly related to quitting behaviour; self-efficacy being the only factor that has a predictive effect on both the intention and behaviour. This finding is consistent with early research suggesting that coping appraisal, especially self-efficacy within this construct, is a better predictor of health behaviour than threat appraisal (Thrul et al., 2013), thus reaffirming that threat communication may be less important for smoking-cessation-related health education.

2.3.2 “Effects of the Motivation Program to Quit Smoking in Royal Thai Air Force Officers with Non-Communicable Disease Risks”

This quasi-experimental study compared the outcome of a smoking cessation program based on the Protection Motivation Theory and a brief intervention among Royal Thai Air Force (RTAF) officers, with non-communicable disease (NCD) risks (Chalermrueangrong & Preechawong, 2019). The purpose of this research was to compare the outcome of a PMT-based smoking cessation program and a brief intervention to a control group among RTAF officers with NCD risks. The Fagerström test for nicotine dependence (FTND), a six-item questionnaire that is widely accepted, was used to assess the severity of nicotine dependence. The intraclass correlation coefficient of the Thai version was 0.83 and Cronbach’s α was 0.52 (Chalermrueangrong & Preechawong, 2019). The “Quit Smoking Questionnaire” (QSQ) was self-reported and assessed the participant’s smoking status. In addition, a device designed to measure the amount of exhaled carbon monoxide (CO) in a smoker’s breath was used to verify smoking cessation. In this study, they used a level of < 8 ppm CO as the abstinence cut

off (8-10 ppm is commonly indicative of abstinence) (MacLaren et al., 2010). The program provided the participants with three weekly sessions of one-on-one counseling lasting 20-30 minutes each. In the first session, the participants were made aware of the adverse effects of tobacco and the dangers of continuing to smoke by using exhaled CO measurements from the Smokerlyzer combined with the results of their health report. The participants were then provided with advice on how to quit smoking by following a mutually agreed upon action plan. In the second week, the goal was to build up an expectation of the positive effects of changing behavior to quit smoking and to encourage the subject's capability of quitting smoking by using the shared experiences of role models (other RTAF officers who successfully stopped smoking). The third activity (eighth week) was the session in which the researcher met the participants individually to measure their exhaled CO, listen to their experiences and give them advice on how to cope with nicotine withdrawal and other suggestions on how to sustain abstinence.

Participants ($n = 60$) were males, between the ages of 21-59 (38.27 ± 10.59), with a BMI ≥ 25 kg/m², fasting blood sugar ≥ 100 mg% or blood pressure $\geq 130/85$ mmHg, smoking at least one cigarette in the past seven days, and able to communicate via mobile phone. The participants were equally divided into two groups, using group matching by age and the number of reported cigarettes smoked per day to control for confounding variables. By the end of the three weekly sessions, only 6 participants in the Motivation to Quit Smoking Program and one in the control group were able to quit successfully. The percentage of participants who reported the seven-day point prevalence abstinence verified by exhaled CO in the experimental group was significantly higher than in the control group (20.0%; 3.3%; $p < 0.05$). Although there was no significant difference

between the two groups at the beginning of the study in the baseline average number of cigarettes smoked per day, by the end of the study, the numbers of cigarettes per day had decreased from 12.87 ± 7.23 and 10.53 ± 7.45 at baseline to 7.23 ± 5.90 and 8.83 ± 6.13 in the experimental and control group, respectively. The reduction in the number of cigarettes smoked per day by participants in the experimental group was significantly greater than that of the control group ($p < 0.05$).

The Motivation to Quit Smoking Program was moderately successful in persuading RTAF officers to stop smoking or at least reduce the number of cigarettes smoked per day. As the study concluded, the percentage of participants who succeeded in smoking cessation was found to be significantly higher in the experimental group ($p < 0.05$) than in the control group. Using RTAF officers who had successfully quit smoking as role models to share experiences and information as well as to inspire the participants to quit smoking was considered effective. Using the CO measuring device to determine the amount of exhaled CO helped participants to see the negative effects of smoking directly and the danger of cigarettes more clearly and was a strong motivator for quitting smoking. As most research studies using PMT focus on adolescent and young adult populations, it is rare to see a study using the constructs of protection and motivation. Although this study used the constructs of the PMT within its study procedures, the introspective correlations between threat appraisal and coping appraisal applications were not assessed. However, the use of PMT among an adult population supports the data that this application promoted smoking cessation as the experimental group reduced the number of cigarettes smoked per day from 12.87 to 7.23, while the control group reduced their cigarettes from 10.53 to 8.83. Using the PMT framework as an intervention to

promote smoking cessation over three weekly information and counselling sessions, the research supports the application that providing knowledge and motivation are effective ways to eliminate the participants' reluctance to quit and provide a clear goal to achieve in their smoking cessation plan.

2.3.3 “Application of the Protection Motivation Theory in Predicting Cigarette Smoking Among Adolescents in China”

This study investigates the role of PMT on perceptions and appraisal pathways within an integrative system to predict tobacco use intention and behaviour among adolescents in China, demonstrating the utility of PMT (Yan et al., 2014). Data collection was conducted in classroom settings using the “Chinese Student Health Behaviour Questionnaire,” distributed to individual students were randomly selected for participation among the eligible high schools ($n = 35$) in Wuhan, China. Participants completed the questionnaire in approximately 25 to 35 minutes. PMT constructs were assessed using the PMT Scale for Adolescent Smoking (Macdonell et al., 2013; Yan et al., 2014).

Participants ($n = 553$) were equally represented by gender (50%), 16.28 ± 0.98 (mean \pm SD) years old with no significant gender differences in grade, parents' education level, or family income; parental approval was required before enrollment into study. Three sets of regression models revealed stronger smoking intentions were significantly associated with more frequent past-month smoking, smoking more cigarettes per day, lower vulnerability and severity, higher extrinsic and intrinsic rewards, lower self-efficacy, and higher response cost (Yan et al., 2014). Past month smoking frequency was associated with PMT constructs in the same manner, and frequency was also significantly

associated with lower response efficacy of not smoking; the strongest relationships were among pairs of variables forming perception scores (i.e., $r = 0.52$ for vulnerability and severity, $r = 0.61$ for extrinsic and intrinsic rewards, and $r = 0.41$ for self-efficacy and response efficacy). To summarize, the study found that greater perceived intrinsic and extrinsic rewards, lower perceived threat, and lower self-efficacy were related to more cigarettes smoked per day, more frequent recent smoking, and higher intention to smoke, respectively.

These study findings provided new evidence supporting the utility of behavioral theories developed in the West to advance tobacco research in China and other developing countries, where 80% of all smokers in the world reside (Giovino et al., 2012; WHO, 2011). When all the PMT measures were analyzed individually, most PMT components were significantly related to smoking intention and behavior, but the strength of the relationships differed for different PMT constructs. This finding implies that different attention should be directed to the more influential PMT constructs in devising and delivering behavioral intervention programs to achieve better effects. However, although it may present a challenge to stress to young adolescents the long-term negative health impacts of smoking (Smith & Stutts, 2003), we cannot ignore the significance of this strategy in tobacco use prevention. Specifically, for tobacco use prevention among adolescents, more attention should be paid to perceived rewards (including intrinsic and extrinsic rewards) and perceived efficacy (including self-efficacy and response efficacy) to strengthen the prevention intervention programs for sustainable effects.

2.3.4 “Adolescents’ Protection Motivation and Smoking Behaviour”

This cluster-randomized controlled trial examines the applicability of the PMT as a theoretical framework to predict the development of smoking behaviour over the course of 2.5 months in a sample of German adolescents (Thrul et al., 2013). Participants completed questionnaires at baseline (T1) and at follow-up (T2) 2.5 months later. Questionnaires at T1 and T2 were connected using a code (first two letters of first names of parents) and participants’ age and gender, thus guaranteeing anonymity and confidentiality. Adolescents participated in a clinic-based emotionally arousing intervention for tobacco prevention. The authors built on the work of Pechmann et al., (2003) to operationalize the constructs in the area of threat appraisal, coping appraisal, and intentions. Current smokers were determined based on a question within the self-reported smoking behaviour questionnaire and biochemical verification of self-reports were conducted for a random subsample at baseline ($n = 74$) and follow-up ($n = 72$) using carbon-monoxide breath analysers (BMC 2000 CO Monitor, Senko Co., Ltd, Korea).

Participants ($n = 494$) were based in 18 German secondary schools from the southwest region of Germany. Participants were equally represented by gender (50.61% female), 13.15 ± 0.89 (mean \pm SD) years old. Excluded students were either not present in the classroom on the day of the assessment ($n = 154$), were current smokers ($n = 70$), or gave inconsistent self-reports of their current smoking status ($n = 33$). Of this sample, $n = 110$ (16.3%) were lost to follow-up. A just identified model with zero degrees of freedom was calculated and revealed a weak to moderate correlation between behavioural intention (T1) and severity, vulnerability, response-efficacy and response costs, and a strong correlation between behavioural intention (T1) and self-efficacy. Behavioural

intention at T2 was weakly to moderately correlated with self-efficacy and weakly negatively correlated with response costs. Results of the path analysis model revealed that self-efficacy significantly predicted behavioural intention at T1. Furthermore, behavioural intention at T1, significantly predicted behavioural intention at T2. No significant effects of age and gender on any of the outcomes were observed. Self-efficacy had a significant indirect association with behavioural intention at T2 via behavioural intention at T1 ($\beta = 0.14, t = 4.1, p < 0.001$) and a significant indirect association with smoking behaviour via behavioural intention at T1 and T2 ($\beta = -0.07, t = -3.7, p < 0.001$).

Study findings provide only partial support for the PMT in the context of adolescent smoking. Contrary to their hypothesis, the threat appraisal constructs of perceived severity and perceived vulnerability were not able to significantly predict concurrent or future behavioural intention and future smoking behaviour. On the other hand, the coping appraisal construct of self-efficacy exhibited some predictive value, suggesting that self-efficacy is the strongest predictor of concurrent smoking-related behavioural intention. This suggests that a high confidence of adolescent in their ability to resist cigarette offers is associated with a high intention to decline any offers. Furthermore, the results suggest that intentions are somewhat stable over time. Overall, this study suggests that coping appraisal, specifically self-efficacy within this construct, is the better predictor of health behaviour compared to threat appraisal; therefore, threat communication may be less important in influencing this behaviour (Thrul et al., 2013).

2.4 Effects of PMT on Drug Use Intention

2.4.1 “Correlates of Protection Motivation Theory (PMT) to Adolescents’ Drug Use Intention

This quantitative cross-sectional exploratory study examined the relationship between adolescents’ drug use intention, demographic factors, and the protection motivation level (Wu et al., 2014). Questionnaires ($n = 2$) were distributed to students in class; the first contained 22 questions based on the PMT, and the second focused on general information, including demographics. The differences of the appraisal factors were between two groups: one with the intention to use drugs (intention group) and one without it (no-intention group). The PMT questions were measured on a five-point Likert scale, measuring the seven factors within the PMT framework. In this study, all items were randomized to minimize the consistency effect (Brace, 2006). The chi-square test/Fisher exact test and the Mann-Whitney U test were used to compare the intention and no-intention groups by demographic factors and PMT measures. Demographic factors with a p -value < 0.1 were further related to PMT measures by using binary logistic regression.

Participants ($n = 318$) were predominantly male (57.5%), nearly half of them (151, 47.5%) between 13 and 15 years among a population age sample of below 21. Less than half of the students (78, 24.5%) had \$500 or more available to spend and the majority had no religious beliefs (211, 66.7%) and lived with both parents (242, 76.1%). Results of the Chi-square test/Fisher exact test showed that the factors of gender, family structure, and pocket money were significantly different among students with and without drug use intention. Results indicated that a significantly higher proportion of female students had the intention to use drugs (male: 2.7%, female: 8.1%, $p < 0.05$). Students living with both parents tended to have a lower intention to use drugs than those living

with one parent or those not living with parents (living with both parents: 3.3%, one parent: 10.0%, not living with parents: 12.5%, $p < 0.05$). Students who had more than \$501 available per month were found to have a higher intention to use drugs. The mean score for threat appraisal only showed significant difference in perceived severity ($p < 0.05$). Results of the logistic regression analysis showed that intrinsic and extrinsic rewards were significant predictors of students' drug use intention. The corresponding odds ratios were 2.90 (95% CI = 1.24-6.81, $p < 0.05$) and 8.04 (95% CI = 2.63-24.56, $p < 0.001$). The mean score for coping appraisal revealed that the different responses to efficacy and self-efficacy were statistically significant with p-values smaller than 0.05 and 0.001, respectively. The intention group also reported a higher response cost of 3.63 compared to 3.50 in the no-intention group, but the difference was not significant.

Study findings provide partial support for the PMT that those in the no-intention group reported significantly higher perceived severity, self-efficacy, and response efficacy compared to the intention group. Adversely, those in the intention to use drugs group reported significantly higher extrinsic and intrinsic rewards. The research suggests that major transitions in the lives of adolescents, like changes in physical development or social situations, as well as adolescents that identify with living with one parent, having either high- or low-income households, lower educational attainment, and higher amount of pocket money were all predictors of greater intention to use drugs. The logistic regression showed that a very good regression model could be developed using PMT. This was determined by the high Nagelkerke R^2 and the results of the goodness of fit tests. Particularly, the two significant predictors, intrinsic and extrinsic rewards, could

serve as a guide for health educators and help design more focused and evidence-based drug abuse prevention campaigns in school settings (Wu et al., 2014).

2.5 Summary of Relevant Research

The majority of reviewed studies were designed to examine the effect that distinguishable demographic characteristics along with PMT threat and coping appraisals had on maladaptive behaviour and intention. Those that were not, examined the effects of a motivational program, supported by the PMT framework, in absence of intercorrelated variance assessment between threat and coping appraisals.

Of the studies assessing PMT appraisal variance, threat and coping appraisal outcomes on intention and behaviour were the most frequently analyzed. Threat appraisal consisted of perceived vulnerability, perceived severity, intrinsic reward, and extrinsic reward while coping appraisal incorporated self-efficacy, response efficacy, and response cost (Rogers, 1975). Various maladaptive behaviours were assessed (i.e., hookah smoke, conventional cigarette, and drug use) with representation of various age groups (i.e., adolescents, youth, young adults, and adults) among varying outcome factors attributed to intention and behaviour (i.e., genetic risk, fear, socio-cognitive determinants, threat information manipulation, coping appraisal manipulation). Among the studies included, each used the PMT constructs using a scale based on the seven components of threat and coping appraisal (Smerecnik et al., 2011; Wright et al., 2006; Sadeghi et al., 2019; Lin & Chang, 2021; Chalermrueangrong & Preechawong, 2019; Yan et al., 2014; Thrul et al., 2013; Wu et al., 2014). Adding further complexity to intervention, multiple study designs were included: cross-sectional exploratory, cluster-randomized controlled trial, and quasi-experimental study.

Despite the differences in maladaptive behaviour, age group, and study design, the

reviewed studies collectively indicate that using specific PMT constructs can affect intention and quitting smoking behaviour in the following two ways:

1.
 - a) The Greater intrinsic and extrinsic reward, the lower the intention to abstain from behaviour;
 - b) The Greater perceived severity, the higher the intention to abstain from behaviour (most effective construct of threat appraisal);
 - c) The Greater perceived vulnerability, the slightly higher (inconsistent) intention to abstain from behaviour;
 - d) The Greater perceived susceptibility, the higher the intention to abstain from behaviour;
 - e) The Greater perceived risk, the higher the potential to motivate quitting, however, coping appraisals, such as self-efficacy perceptions, need to be considered for optimal affect;
2.
 - a) The Greater response cost, the lower the intention to abstain from behaviour;
 - b) The Greater self-efficacy, the higher the intention to abstain from or reduce behaviour (strongest predictor);
 - c) The Greater response efficacy, the higher the intention to abstain from or reduce behaviour;

Variance between threat and coping appraisal outcomes between studies would likely be attributable to maladaptive behaviour in question and demographic of participants included within the study design.

It is important to examine the effects of PMT on maladaptive behaviour because the rate of novel, foreign devices such as e-cigarettes in Canada, are becoming increasingly prevalent

among teens and young adults (Chadi, 2019). Threat and coping appraisal applications are theoretically and statistically correlated with intention to abstain from maladaptive behaviour; self-efficacy and coping appraisals being the strongest predictor for intention and quitting behaviour because it implies a strong belief in the response behaviour for health benefits and in the ability and control of vicarious experience in protecting oneself against potentially health-threatening substances, and higher self-ability, to deter temptation or pressure; followed by perceived severity because the consequences may relate to an anticipated event that may occur in the future, or to a current state such as a pre-existing health problem, however, research surrounding the effectiveness of perceived severity remains inconclusive (Jones et al., 2014).

Chapter 3

3 Methods

The study's protocol and materials underwent full board review and were approved by the University of Western Ontario's Health Sciences' Research Ethics Board in December 2020 (See Appendix A). Recruitment began in January 2021 and continued until data collection concluded in April 2021, at which point treatment effects on study outcomes were analyzed. Study design follows the Consort checklist of information for reporting randomised trials (Consort, 2010). All participants read the Letter of Information (See Appendix A) and provided informed consent (See Appendix A) prior to participation in the study.

3.1 Recruitment

Participants were recruited through digital posters in university student Facebook groups and the Mass Email Recruitment system at Western. The student investigator (SI) posted the study recruitment poster outlining study inclusion criteria, general objectives, and asked potential participants to email the attached SI email if interested in participating (See Appendix A). The

mass email posted by Western's Mass Email Recruitment System followed a general script providing an overview of the study's objectives and procedures, eligibility criteria, and contact information (See Appendix A).

Individuals that expressed an interest in participating were sent a standardized email containing the 'Letter of Information' describing the study objectives and procedures and asked individuals to email a signed copy of said letter back to the SI (See Figure 3). Individuals that self-identified as eligible with a signed copy of the 'Letter of Information' sent to the SI were provided the baseline questionnaire links to begin data collection (See Appendix A). Following baseline assessment, participants that completed the self-reported evaluations within seven days of contact were provided the next set of questionnaires (T1, T2, T3). For each assessment day, a reminder was sent to individual participants four days after scheduled completion (See Appendix B) to notify them to complete that set of questionnaires within the next three days. Those who failed to submit their self-report questionnaires within the pre-defined seven days were emailed a notice of exclusion by the SI, informing the participant that their collected data would be included in the study's findings, but that they have been removed from further data collection and subsequent participation in the study (See Appendix B).

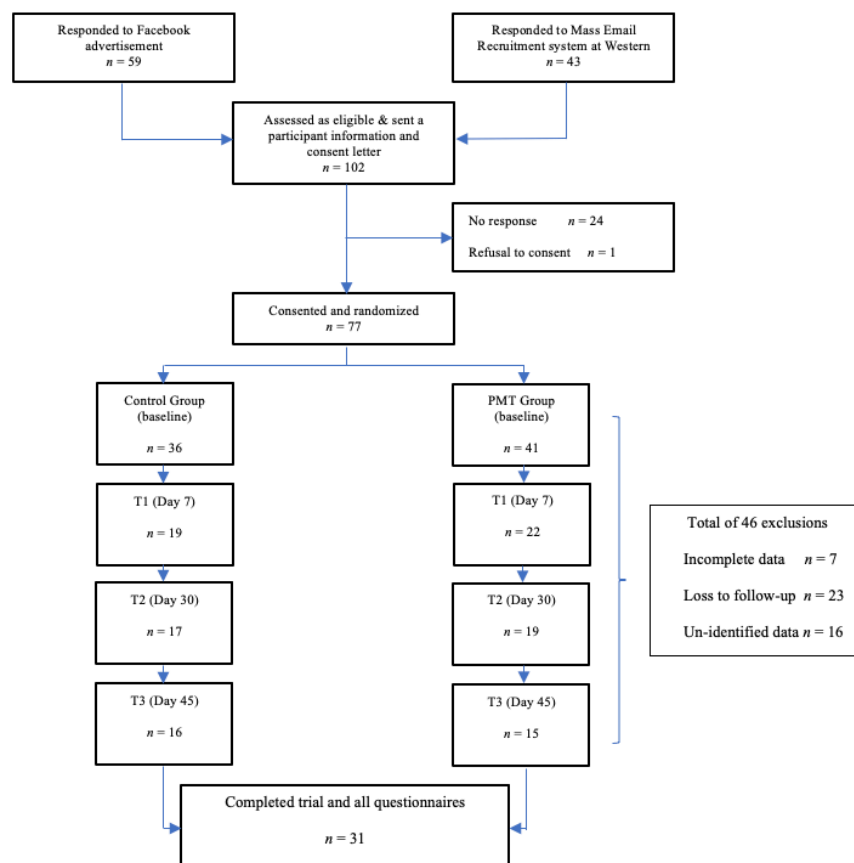
3.2 Sample

Prime candidates were current undergraduate students in Canada that planned to reduce their current vaping habits by expanding their knowledge on vaping products and reflecting on their own experiences because this intervention would, ideally, support their reduction and maintenance of vaping cessation. Inclusion and exclusion criteria were enforced to minimize the confounding effects of extraneous variables on outcomes of interest.

3.2.1 Eligibility Criteria

Individuals had to be able to read and understand English, over the age of 18 years, current university undergraduate student in Canada, who self-report as current users of vaping products (>3x in the past 30 days) and intend to adhere to the study intervention regimen. The language restriction was imposed to assure that participants provided informed consent, complied with procedure instructions, and appreciate

Figure 3 Flow diagram of recruitment and retention



Note. Number of potential participants reached through Facebook advertisements and the Mass Email Recruitment System remains uncertain

intervention content. Age and education restrictions were imposed to minimize the effect that social and environment differences could have on participants' intention to vape. Vaping and intention restrictions were imposed to minimize the mediating effect that

experience, and behaviour differences could have on participants' affective responses to intervention details and intention to reduce vaping behaviour.

Participants were excluded from study if they had activity restrictions that would limit their ability to engage in questionnaire testing, were currently practicing in behaviour therapy treatment specific to vaping, were under the legal age of 18 at the time of signing/submitting the consent form or failed to complete and submit completed questionnaires within the 7-day study timeframe (starting the day that set of surveys is emailed by the student investigator). Health, function-associated limitations, behaviour rehabilitations participation, and age restrictions were imposed because these conditions would have increased individuals' risk of incurring adverse outcomes following intervention related to stress, anxiety, and potential psychological distress (Pascoe et al., 2019). Timeframe restrictions were imposed because they would have influenced relative anxiety, intention, and behaviour outcomes.

3.2.2 Sample Size

The a priori sample size calculation took into account the large effect size ($\eta^2 = .09$) obtained by Droulers et al., (2017) and the medium effect size ($\eta^2 = .05$) obtained by Wright et al., (2008) in their studies combining behaviour health risk information and intentions to quit smoking. Based on these results, approximately 20-50 participants were needed per group for a between-group design with a level of .05 and a power of .80 (Cohen, 1992).

3.3 Randomization

Participants were randomly allocated to treatment groups using block randomization and

a random number generator to place participants in groups of two. This block size was chosen to increase the likelihood of having an equal number of participants in both treatment groups. We chose this method of randomization to assign groups equally because it is short enough to prevent imbalance and long enough to prevent guessing allocation in trials. Block randomization was implemented for our two-group treatment allocation using a 1:1 ratio with block sizes of two. Therefore, participants were recruited on a concurrent basis and placed into treatment groups in blocks of two.

3.4 Instruments

3.4.1 Demographic and Modified Youth Vaping Questionnaires

Two seven-item vaping Canadian student vaping demographic and tobacco use questionnaires derived from an existing Canadian Student Tobacco, Alcohol, and Drugs Survey (CSTADS) conducted by a consortium of researchers across Canada, centralized at the University of Waterloo (2014). Excluding drugs assessment questions, the Demographic and Youth Vaping Questionnaires collected descriptive information, social influence, current behaviour, and use of past tobacco-based products. Example items include “What is your ethnicity?” (Demographic) (See Appendix C) and “Have you ever used chewing tobacco, cigarettes, cigars, cigarillos, or little cigars?” (YVQ-A) (See Appendix C).

3.4.2 Modified Protection Motivation Theory Questionnaire

A seventeen-item PMT questionnaire derived from an existing PMT scale for physical activity measured the two threat appraisals (PV, PS) and two goal intention items derived from previous PMT and exercise research (Gaston & Prapavessis, 2009). As previously mentioned, because vaping is a relatively new smoking behaviour and

there is no literature to suggest that reducing/quitting vaping provides health benefits or reduces health costs, coping constructs (self-efficacy and response efficacy) were not implemented. To ensure only true details of known health information is used, only PV and PS items were tested from the PMT appraisals to measure the effect on vaping intention.

3.4.2.1 Threat appraisals

PV was assessed by four 10-point items and PS was assessed by four 10-point items (0= strongly disagree to 10 = strongly agree), commonly used in the PMT literature (Courneya & Hellsten, 2001). Example items include, “I feel that my chance of developing health problems at some point because of vaping is” (PV; see Appendix C) and “I feel that it would be very serious for me to develop health problems if I continue to vape” (PS; see Appendix C). The internal consistency Cronbach’s alpha for this scale for PS was $\alpha = 0.88$, for PV $\alpha = 0.92$.

3.4.2.2 Goal Intention

Goal intention was assessed by three 10-point items (0 = Not At All to 10= Very Seriously). An example item is, “Would you seriously consider starting a structured program designed to help you reduce or quit vaping to decrease your risk of developing health problems?” (See Appendix C). The internal consistency Cronbach’s alpha for this scale for intention was $\alpha = 0.92$.

3.4.2.3 Behaviour

Vaping behaviour was assessed by one 5-point item (0 = 0 times to 5 = More Than 30). The repeated measure item is “During the past X days, how many times did you vape?” (See Appendix C).

3.5 PMT Video Creation

Videos were retrieved from publicly accessible forum channels on YouTube under “vaping education” and “general health information”, respectively, through the online search tab. For the PMT intervention video, two separate videos highlighting the severity of vaping on health and susceptibility of vaping among young adult populations were cut and combined into one 8-minute video using iMovie on MacOS. For the attention control video, this method was repeated, instead combining two separate videos focusing on general lifestyle and health information. Both video links were "Unlisted" (only those with the video link can open the video) and played through YouTube; group intervention links were emailed to respective participants (comment sections and "Like/Dislike" buttons on both videos were disabled to prevent participant interaction).

Participant groups were one of two treatment conditions: PMT present or PMT absent (attention control). The PMT present group watched an 8-minute informational video (video link: <https://www.youtube.com/watch?v=WTKevKge2dg&t=171s>) that explained the current research and health risks associated with vaping, within the context of a threat appraisal focus (Perceived Vulnerability and Perceived Severity). During this video intervention, the severity and vulnerability of vaping among young adults, both the short and long-term health effects were presented. In addition, the video explained the negative health impacts of vaping and the lack of research and information that currently exists on popular vaping products, including the potentially devastating impact it may have on the health of young adult populations. The first half of the PMT present video included narration by "Science Insider" producer, Benji Jones, including dialogue regarding the risks associated with vaping by Chief Pediatric Pulmonology at the NYU Winthrop Hospital, Dr. Melodi Pirzada, and information on nicotine by the Director of

Pediatric Pulmonology at NYU's Langone Hassenfeld Children's Hospital, Dr. Mikhail Kazachkov. The second half of the PMT present video included personal experiences and narratives by students at the University of Utah with information regarding our current knowledge of vaping health effects through research by Dr. Sean Maddock and Dr. Sean Callahan from the University of Utah to highlight the susceptibility of vaping for a population of young adults in university.

3.6 Attention Control Video

The PMT absent group featured an 8-minute nutritional information video (video link: <https://www.youtube.com/watch?v=W4RKILJU8RM>) as an attention control strategy titled "Health Effects". During this video intervention, the general risks and benefits of nutrition and a healthy lifestyle were presented. The focus of this video was on how a balanced diet and proper lifestyle choices (i.e., adequate sleep, diet, etc.) can benefit your life in the short-term and long-term. In the nutrition and lifestyle choices intervention, the topic of substance abuse was discussed briefly but without depth to illustrate the risks to the health of young adults titled. The first half of the PMT absent video was presented by the Alliance for Aging Research, including an immersive video design, explaining the impact that nutrition may have as we age, reviewed by Dr. Steven Austad and Senior Nutritionist Johanna Dwyer. The second half of the PMT absent video was presented by TED-Ed with narration by Addison Anderson, including a similar immersive video design, explaining how the food we eat may affect our brain and overall health. The nutrition and lifestyle information design were administered as a control because it provides informative lifestyle choices regarding nutrition that can help promote your overall health without having an underlying link to vaping behaviour and its subsequent effect on the status of health. The reasoning behind this is to separate and recognize the impact of threat appraisal

PMT, compared to general nutrition and lifestyle information on behaviour-intention and action-behaviour of a Canadian student population.

3.7 Procedures

Participants were recruited on a concurrent basis through poster advertisements on university student Facebook groups and the Mass Email Recruitment system at Western. Individuals that self-identified as eligible emailed the student investigator (SI) where the Letter of Information and Consent was relayed back to the prospective email contact of the individual. Eligible participants that signed the consent form then emailed the forms back to the SI. Participants were allocated to one of two experimental groups using a blocked randomization method; participants were recruited on a concurrent basis and randomized within blocks such that an equal number are assigned to each treatment. To avoid the presence of stratification errors we reviewed our allocation design before administering study intervention and purpose-questionnaires to prevent participant mismanagement during the protocol (no participant or researcher blinding was present).

The baseline assessment was comprised of identifiable questionnaires to assess their history and experience with vaping and measure their intention to vape less, incorporated within the 4-questionnaire links: Demographic Assessment, Youth Vaping, and PMT (I & II). At Day 7 (T1), participants were emailed their respective video link along with the questionnaires and were instructed to complete the surveys after watching their videos. The study intervention was a single site trial delivered as a video link to the email provided by the participant; both intervention videos were played on YouTube and participants were instructed to complete the surveys immediately after watching the video attached to the email sent to them. The participants completed self-reported questionnaires at 3 follow-up periods after baseline in the 6-week

protocol (all questionnaires were sent by the SI to the email provided by the participants). As illustrated in Schema 3.3, self-reported vaping behaviour questionnaires were managed at Baseline, Day 7 (T1), Day 30 (T2), and Day 45 (T3). For every questionnaire set date, the participants had 7 days to complete that compound of questionnaires. A follow-up "reminder" email was sent by the SI to the participant emails of those who had failed to submit that set of questionnaires. The follow-up emails were designed to remind the participants that if they failed to submit the questionnaires within the following 3 days, they would be withdrawn from the study. All questionnaire links were created using the Qualtrics Survey Software and were distributed by the SI to the email provided by the individual participants.

3.8 Data Collection & Storage

Participants were allocated a participant ID (XX-YYY) upon enrollment in the study. Questionnaires used to collect data were labeled using participants' ID (See Appendix C), and no identifiers were associated with participant ID to protect their anonymity. VeraCrypt encryption software was used to secure participant information on the SI's laptop and BitLocker-encryption was used for Personal Vault OneDrive data storage including study data, source data (including surveys), and Letter of Information and Consent.

3.9 Statistical Analyses

All analyses were conducted using IBM SPSS Statistics 25 for MacOS. All analyses were by intention-to-treat and included all participants. Missing values (T0, T1...) were replaced using a multiple imputation analyses methodology and computed separately from completed data analyses (Jakobsen et al., 2017). Presentation of statistical results and analyses methods for both completed data and sensitivity data (imputed) are illustrated separately below. Both data sets

used one-way ANOVAs and chi-square procedures to ensure that there were no systematic differences between groups on demographic characteristics (See Table 1 and Table 6). Separate 2 (group) by 4 (time) repeated measures ANOVAs were conducted for each of the variable measures: PV, PS, intention, and behaviour. Pearson correlation analyses were used to measure the statistical strength and direction of relationship between threat appraisal variables and vaping intention and behaviour based on the method of covariance (See Table 3). Finally, a linear regression model was conducted to predict the parameters of threat appraisal on intention and intention on behaviour variables (See Table 5 and Table 10).

Chapter 4

4 Results

4.1 Group Equivalency

One-way ANOVAs revealed no significant differences indicating systematic differences between groups with respect to age, $F(7, 49) = 1.69, p = .11$; in addition, the mean academic year of the two groups being very similar (3.19 (SD = 1.35) PMT; 3.13 (SD = 1.53) control). No significant differences emerged (<0.05). Moreover, chi-square analyses indicated no significant differences between gender $\chi^2(19, N = 83) = 23.59, p = .22$ among the treatment conditions. As can be seen from Table 1, no significant differences emerged ($p < 0.05$), indicating that there were no significant systematic differences between groups with respect to demographic variables. Therefore, it was deemed unnecessary to use demographic variables as covariates in the subsequent analyses.

Table 1 Demographic characteristic for the two treatment conditions

Variable	PMT ($n = 41$)	Control ($n = 36$)	Statistic ($n = 77$)	p level
Age in years (SD)	21.58 (3.23)	22.69 (3.70)	$F(7, 49) = 1.69$.41

Academic Year	3.19 (1.35)	3.13 (1.53)	$F(4, 59) = 0.49$.74
Gender				
Male	46.3 %	44.4 %	$\chi^2(19, N = 83) = 23.59$.88
Female	53.7 %	55.6 %		
Other	0.0 %	0.0 %		
Prefer not to answer	0.0 %	0.0 %		
Vaping Behaviour (Past 30 Days)				
1-5 days	17.2 %	29.2 %	$\chi^2(76, N = 83) = 74.57$.87
5-15 days	38.0 %	33.3 %		
16-29 days	17.2 %	20.8 %		
All 30 days	27.6 %	16.7 %		
Ethnicity				
Caucasian	61.0 %	50.0 %	$\chi^2(95, N = 83) = 108.0$.42
African American	4.9 %	2.7 %		
Hispanic American	2.4 %	5.6 %		
Asian American	12.2 %	22.2 %		
Indigenous Peoples	12.2 %	5.6 %		
Other	7.3 %	13.9 %		
Household Income				
Under \$25,000	17.1 %	25.0 %	$\chi^2(76, N = 83) = 83.00$.41
\$25,000-\$60,000	19.5 %	13.9 %		
\$60,000-\$100,000	26.8 %	30.6 %		
\$100,000-\$150,000	22.0 %	22.2 %		
Prefer not to answer	14.6 %	8.3 %		
Employment Status				
Employed full-time (>40 hrs/wk)	14.6 %	13.9 %	$\chi^2(57, N = 83) = 52.00$.24
Employed part-time (<40 hrs/wk)	48.8 %	41.7 %		
Unemployed	29.3 %	33.3 %		
Self-employed	7.3 %	11.1 %		
Age First Tried Vaping				
10 or younger	0.0 %	0.0 %	$\chi^2(36, N = 83) = 34.89$.17
10-15	14.3 %	3.5 %		
16-18	42.9 %	41.4 %		
19 or older	42.9 %	55.1 %		
Parental Vaping Presence				
Yes	13.9 %	20.0 %	$\chi^2(19, N = 83) = 25.12$.40
No	86.1 %	80.0 %		
Four Closest Friends that Vape				
None	8.3 %	3.3 %	$\chi^2(76, N = 83) = 91.38$.84
One	19.4 %	40.0 %		
Two	24.0 %	16.7 %		
Three	22.2 %	16.7 %		
All four	25.0 %	23.3 %		
Other Products/ Devices Used				
Yes	86.1 %	69.0 %	$\chi^2(38, N = 83) = 53.59$.07
No	13.9 %	24.1 %		

Prefer not to say

0.0 %

6.9 %

Note. Standard deviation presented in parentheses; *PMT* protection motivation theory group, *Control* general health information group, *Academic year* within institution

4.2 Group Differences

4.2.1 Threat Appraisal Beliefs Towards Vaping

Separate one-way factorial repeated measure ANOVAs showed that the two treatment groups differed significantly across time on PS and PV (See Table 2, Figure 4, and Table 3). Specifically, participants in the PMT intervention group increased their PV scores from baseline (T0) to 7-day post-treatment (T1) to a greater extent than their attention control counterparts (See Figure 4). PV then decreased from 7-day post-treatment (T1) to 30-day post-treatment (T2) and increased from 30-day post-treatment (T2) and 45-day post-treatment in a similar manner for both groups. For perceived severity (PS), participants in the PMT intervention group increased PS scores from T0 to T1, whereas PS scores remained relatively stable (slight decrease) from T0 to T1 for those in the attention control condition. PS then decreased from T1 to T2 and remained stable from T2 and T3 for those in the PMT intervention. In contrast, PS remained relatively stable (slight decrease) from T1 to T2, and T2 to T3 for those in the attention control condition (See Figure 4).

4.2.2 Vaping Intention

Non-significant treatment by time group differences for intention to reduce vaping behaviour were found (See Table 2, Figure 4, and Table 3). However, it is important to note that the effect size for this interaction was moderate in size and favoured the PMT intervention group. Specifically, participants in the PMT intervention group increased their intention scores from baseline (T0) to Day 7 (T1) to a greater extent than their

control counterparts (See Figure 4). This pattern of divergence remained consistent in the PMT group from T1 to Day 30 (T2) then evolved into a gradual increase in intention from T2 to Day 45 (T3). In contrast, the attention control group decreased from baseline to T1 and remained uniform from T1 to T3 (See Figure 4).

4.2.3 Vaping Behaviour

Non-significant effects were revealed between treatment groups for vaping behaviour for the follow-up assessments (See Table 2, Figure 4, and Table 3). The effect size for this interaction was large, and generally favoured the PMT intervention group. Specifically, participants in the PMT intervention and attention control group both reported their greatest change in vaping behaviour from baseline to T1 (See Figure 4). Although both groups saw a decline, PMT intervention group reported a greater change. From T1 to T2, behaviour saw a slight increase (consistent between both treatment groups), followed by a small decline for the PMT intervention group and a steep decline for the experimental group from T2 to T3.

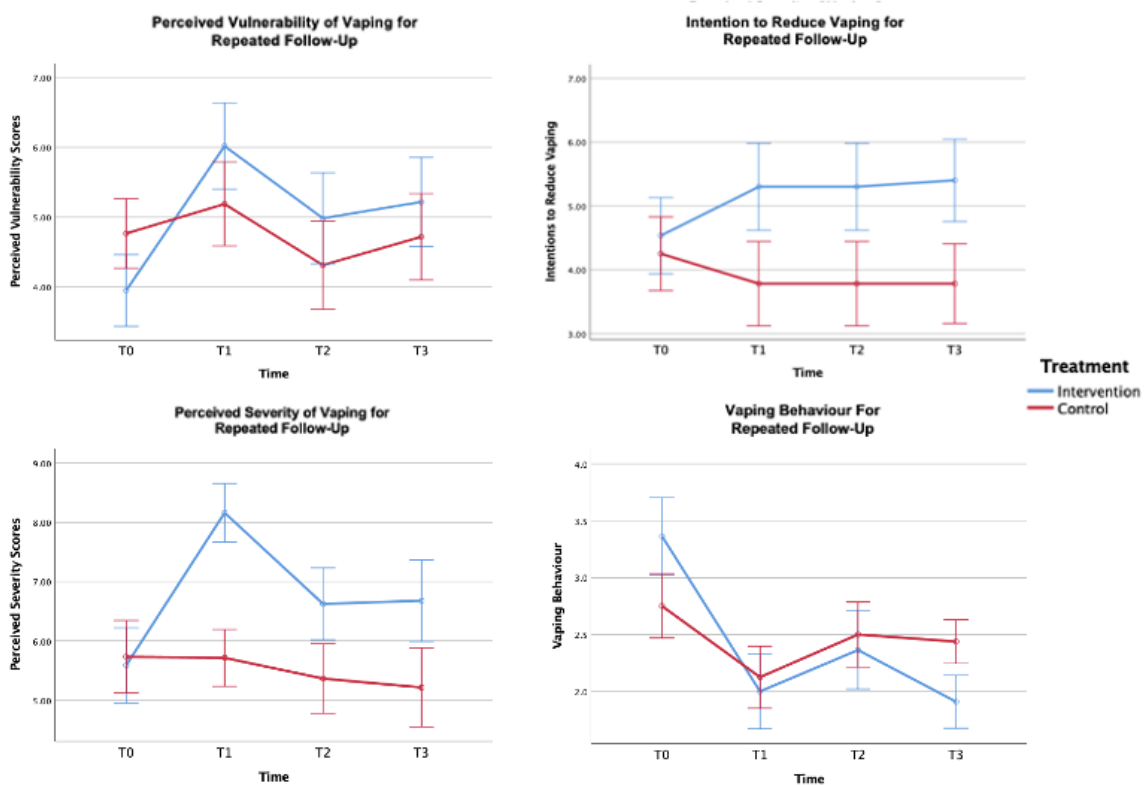
Table 2 Treatment by time interaction effects for threat appraisal, intention, and behaviour between treatment conditions

Variables	<i>F</i> (1, 28)	<i>p</i>	Partial Eta Squared (η_p^2)	Observed Power
Perceived Vulnerability	3.28	.036	.27	.69
Perceived Severity	3.69	.025	.31	.74
Intention	124.7	.284	.09	.26
Behaviour	8.08	.123	.22	.47

Table 3 Mean and standard deviation for threat appraisal, intention, and behaviour for PMT and Control condition

Variables	T0 (M(SD))	T1	T2	T3
<i>n</i> = 15				
Perceived Vulnerability	3.95 (2.4)	6.02 (2.4)	4.98 (2.8)	5.22 (2.7)
Perceived Severity	5.59 (2.8)	8.16 (1.5)	6.62 (2.3)	6.68 (2.7)
Intention	4.53 (2.5)	5.30 (2.8)	5.30 (2.8)	5.40 (3.0)
Behaviour	3.36 (1.3)	2.0 (1.2)	2.36 (1.1)	1.91 (0.8)
Variables	T0 (M(SD))	T1	T2	T3
<i>n</i> = 16				
Perceived Vulnerability	4.77 (1.5)	5.19 (2.4)	4.31 (2.3)	4.72 (2.2)
Perceived Severity	5.73 (1.9)	5.72 (2.1)	5.37 (2.2)	5.22 (2.4)
Intention	4.25 (2.2)	3.78 (2.5)	3.78 (2.5)	3.78 (1.9)
Behaviour	2.75 (1.0)	2.13 (1.0)	2.50 (1.2)	2.44 (.73)

Note. T0 = Baseline, T1 = Day 7, T2 = Day 30, T3 = Day 45

Figure 4 Mean and standard error scores between treatment groups across time for PV, PS, intention, and behaviour

Note. T0 = Baseline, T1 = Day 7, T2 = Day 30, T3 = Day 45

4.3 Correlation Analysis

Bivariate Pearson correlations between threat appraisal variables, vaping intention, and vaping behaviour at baseline and follow-up are presented in Table 4. In line with the tenets of PMT, if bivariate relations were found between the predictor variables and the criterion variable of interest, they were then entered into a regression analysis to determine their uncorrelated contribution. Perceived vulnerability and severity were significantly related to each other and intention at multiple follow-up time points. Goal intention was not found to be significantly related to behavior at any time point.

4.4 Linear Regression Analysis

Linear Regression analysis between bivariate variables (PV, PS, Intention) are presented in Table 5. The linear regression for predicting intention found both PV and PS to be significant influencers. Moreover, PV is revealed to be the strongest measure of vaping intention with significant effects at T0, T1 and T2, followed by a significant PS effect at T3.

Table 4 Bivariate correlations between the modified PMT variables with intention and behaviour

Variable	<i>n</i>	Mean	SD	1	2	3	4
<i>Baseline (T0)</i>							
1. Perceived Vulnerability	63	5.29	2.48	-	.71**	.66**	.28*
2. Perceived Severity	62	6.30	2.36		-	.49**	.14
3. Intention	64	5.02	2.52			-	.13
4. Behaviour	65	2.97	1.36				-
<i>Day 7 (T1)</i>							
1. Perceived Vulnerability	51	5.89	2.42	-	.56**	.59**	-.03
2. Perceived Severity	50	7.16	1.97		-	.31	-.09
3. Intention	40	4.70	2.76			-	.18
4. Behaviour	50	2.32	1.24				-
<i>Day 30 (T2)</i>							
1. Perceived Vulnerability	39	4.76	2.38	-	.72**	.78**	.19
2. Perceived Severity	39	6.13	2.15		-	.51**	.18
3. Intention	38	4.67	2.78			-	.26
4. Behaviour	38	2.53	1.20				-
<i>Day 45 (T3)</i>							
1. Perceived Vulnerability	31	4.96	2.44	-	.45*	.38*	.12
2. Perceived Severity	31	5.91	2.58		-	.53*	.16
3. Intention	31	4.56	2.59			-	.23
4. Behaviour	31	2.16	0.82				-

Note. * $p < .05$; ** $p < .01$

Table 5 Linear regression analyses predicting intention

Variable	Baseline (T0)		Day 7 (T1)		Day 30 (T2)		Day 45 (T3)	
	<i>B</i> (SE <i>B</i>)	β	<i>B</i> (SE <i>B</i>)	β	<i>B</i> (SE <i>B</i>)	β	<i>B</i> (SE <i>B</i>)	β
Perceived Vulnerability	.31 (.28)	.27	.67 (.18)***	.56	1.0 (.18)***	.86	.17 (.19)	.16
Perceived Severity	.21 (.26)	.22	-.04 (.22)	-.03	-.12 (.22)	-.09	.41 (.19)*	.41

Note. Only PMT variables which were significantly correlated with intention were entered in each regression model.

* $p < .05$; ** $p < .01$; *** $p < .001$

4.5 Missing and Excluded Data

Multiple imputation analyses were implemented for all missing data points across all variables within both treatment groups. This strategy of analyses was used to negate the potential statistical uncertainty associated with the presence of missing data by creating several different plausible imputed data sets and appropriately combining result obtained from each of them. Through data analysis patterns of missing values our missing data was shown as ‘missing at random’, with 42.24 % of all values collected containing missing data, negating the decision to use ‘single imputation’ or ‘complete case analysis’ strategies (Jakobsen et al., 2017).

4.6 Imputed Results

Separate data analyses for missing values (T0, T1, T2, T3) were replaced using a multiple imputation analyses methodology across all variables within both treatment groups. This strategy of analyses was used to negate the potential statistical uncertainty associated with the presence of missing data by creating several different plausible imputed data sets and appropriately combining results obtained from each of them.

4.7 Imputed Group Equivalency

One-way ANOVAs revealed no significant differences indicating systematic differences between groups with respect to age, $F(1, 422) = 3.67, p = .06$; in addition, the mean academic year of the two groups proved to be insignificant ($p > .05$) (3.19 (SD = 1.34) PMT; 3.08 (SD =

1.56) control). Moreover, Chi-square tests indicated no significant differences between gender ($\chi^2(1, N = 448) = .05, p = .83$), vaping behaviour ($\chi^2(4, N = 448) = 15.55, p = .17$), household income ($\chi^2(4, N = 448) = 9.06, p = .13$), employment status ($\chi^2(3, N = 448) = 6.3, p = .10$), or prevalence among friends ($\chi^2(4, N = 393) = 27.00 = p = .39$ within treatment conditions.

However, as can be seen from Table 1, regarding demographic variables, significant differences emerged with ethnicity, age first tried, parental vaping presence, and other products/devices used. Therefore, a repeated measures ANCOVA was conducted to determine a significant interaction effect to reject the null hypothesis and meet the homogeneity of regression between treatment groups and vaping intention, controlling for ethnicity, age first tried, parental vaping presence, and other products/devices used. Results showed a non-significant effect of treatment group on vaping intention after controlling for aforementioned covariates except for age first tried, $F(1, 346) = 11.85, p < .05$. Post-hoc of age first tried between groups revealed a non-statistically significant ($p = .95$) effect between PMT intervention and attention control, failing to reject the null hypothesis that we meet homogeneity of regression but the covariate not having a significant effect on intention to vape.

Table 6 Imputed demographic characteristic for the two treatment conditions

Variable	PMT ($n = 82$)	Control ($n = 57$)	Statistic ($n = 139$)	p level
Age in years (SD)	21.91 (3.51)	22.54 (3.51)	$F(1, 442) = 3.67$.06
Academic Year	3.19 (1.34)	3.08 (1.56)	$F(1, 442) = .70$.40
Gender				
Male	46.1 %	45.5 %	$\chi^2(1, N = 448) = .05$.83
Female	53.9 %	54.5 %		
Other	0.0 %	0.0 %		
Prefer not to answer	0.0 %	0.0 %		
Vaping Behaviour (Past 30 Days)				
1-5 days	17.59 %	31.01 %	$\chi^2(4, N = 448) = 15.55$.17
5-15 days	35.71 %	32.55 %		
16-29 days	18.68 %	20.94 %		
All 30 days	28.02 %	15.50 %		
Ethnicity				

Caucasian	60.1 %	50.0 %	$\chi^2(5, N = 448) = 17.75$.01
African American	4.4 %	2.6 %		
Hispanic American	2.6 %	5.8 %		
Asian American	15.3 %	19.9 %		
Indigenous Peoples	11.0 %	6.4 %		
Other	6.6 %	15.3 %		
Household Income				
Under \$25,000	17.1%	25.7 %	$\chi^2(4, N = 448) = 9.06$.05
\$25,000-\$60,000	17.5 %	16.0 %		
\$60,000-\$100,000	30.7 %	26.9 %		
\$100,000-\$150,000	20.6 %	23.7 %		
Prefer not to answer	14.1 %	7.7 %		
Employment Status				
Employed full-time (>40 hrs/wk)	16.2 %	10.9 %	$\chi^2(3, N = 448) = 6.3$.09
Employed part-time (<40 hrs/wk)	46.5 %	42.3 %		
Unemployed	27.2 %	37.2 %		
Self-employed	10.1 %	9.6 %		
Age First Tried Vaping				
10 or younger	0.0 %	0.0 %	$\chi^2(2, N = 382) = 13.21$.01
10-15	13.6 %	3.7 %		
16-18	43.2 %	40.7 %		
19 or older	43.2 %	55.6 %		
Parental Vaping Presence				
Yes	13.2 %	21.0 %	$\chi^2(1, N = 393) = 4.72$.03
No	86.8 %	79.0 %		
Four Closest Friends that Vape				
None	8.9 %	2.2 %	$\chi^2(4, N = 393) = 27.00$.62
One	20.5 %	39.1 %		
Two	25.8 %	15.2 %		
Three	21.1 %	18.1 %		
All four	23.7 %	25.4 %		
Other Products/ Devices Used				
Yes	84.4 %	70.1 %	$\chi^2(2, N = 388) = 21.01$.01
No	15.6 %	22.6 %		
Prefer not to say	0.0 %	7.3 %		

Note. Standard deviation presented in parentheses; *PMT* protection motivation theory group, *Control* general health information group, *Academic year* within institution

4.8 Imputed Group Differences

4.8.1 Threat Appraisal Beliefs Towards Vaping

Separate one-way ANOVAs showed that both treatment groups differed significantly on PS and PV across time (See Table 7, Figure 5, and Table 8). Specifically,

participants in the PMT intervention group increased their PV scores from baseline (T0) to Day 7 (T1) to a greater extent than their attention control counterparts (See Figure 5). PV then decreased from T1 to Day 30 (T2) and again from T2 to Day 45 (T3) in a similar manner for both groups. For perceived severity (PS), participants in the PMT intervention group increased PS scores from T0 to T1, whereas PS scores remained relatively stable (slight decrease) from T0 to T1 for those in the attention control condition. PS then decreased from T1 to T2 and spiked up again from T2 to T3 in the PMT intervention. In contrast, PS remained relatively stable (slight decrease) from T1 to T2 but saw a jump from T2 to T3 in the attention control condition (See Figure 4).

4.8.2 Vaping Intention

Significant treatment group differences across time for intention to reduce vaping behaviour were revealed (See Table 7, Figure 5, and Table 8). Specifically, participants in the PMT intervention group increased their intention scores from baseline (T0) to Day 7 (T1) to a greater extent than their control counterparts (see Figure 5). This pattern of divergence remained consistent from T1 to Day 30 (T2) then revealed an increase in intention from T2 to Day 45 (T3). In contrast, the attention control group decreased from baseline to T1, remained uniform from T1 to T2 and revealed another gradual decrease from T2 to T3 (See Figure 5).

4.8.3 Vaping Behaviour

Significant treatment group differences across time for vaping behaviour were found (See Table 7, figure 5, Table 8). Specifically, participants in the PMT intervention and attention control group reported a gradual decline (PMT intervention holding the greater change) from baseline to T1 (See Figure 4). From T1 to T2, behaviour saw a

slight increase (consistent between both treatment groups), followed by the largest change from T2 to T3 (PMT intervention holding the greater difference) showing a decline in vaping behaviour at final follow-up (See Figure 5).

Table 7 Imputed treatment by time interaction effects for threat appraisal, intention, and behaviour between treatment conditions

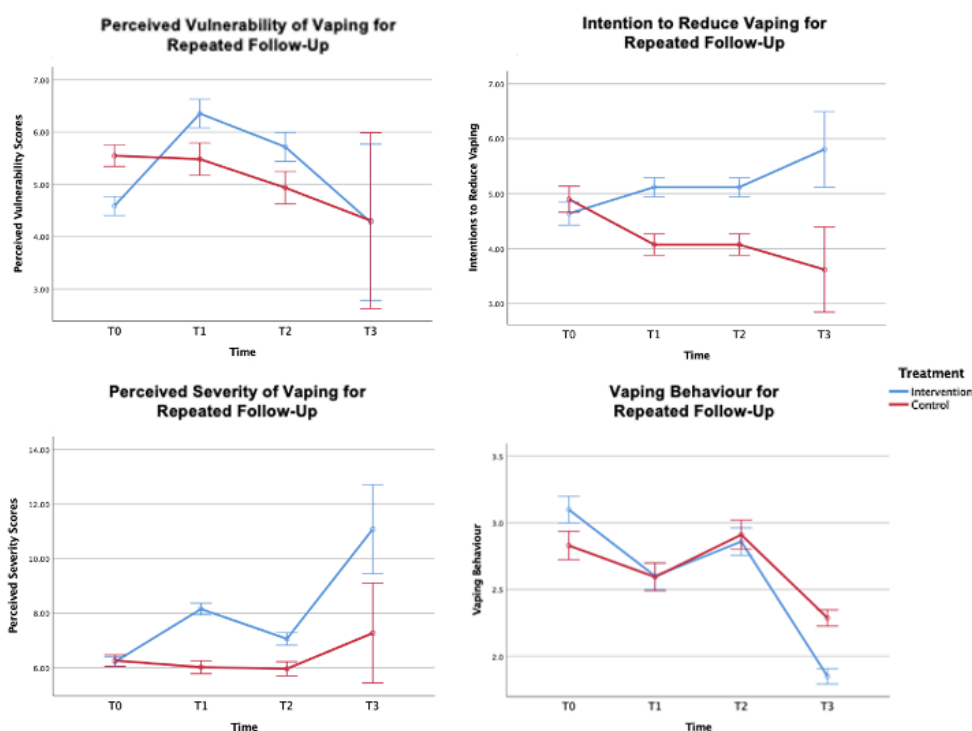
Variables	<i>F</i> (3, 413)	<i>p</i>	Partial Eta Squared (η_p^2)	Observed Power
Perceived Vulnerability	8.52	.001	.06	.99
Perceived Severity	10.08	.001	.07	1.0
Intention	815.6	.001	.05	.99
Behaviour	68.04	.001	.06	.99

Table 8 Imputed mean and standard deviation for threat appraisal, intention, and behaviour for PMT and Control conditions

Variables	T0 (M(SD))	T1	T2	T3
<i>n</i> = 244				
Perceived Vulnerability	4.71 (2.8)	6.42 (3.9)	5.86 (4.0)	4.09 (21.7)
Perceived Severity	6.34 (2.8)	8.15 (3.0)	7.14 (3.2)	11.96 (19.9)
Intention	4.66 (2.9)	5.08 (2.5)	5.08 (2.5)	5.89 (9.1)
Behaviour	3.06 (1.4)	2.69 (1.4)	2.93 (1.4)	1.84 (0.8)
<i>n</i> = 172				
Perceived Vulnerability	5.71 (2.4)	5.54 (4.1)	5.06 (3.8)	4.23 (17.0)
Perceived Severity	6.37 (2.3)	6.08 (3.1)	6.08 (3.6)	7.67 (16.1)
Intention	5.03 (3.2)	4.13 (2.4)	4.13 (2.4)	3.59 (5.9)
Behaviour	2.84 (1.2)	2.64 (1.3)	2.95 (1.4)	2.27 (0.8)

Note. T0 = Baseline, T1 = Day 7, T2 = Day 30, T3 = Day 45

Figure 5 Imputed mean and standard error scores between treatment groups across time for PV, PS, intention, and behaviour



Note. T0 = Baseline, T1 = Day 7, T2 = Day 30, T3 = Day 45

4.9 Imputed Correlation Analysis

Bivariate Pearson correlations between threat appraisal variables, vaping intention, and vaping behaviour at baseline and follow-up are presented in Table 9. If bivariate relations were found between the predictor variables and the criterion variable of interest, they were then entered into a regression analysis to determine their uncorrelation contribution. Perceived vulnerability and severity were significantly related to each other and intention at multiple follow-up time points, however, only PS showed significant effect on intention and behaviour at final follow-up (T3). In addition, intention did not maintain a consistently significant association with vaping behaviour. Specifically, no association was found at baseline, T1, and T3. However, a positive association was found at T2, suggesting that higher intentions to reduce vaping are

associated with higher rates of vaping behaviour. Due to this contradictory finding this relationship was not pursued further through regression analysis.

4.10 Imputed Linear Regression Analysis

Linear Regression analysis between significant bivariate variables (PV, PS, and Intention) are presented in Table 10. For complete data the linear regression for predicting intention found both PV and PS to be significant influencers. Moreover, the imputed analysis supports the completed data in that PV is revealed to be the strongest measure of vaping intention with significant effects at all timepoints, with PS strengthening in effect over time, holding a significant effect at T2 and T3 timepoints (See Table 10).

Table 9 Imputed bivariate correlations between the modified PMT variables with intention and behaviour

Variable	<i>n</i>	Mean	SD	1	2	3	4
<i>Baseline (T0)</i>							
1. Perceived Vulnerability	448	5.12	2.65	-	.61**	.61**	.25**
2. Perceived Severity	447	6.36	2.61		-	.38**	.10*
3. Intention	449	4.81	3.05			-	.08
4. Behaviour	450	2.97	1.35				-
<i>Day 7 (T1)</i>							
1. Perceived Vulnerability	436	6.07	4.06	-	.43**	.34**	.03
2. Perceived Severity	435	7.31	3.23		-	.20**	-.00
3. Intention	425	4.70	2.49			-	.09
4. Behaviour	435	2.70	1.33				-
<i>Day 30 (T2)</i>							
1. Perceived Vulnerability	424	5.54	4.01	-	.80**	.43**	.19**
2. Perceived Severity	424	6.71	3.33		-	.29**	.19**
3. Intention	423	4.70	2.49			-	.17**
4. Behaviour	423	2.93	1.39				-
<i>Day 45 (T3)</i>							
1. Perceived Vulnerability	416	4.13	20.28	-	-.20**	.59**	.02
2. Perceived Severity	416	10.23	18.68		-	.13**	-.18**
3. Intention	416	4.94	8.05			-	-.05
4. Behaviour	416	2.02	0.81				-

Note: * $p < .05$; ** $p < .01$

Table 10 Imputed linear regression analyses predicting intention

Variable	Baseline (T0)		Day 7 (T1)		Day 30 (T2)		Day 45 (T3)	
	<i>B (SE B)</i>	β	<i>B (SE B)</i>	β	<i>B (SE B)</i>	β	<i>B (SE B)</i>	β
Perceived Vulnerability	.72 (.06)***	.63	.20 (.03)***	.31	.33 (.05)***	.52	.30 (.02)***	.65
Perceived Severity	.00 (.06)	.00	.06 (.04)	.07	-.11 (.06)*	-.15	.12 (.02)***	.26

Note. Only PMT variables which were significantly correlated with intention were entered in each regression model.

* $p < .05$; ** $p < .01$; *** $p < .001$

Chapter 5

5 Discussion

The results of the present study support the view that both threat appraisal applications grounded in PMT (PV, PS) are effective mechanisms to influence reduced vaping intention, however PV maintains the strongest effect on intention within a 6-week protocol design. Findings for both complete and imputed data highlight the isolated corroboration of threat appraisal in predicting intentions in a Canadian university student population. Among these two sets of data analysis, general findings regarding threat appraisal and intention are replicated. Beyond these general observations, commentary related to the specific hypothesis' that were generated warrant further examination.

5.1 Hypothesis I

It was hypothesized that those exposed to the threat appraisal information grounded in the PMT components of severity and vulnerability would score higher on purpose-built questions reflecting these components than their attentional control counterparts. Analysis within completed data revealed significant differences between PV and PS with respect to the experimental group (PV, $p = .04$; PS, $p = .03$) over the 6-week study period. Imputed data results supported these findings with greater significance among threat variables (PV, $p = .001$; PS $p = .001$). Partial eta squared was used to measure effect size for our repeated measures design, using the following values to interpret the strength of the effect: $\eta_p^2 = .01$ indicates a small effect; $\eta_p^2 = .05$ indicates a medium effect; $\eta_p^2 = .09$ indicates a large effect (Lakens, 2013). Among completed and imputed data sets, our effect size using this criterion indicated that PS was most strongly influenced, follow by PV across the 6-week protocol. The emergence of PS being the more susceptible to our threat intervention may be explained by the potential health effects of

vaping described by health professionals in the experimental group. As a relatively new product in North America, the potential health effects of vaping remain unclear. To those participating in this study, hearing that vaping may cause sudden pneumonia or a pneumothorax (collapsed lung), could be a reason for the shown raise in participant perception of the severity of harm related to vaping. With respect to PV, we chose to include the dialogue of vaping health threat focused on young adult populations. Therefore, the perceived potential severity of health outcomes mentioned above were directly linked to the vulnerability of the participants age group. This experimental design would explain why a significant difference for both PS and PV was consistently shown for both data sets. In addition, because vaping is a relatively new device, the greater difference shown in PS may be a result of the participant's learning of the severity of these health outcomes for the first time, causing PS to show a greater difference in change compared to the components of perceived vulnerability. This finding may also be explained by the presence of defensive denial among the young adult population of students in university with evidence to suggest that younger people perceive less vulnerability to health risks (Millstein & Halpern-Felsher, 2002). This may have attenuated the impact of the vulnerability manipulation. According to the relationship of means within the completed data, both variables related to threat appraisal (PV, PS) elucidated the largest difference in variability from baseline to T1 (following intervention). This finding shows that the effect of the threat appraisal intervention on PV and PS is strongest immediately after receiving health risk information. However, among the imputed data, the largest difference was apparent between Day 30 (T2) and Day 45 (T3), garnering future research to further investigate the difference in perceived PV and PS components of threat appraisal over longer follow-up periods.

While studies have used the constructs of PMT in the past, we are the first study to isolate the threat appraisal components of vaping within an educational video-implementation design. Given the short existence of modern vaping devices, there is no research to support the health benefits of reducing or abstaining from vaping behaviour (response efficacy). Therefore, to maintain confidence in our intervention implementation design, we formatted our study to only include the literature supported health risk information of continued vaping and did not propose false speculations related to the health benefits of reducing and abstaining from vaping.

5.2 Hypothesis II

It was hypothesized that those exposed to the threat appraisal information will show lower intentions to vape and lower vaping use compared to their attentional information (nutrition and lifestyle information group) control counterpart. With respect to intention, analysis within completed data revealed non-significant reductions in intentions to vape over time. Following threat information implementation at Day 7 (T1), both sets of data showed an increase in intention to vape less with consistent intentions at Day 30 (T2) followed by a period between T1 and T2 where the intention to reduce vaping within the PMT intervention group remained uniform between both data sets. Following this stage of consistent intention measures, both data sets showed an increase in intention from T2 to Day 45 (T3). Regarding the imputed data, this change from T2 to T3 was the largest difference across timepoints for intention. These findings warrant future research to further investigate the difference in PV and PS components of threat appraisal on intention over longer follow-up periods. With respect to the PMT intervention group, the increase from T0 to T1 is explained by the application of the threat intervention while the increase from T2 to T3, consistent across both data sets of participants in the PMT intervention, may be a factor of increased perceived severity and vulnerability.

Although we see a positive change in intention over time for the PMT intervention group, the lack of statistically significant change shown in the completed data analysis can be explained by low observed power ($\beta = .26$) resulting from the small sample size in the PMT intervention group. After conducting the imputed data analysis, we saw a large increase in observed power ($\beta = .99$) and only a modest change in effect size (completed data: $\eta_p^2 = .09$; imputed data: $\eta_p^2 = .05$) between the two data sets, revealing intentions to reduce vaping in the imputed data set to show statistically significant change over time. This change in statistical significance is best explained by the larger sample of participants included in the PMT intervention group with the imputed data revealing the greater observed power. This modest change in effect size and the similarity of intention change over time for the PMT group between data sets reinforces our confidence in the imputed data analysis. Overall, we found consistent evidence to support the hypothesis that the threat appraisal intervention will have a significant positive effect on intentions to vape less. This is in line with past PMT literature focusing on similar behaviours (such as conventional cigarette smoking), research that found threat components are effective constructs to influence intention (Thrul et al., 2013).

With respect to vaping use, we found inconsistent and thus less convincing evidence for the effectiveness of the PMT intervention. The complete data analysis showed a large non-significant treatment effect over time for behaviour for the PMT intervention group ($\eta_p^2 = .22$; $p = .12$). The observed power for this analysis was low $\beta = .47$; In contrast, the imputed data analysis, reached statistically significant ($p = .001$), with a large increase in observed power ($\beta = .99$), but large reduction in effect size ($\eta_p^2 = .06$). This large discrepancy in effect size for behaviour between data sets raises the question “What is the real treatment effect for vaping

use?” The benefits of collecting follow-up vaping behavior data must be weighed against the costs of having too much missing follow-up data to estimate.

5.3 Hypothesis III

It was hypothesized that increases in both severity and vulnerability of vaping usage will be associated with a reduction in intentions to vape. Furthermore, that reduction in intentions to vape will be associated with lower vaping use. Bivariate analysis findings revealed an iterative association of significance between PV and PS with intention. Both PV and PS revealed a significant influence in association with the threat appraisal intervention and influenced vaping intention (See Table 4 and Table 9).

Among both data sets, bivariate correlation analysis revealed that PV corroborated strongest with vaping intention overall. Completed data analysis revealed PV to be the strongest indicator of intention at three time points (T0, T1, T2), while PS was shown to be the strongest predictor at final follow-up (T3). Imputed data showed that PV and PS maintained a significant effect for intention at all time points with PV holding the strongest effect at each timepoint. Taken together, these correlation findings imply that the vaping intention reduction effects observed favoring the experimental PMT group likely occurred because the PMT intervention was able to successfully manipulate the threat appraisal constructs PV and PS.

Limited and inconsistent evidence was found to support relations between vaping intentions and vaping use (behavior). For instance, a relationship between these two constructs was only found with imputed data at T2. However, this association revealed a contradictory relationship ($\beta = .17$) suggesting that increases in intentions to reduce vaping is associated with increases in vaping behavior. In turn, because of the moderate-to-large effect in vaping use

favoring the experimental group in both complete and imputed data sets (hypothesis II), it is concluded that intention was not responsible for behaviour treatment group differences observed.

Past PMT literature focusing on behaviour change supports our findings that both PS and PV are effective constructs to influence intention. However, PMT studies focusing on the corroboration between smoking intention and behaviour in well-known products, such as conventional cigarettes, show a stronger relationship between the two variables. The absence of association between intention and behaviour may be explained by the missing components related to planned behaviour (Teasdale et al., 2016). The outcomes within our study, along with previous literature (Zhao et al., 2020), leads us to believe that with the emergence of evidence supporting vaping cessation for reduced health risk, the implementation of a planned behaviour framework in future research would bridge the gap between goal intention and behavior (Wu et al., 2014).

5.4 Future Direction

The inclusion of future studies using other threat information models such as the looming vulnerability principle (Riskind, 1997) that explains how people become anxious when they perceive threats as growing larger and accelerating towards them over time, are warranted to expand on health threatening behaviour change research. In addition, the future scope of vaping research should explore how vaping behaviour might augment the risk of developing health problems or if the general notion of vaping as a healthier alternative to smoking cigarettes is true. Moreover, the scale correspondence for the questions measuring intention and behaviour would be improved with the implementation of similar language from the intention questions to the self-reported behaviour measure to elicit a more cohesive transition. Additionally, the inclusion and manipulation of implementation constructs to serve as bridging (mediating) the intention-

behaviour gap is warranted. Although attempts were made to standardize intervention delivery (i.e., using pre-determined email scripts), the possibility of sampling bias can't be ruled out. Importantly, future research is needed to verify the findings of this study and further investigate the relationship between perceived vulnerability and perceived severity to reduce vaping intention and behaviour to design effective health behaviour change interventions for student populations.

Regarding the effect of PS later in follow-up (T3), further investigation in future PMT threat appraisal research is warranted. Related to future inquiry, although we influenced PS greater than PV through our threat information intervention, PV was shown to be the greater predictor of intention. This observed threat appraisal corroboration to intention should be examined in future studies and a better way to effect PV needs to be designed in future experimental interventions to have a stronger influence on intention.

5.5 Strengths & Limitations

5.5.1 Strengths

There are a number of strengths in the present study including the PMT threat appraisal design was derived from theory-driven interventions regarding past PMT literature for behaviour intention. In addition, vaping intervention information was provided by professional authorized health researchers, addressing the direct health effects of vaping prospectively, extending the existing cross-sectional research using scientifically supported information rather than bogus figures to embellish greater perceived threat related to vaping. Another strength of our threat intervention is the cost-effectiveness and scalability of delivery to reach population numbers. This design can therefore be easily implemented in settings of public and private health offices with limited financial or structural obstacles to help effect

change in larger populations. Regarding the measurement tools of our threat intervention, the consistency in data collection using research-supported questionnaires (McNair et al., 1971; Spielberger et al., 1983; Gaston & Prapavessis, 2009; Courneya & Hellsten, 2001; Schwarzer et al., 2011; Schacham, 1983; Milne et al., 2000) supports the reliability of accurate representations of behaviour intention and action-behaviour of the Canadian university student population who vape. Moreover, the data collected from the Canadian student population spans from 23 different universities across six provinces, accounting for an accurate representation of the desired sample population in Canada. Lastly, the precise and consistent measure of the Canadian university student population who vaped more than 3 times in the past 30 days, provides an accurate representation of the potential changes in intention related to university students receiving specific health risk information.

5.5.2 Limitations

Despite the aforementioned strengths, this study is not without limitations. The scales used to measure vaping behaviour were collected using a self-report method. To combat this issue, future studies should objectively measure vaping behaviour using air quality monitors that accurately detect various gases and fumes, such as those left behind by vaping devices to ensure accurate recordings of behaviour. In addition, a portion of data was missing participant ID numbers and were removed due to lack of representation or loss to follow-up. Due to the prospective design, 30% of the sample that completed the baseline survey failed to complete the second survey. Future studies can address this by implementing questionnaires designed to restrict participants from submitting their responses before answering each question. Moreover, participant ID numbers should be selected out of an attached list of numbers rather than an open text box to aid in acuity of participant identification response. In

addition, the PMT questionnaire, secondary, and tertiary scales were modified to examine the measurement of intention and behaviour related to vaping where they have previously only been used for other health-threatening behaviour (i.e., conventional cigarette usage). In response, these questionnaires need to go through further psychometric evaluation in future design studies to strengthen their accuracy of effect. Importantly, the 6-week length of study does not predict continued habitual behaviour. As a result, future studies should examine the effect of threat appraisal application within a longitudinal study design. Additionally, the results can only be generalized to a Canadian university population and more work needs to be done to determine the applicability to other populations such as children, adults, and older adults in Canada, as well as internationally. It is likely that different age groups, such as adults, may have a stronger threat perception towards vaping compared to adolescent, youth, older adult, and university student populations (Wright et al., 2006). Moreover, as the research surrounding the health benefits of abstaining from vaping behaviour remains unclear; the assumption that reducing and/or abstaining from vaping all together to benefit your overall health remains uncertain. As previously acknowledged above, we need to further examine the effect of dynamic and static threat, as well as the influence of goal intention and behaviour planning principles to explore the optimal conditions under which this effect occurs (i.e., does an evolving threat influence intention; how important are planning principles for intentions to reduce behaviour to be successful?). While the present research addressed the effect of static threat and provided evidence for the benefit of threat information to influence intention, future research designs continuing to explore the optimal conditions of intention and behaviour change are warranted.

Chapter 6

6 Conclusion

In conclusion, this is the first study to support the view that presenting isolated factual threat appraisal information to Canadian university students, concerning the possible negative health effects of vaping, may be an effective resource for vaping intention and behaviour change research. However, more studies are needed to further investigate the relationships between threat appraisal and reduction in vaping intention and behaviours to design effective health behaviour change interventions for student populations and confirm whether such an intervention can lead to long-lasting behaviour change. This discovery, in addition to the inclusion of PMT coping appraisal in future vaping research, may help shed more light on the intention-behaviour gap observed in vaping and support behaviour change after the intention has been set.

References

- Azagba, S. (2018). E-cigarette use, dual use of e-cigarettes and tobacco cigarettes, and frequency of cannabis use among high school students. *Addictive Behaviors*,79, 166-170.
doi:10.1016/j.addbeh.2017.12.028
- Bein, K., & Leikauf, G. D. (2011). Acrolein - a pulmonary hazard. *Molecular Nutrition & Food Research*,55(9), 1342-1360. doi:10.1002/mnfr.201100279
- Brace, I. (2006). Questionnaire Design. *International Journal of Market Research*,48(3), 377378.
doi:10.1177/147078530604800308
- Boakye, E., Obisesan, O. H., Osei, A. D., Dzaye, O., Uddin, S. M., Hirsch, G. A., & Blaha, M. J. (2020). The Promise and Peril of Vaping. *Current Cardiology Reports*,22(12).
doi:10.1007/s11886-020-01414-x
- Boer, H., & Seydel, E. (1996). Protection Motivation Theory. *Encyclopedia of Sport and Exercise Psychology*. doi:10.4135/9781483332222.n225
- Burch, J., & Ciapponi, A. (2019). Can use of electronic cigarettes help people quit smoking? *Cochrane Clinical Answers*. doi:10.1002/cca.2571
- Callahan-Lyon, P. (2014). Electronic cigarettes: Human health effects. *Tobacco Control*,23(Suppl 2), Ii36-Ii40. doi:10.1136/tobaccocontrol-2013-051470
- Canada, H. (2021, March 29). Government of Canada. Retrieved from
<https://www.canada.ca/en/health-canada/services/smoking-tobacco/vaping/canada.html>
- Chadi, N., Schroeder, R., Jensen, J. W., & Levy, S. (2019). Association Between Electronic Cigarette Use and Marijuana Use Among Adolescents and Young Adults. *JAMA Pediatrics*,173(10). doi:10.1001/jamapediatrics.2019.2574

- Chalermrueangrong, J., & Preechawong, S. (2019). Effect of the motivation program to quit smoking in Royal Thai Air Force officers with non-communicable disease risks. *Journal of Health Research*,33(5), 416-424. doi:10.1108/jhr-11-2018-0143
- Cole, A. G., Aleyan, S., Battista, K., & Leatherdale, S. T. (2020). Correction to: Trends in youth e-cigarette and cigarette use between 2013 and 2019: Insights from repeat cross-sectional data from the COMPASS study. *Canadian Journal of Public Health*,112(1), 70-70. doi:10.17269/s41997-020-00441-z
- Courneya, K. S., & Hellsten, L. M. (2001). Cancer prevention as a source of exercise motivation: An experimental test using protection motivation theory. *Psychology, Health & Medicine*,6(1), 59-64. doi:10.1080/13548500125267
- Czoli, C. D., Hammond, D., & White, C. M. (2014). Electronic cigarettes in Canada: Prevalence of use and perceptions among youth and young adults. *Canadian Journal of Public Health*,105(2). doi:10.17269/cjph.105.4119
- Darabseh, M. Z., Selfe, J., Morse, C. I., & Degens, H. (2020). Is vaping better than smoking for cardiorespiratory and muscle function? *Multidisciplinary Respiratory Medicine*,15. doi:10.4081/mrm.2020.674
- Droulers, O., Gallopel-Morvan, K., Lacoste-Badie, S., & Lajante, M. (2017). The influence of threatening visual warnings on tobacco packaging: Measuring the impact of threat level, image size, and type of pack through psychophysiological and self-report methods. *Plos One*,12(9). doi:10.1371/journal.pone.0184415
- Dunworth, J., About the Author James Dunworth Main blogger at the Ashtray Blog. (2020, April 30). An Interview with The Inventor of the Electronic Cigarette. Retrieved from

<https://www.ecigarettdirect.co.uk/ashtray-blog/2013/10/interview-inventor-e-cigarette-herbert-a-gilbert.html>

- Fataar, F., & Hammond, D. (2019). The Prevalence of Vaping and Smoking as Modes of Delivery for Nicotine and Cannabis among Youth in Canada, England and the United States. *International Journal of Environmental Research and Public Health*,16(21), 4111. doi:10.3390/ijerph16214111
- Gambaryan, M. (2018). Exposure to e-cigarettes in Russia: Results from Russian Tobacco control policy Evaluation study. *Tobacco Prevention & Cessation*,4(Supplement). doi:10.18332/tpc/90389
- Gaston, A., & Prapavessis, H. (2009). Using a combined protection motivation theory and health action process approach intervention to promote exercise during pregnancy. *Journal of Behavioral Medicine*,37(2), 173-184. doi:10.1007/s10865-012-9477-2
- Gay, B., Field, Z., Patel, S., Alvarez, R. M., Nasser, W., Madruga, M., & Carlan, S. J. (2020). Vaping-Induced Lung Injury: A Case of Lipoid Pneumonia Associated with E-Cigarettes Containing Cannabis. *Case Reports in Pulmonology*,2020, 1-4. doi:10.1155/2020/7151834
- Gilbert, H. A. (1965). U.S. Patent No. 3200819A. Washington, DC: U.S. Patent and Trademark Office.
- Giovino, G. A., Mirza, S. A., Samet, J. M., Gupta, P. C., Jarvis, M. J., Bhala, N., Asma, S. (2012). Tobacco use in 3 billion individuals from 16 countries: An analysis of nationally representative cross-sectional household surveys. *The Lancet*,380(9842), 668-679. doi:10.1016/s0140-6736(12)61085-x

- Goniewicz, M. L., Knysak, J., Gawron, M., Kosmider, L., Sobczak, A., Kurek, J., Benowitz, N. (2013). Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. *Tobacco Control*,23(2), 133-139. doi:10.1136/tobaccocontrol-2012-050859
- Gravely, S., Driezen, P., Ouimet, J., Quah, A. C., Cummings, K. M., Thompson, M. E., Fong, G. T. (2019). Prevalence of awareness, ever-use and current use of nicotine vaping products (NVPs) among adult current smokers and ex-smokers in 14 countries with differing regulations on sales and marketing of NVPs: Cross-sectional findings from the ITC Project. *Addiction*,114(6), 1060-1073. doi:10.1111/add.14558
- Hajek, P., Phillips-Waller, A., Przulj, D., Pesola, F., Smith, K. M., Bisal, N., Mcrobbie, H. J. (2019). A Randomized Trial of E-Cigarettes versus Nicotine-Replacement Therapy. *New England Journal of Medicine*,380(7), 629-637. doi:10.1056/nejmoa1808779
- Hammond, D., Reid, J. L., Rynard, V. L., Fong, G. T., Cummings, K. M., McNeill, A., White, C. M. (2019). Prevalence of vaping and smoking among adolescents in Canada, England, and the United States: Repeat national cross-sectional surveys. doi:10.1136/bmj.l2219
- Home. (2019, April 10). Retrieved from <https://uwaterloo.ca/canadian-student-tobacco-alcohol-drugs-survey/>
- Jackson, C. D., Carter, J., & Kansagara, D. (2021). E-Cigarettes Versus Nicotine Replacement Therapy for Smoking Cessation. *Journal of General Internal Medicine*. doi:10.1007/s11606-020-06408-7
- Jakobsen, J. C., Gluud, C., Wetterslev, J., & Winkel, P. (2017). When and how should multiple imputation be used for handling missing data in randomised clinical trials – a practical guide with flowcharts. *BMC Medical Research Methodology*,17(1). doi:10.1186/s12874-017-0442-1

- Jones, C. L., Jensen, J. D., Scherr, C. L., Brown, N. R., Christy, K., & Weaver, J. (2014). The Health Belief Model as an Explanatory Framework in Communication Research: Exploring Parallel, Serial, and Moderated Mediation. *Health Communication*,30(6), 566-576. doi:10.1080/10410236.2013.873363
- Kasza, K. (2018). Tobacco-Product Use by Adults and Youths in the United States in 2013 and 2014. *New England Journal of Medicine*,378(5), 492-492. doi:10.1056/nejmx170001
- Lin, H., & Chang, C. (2021). Factors associated with the quitting intention among Chinese adults: Application of protection motivation theory. *Current Psychology*. doi:10.1007/s12144-021-01500-5
- Macdonell, K. (2013). A Protection Motivation Theory-Based Scale for Tobacco Research among Chinese Youth. *Journal of Addiction Research & Therapy*,04(03). doi:10.4172/2155-6105.1000154
- Maclaren, D. J., Conigrave, K. M., Robertson, J. A., Ivers, R. G., Eades, S., & Clough, A. R. (2010). Using breath carbon monoxide to validate self-reported tobacco smoking in remote Australian Indigenous communities. *Population Health Metrics*,8(1). doi:10.1186/1478-7954-8-2
- Maglia, M., Caponnetto, P., Piazza, J. D., Torre, D. L., & Polosa, R. (2017). Dual use of electronic cigarettes and classic cigarettes: A systematic review. *Addiction Research & Theory*,26(4), 330-338. doi:10.1080/16066359.2017.1388372
- Masiero, M., Cutica, I., Russo, S., Mazzocco, K., & Pravettoni, G. (2018). Psycho-cognitive predictors of burnout in healthcare professionals working in emergency departments. *Journal of Clinical Nursing*,27(13-14), 2691-2698. doi:10.1111/jocn.14376

- McRobbie, H. (2016). Modelling the Population Health Effects of E-Cigarettes Use: Current Data Can Help Guide Future Policy Decisions. *Nicotine & Tobacco Research*,19(2), 131-132. doi:10.1093/ntr/ntw387
- Medicine, T. L. (2020). The EVALI outbreak and vaping in the COVID-19 era. *The Lancet Respiratory Medicine*,8(9), 831. doi:10.1016/s2213-2600(20)30360-x
- Millstein, S. G., & Halpern-Felsher, B. L. (2002). Perceptions of risk and vulnerability. *Journal of Adolescent Health*,31(1), 10-27. doi:10.1016/s1054-139x(02)00412-3
- Morello, P., Perez, A., Peña, L., Lozano, P., Trasher, J., Sargent, J., & Mejia, R. (2016). Prevalence and predictors of e-cigarette trial among adolescents in Argentina. *Tobacco Prevention & Cessation*,2(December). doi:10.18332/tpc/66950
- Ogunwale, M. A., Li, M., Raju, M. V., Chen, Y., Nantz, M. H., Conklin, D. J., & Fu, X. (2017). Aldehyde Detection in Electronic Cigarette Aerosols. *ACS Omega*,2(3), 1207-1214. doi:10.1021/acsomega.6b00489
- Olmedo, P., Goessler, W., Tanda, S., Grau-Perez, M., Jarmul, S., Aherrera, A., Rule, A. M. (2018). Metal Concentrations in e-Cigarette Liquid and Aerosol Samples: The Contribution of Metallic Coils. *Environmental Health Perspectives*,126(2), 027010. doi:10.1289/ehp2175
- Pascoe, M. C., Hetrick, S. E., & Parker, A. G. (2019). The impact of stress on students in secondary school and higher education. *International Journal of Adolescence and Youth*,25(1), 104-112. doi:10.1080/02673843.2019.1596823
- Pechacek, T. F., Nayak, P., Gregory, K. R., Weaver, S. R., & Eriksen, M. P. (2016). The Potential That Electronic Nicotine Delivery Systems Can be a Disruptive Technology:

- Results from a National Survey. *Nicotine & Tobacco Research*,18(10), 1989-1997.
doi:10.1093/ntr/ntw102
- Pechmann, C., Zhao, G., Goldberg, M. E., & Reibling, E. T. (2003). What to Convey in Antismoking Advertisements for Adolescents: The use of Protection Motivation Theory to Identify Effective Message Themes. *Journal of Marketing*,67(2), 1-18.
doi:10.1509/jmkg.67.2.1.18607
- Peruzzi, M., Biondi-Zoccai, G., Carnevale, R., Cavarretta, E., Frati, G., & Versaci, F. (2020). Vaping Cardiovascular Health Risks: An Updated Umbrella Review. *Current Emergency and Hospital Medicine Reports*,8(3), 103-109. doi:10.1007/s40138-020-00219-0
- Prapavessis, H., Jesus, S. D., Fitzgeorge, L., Faulkner, G., Maddison, R., & Batten, S. (2016). Exercise to Enhance Smoking Cessation: The Getting Physical on Cigarette Randomized Control Trial. *Annals of Behavioral Medicine*,50(3), 358-369. doi:10.1007/s12160-015-9761-9
- Rogers, R. W. (1975). A Protection Motivation Theory of Fear Appeals and Attitude Change. *The Journal of Psychology*,91(1), 93-114.doi:10.1080/00223980.1975.9915803
- Ruiter, R. A. (2001). Evoked fear and effects of appeals on attitudes to performing breast self-examination: An information-processing perspective. *Health Education Research*,16(3), 307-319. doi:10.1093/her/16.3.307
- Sadeghi, R., Mahmoodabad, S. S., Fallahzadeh, H., Rezaeian, M., Bidaki, R., & Khanjani, N. (2019). Hookah is the enemy of health campaign: A campaign for prevention of hookah smoking among youth. *Health Promotion International*,35(5), 1125-1136.
doi:10.1093/heapro/daz109

- Sassano, M. F., Davis, E. S., Keating, J. E., Zorn, B. T., Kochar, T. K., Wolfgang, M. C., Tarran, R. (2018). Evaluation of e-liquid toxicity using an open-source high-throughput screening assay. *PLOS Biology*,16(3). doi:10.1371/journal.pbio.2003904
- Sheeran, P., & Orbell, S. (2000). Using implementation intentions to increase attendance for cervical cancer screening. *Health Psychology*,19(3), 283-289. doi:10.1037/0278-6133.19.3.283
- Siegel, M. B., Tanwar, K. L., & Wood, K. S. (2011). Electronic Cigarettes as a Smoking Cessation Tool. *American Journal of Preventive Medicine*,40(4), 472-475. doi:10.1016/j.amepre.2010.12.006
- Silagy, C., Mant, D., Fowler, G., & Lodge, M. (1994). Meta-analysis on efficacy of nicotine replacement therapies in smoking cessation. *The Lancet*,343(8890), 139-142. doi:10.1016/s0140-6736(94)90933-4
- Silver, B., Ripley-Moffitt, C., Greyber, J., & Goldstein, A. O. (2016). Successful use of nicotine replacement therapy to quit e-cigarettes: Lack of treatment protocol highlights need for guidelines. *Clinical Case Reports*,4(4), 409-411. doi:10.1002/ccr3.477
- Smerecnik, C., Quaak, M., Schayck, C. P., Schooten, F. V., & Vries, H. D. (2011). Are smokers interested in genetic testing for smoking addiction? A socio-cognitive approach. *Psychology & Health*,26(8), 1099-1112. doi:10.1080/08870446.2010.541909
- Smith, K. H., & Stutts, M. A. (2003). Effects of short-term cosmetic versus long-term health fear appeals in anti-smoking advertisements on the smoking behaviour of adolescents. *Journal of Consumer Behaviour*,3(2), 157-177. doi:10.1002/cb.130

Statistics Canada. Canadian Tobacco and Nicotine Survey, 2019:

<https://www150.statcan.gc.ca/n1/daily-quotidien/200305/dq200305aeng.htm> (Accessed March 1, 2021).

Steinmetz, K. (2014, November 17). Vape: Oxford's 2014 Word of the Year. Retrieved from <https://time.com/3590093/oxfords-2014-word-of-the-year-is-vape/>

Staff, R. (2018). Vaping could increase risk of pneumonia, study finds. *The Pharmaceutical Journal*. doi:10.1211/pj.2018.20204376

Teasdale, J. E., Newby, A. C., Timpson, N. J., Munafò, M. R., & White, S. J. (2016). Cigarette smoke but not electronic cigarette aerosol activates a stress response in human coronary artery endothelial cells in culture. *Drug and Alcohol Dependence*, 163, 256-260. doi:10.1016/j.drugalcdep.2016.04.020

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., Goldsmith, C. H. (2010). A tutorial on pilot studies: The what, why and how. *BMC Medical Research Methodology*, 10(1). doi:10.1186/1471-2288-10-1

Thrul, J., Stemmler, M., Buhler, A., & Kuntsche, E. (2013). Adolescents protection motivation and smoking behaviour. *Health Education Research*, 28(4), 683-691. doi:10.1093/her/cyt062

Tommasi, S., Caliri, A., Caceres, A., Moreno, D., Li, M., Chen, Y., Besaratinia, A. (2019). Deregulation of Biologically Significant Genes and Associated Molecular Pathways in the Oral Epithelium of Electronic Cigarette Users. *International Journal of Molecular Sciences*, 20(3), 738. doi:10.3390/ijms20030738

Trenda, E. (2020, October 12). E-cigarettes: Share of users France 2018. Retrieved from <https://www.statista.com/statistics/978458/users-electronic-cigarette-france/>

- Trtchounian A, Williams M, Talbot P. Conventional and electronic cigarettes (e-cigarettes) have different smoking characteristics. *Nicotine Tob Res.* 2010 Sep;12(9):905-12. doi: 10.1093/ntr/ntq114. Epub 2010 Jul 19. PMID: 20644205.
- Tulloch, H., Reida, R., Dangeloa, M. S., Plotnikoff, R. C., Morrina, L., Beatona, L., Pipe, A. (2009). Predicting short and long-term exercise intentions and behaviour in patients with coronary artery disease: A test of protection motivation theory. *Psychology & Health*,24(3), 255-269. doi:10.1080/08870440701805390
- U.S. Department of Health and Human Services (2016). E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- Ven, K., Ritter, A., Berends, L., Chalmers, J., & Lancaster, K. (2020). Perceptions of purchasing and payment mechanisms in alcohol and other drug treatment services in Australia: A qualitative study involving alcohol and other drug service providers and purchasers of treatment. *Drug and Alcohol Review*,39(2), 189-197. doi:10.1111/dar.13027
- Vindhyal, M. R., Ndunda, P., Munguti, C., Vindhyal, S., & Okut, H. (2019). Impact On Cardiovascular Outcomes Among E-Cigarette Users: A Review from National Health Interview Surveys. *Journal of the American College of Cardiology*,73(9), 11. doi:10.1016/s0735-1097(19)33773-8
- Webb, T. L., Sniehotta, F. F., & Michie, S. (2010). Using theories of behaviour change to inform interventions for addictive behaviours. *Addiction*,105(11), 1879-1892. doi:10.1111/j.1360-0443.2010.03028.x

- Weinstein, N. D. (1988). The precaution adoption process. *Health Psychology*,7(4), 355-386.
doi:10.1037/0278-6133.7.4.355
- WHO calls for ban on indoor use of e-cigarettes. (2014). *The Pharmaceutical Journal*.
doi:10.1211/pj.2014.20066268
- Worsley, D. J., Jones, K., & Marshman, Z. (2014). Patients are asking about e-cigarettes. What do we tell them? *British Dental Journal*,217(2), 91-95. doi:10.1038/sj.bdj.2014.596
- Wright, A. J., French, D. P., Weinman, J., & Marteau, T. M. (2006). Can genetic risk information enhance motivation for smoking cessation? An analogue study. *Health Psychology*,25(6), 740-752. doi:10.1037/0278-6133.25.6.740
- Wu, C., Wong, H., Chou, L., To, B., Lee, W., & Loke, A. (2014). Correlates of Protective Motivation Theory (PMT) to Adolescents' Drug Use Intention. *International Journal of Environmental Research and Public Health*,11(1), 671-684.doi:10.3390/ijerph110100671
- Xie, W., Kathuria, H., Galiatsatos, P., Blaha, M. J., Hamburg, N. M., Robertson, R. M., Stokes, A. C. (2020). Association of Electronic Cigarette Use With Incident Respiratory Conditions Among US Adults From 2013 to 2018. *JAMA Network Open*,3(11).
doi:10.1001/jamanetworkopen.2020.20816
- Yan, Y., Jacques-Tiura, A. J., Chen, X., Xie, N., Chen, J., Yang, N., Macdonell, K. K. (2014). Application of the Protection Motivation Theory in predicting cigarette smoking among adolescents in China. *Addictive Behaviors*,39(1), 181-188.
doi:10.1016/j.addbeh.2013.09.027
- Zhao, Z., Zhang, M., Wu, J., Xu, X., Yin, P., Huang, Z., Zhou, M. (2020). E-cigarette use among adults in China: Findings from repeated cross-sectional surveys in 2015–16 and 2018–19. *The Lancet Public Health*,5(12). doi:10.1016/s2468-2667(20)30145-6

Appendix A

Script for General Announcement

Study Title: Information Interventions to Reduce Vaping in a Student Population

Principal Investigator:

Dr. Harry Prapavessis, PhD
Department of Kinesiology
Western University
[REDACTED]

Student-Investigator:

Babac Salmani, MA
Department of Kinesiology
Western University
[REDACTED]

Date: [Insert Date]

Dear Student:

Hello, my name is Babac Salmani and I am the Student Investigator (SI) in the 6-week study on vaping behaviour among university students in Canada. As part of the research investigation, participants are responsible for reviewing and submitting a signed Letter of Information/Consent form to the SI.

You are invited to participate in a research study to evaluate intention to vape and subsequent vaping behaviour. I have attached a Letter of Information/Consent form to this email to outline the background, purpose, and description of the study along with the responsibilities that you must uphold as a participant.

As a valued participant in our study, we are excited to gather your feedback to help expand the understanding around vaping behaviour. Please take a few minutes and review the Letter of Information/Consent attached to this email and submit a signed copy to the SI email shown here:
[REDACTED]

7 additional days are provided to participants to review and submit their acknowledgment of the study considerations and interventions from the day they are sent out; in order to become a participant, the Letter of Information/Consent form must be complete and submitted within this time.

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. Confidentiality of all participants will be maintained. The data will be kept secure, and password protected.

Any additional questions regarding the project can be directed to me, Babac Salmani at
[REDACTED]

Respectfully,

Babac Salmani
Student Investigator
Western University

Mass Email Recruitment Script

Subject Line: Vaping Behaviour Study (Mass Email Recruitment)

Dear Student,

You are invited to participate in a research study to evaluate intention to vape and subsequent vaping behaviour. This study was designed to develop a greater understanding of how to effect behaviour-intention and action-behaviour change regarding vaping in university students across Canada.

We are looking for student volunteers to complete 12 online surveys at four timepoints over a 6-week period during the academic year: one survey at day 1 (Baseline), one on day 7 (T1), and one on day 30 (T2), and one on day 45 (T3). (Start date (Baseline) will depend on when you review and submit your consent form to the student-investigator (SI)). The surveys should take you about 10 minutes total to complete.

The following inclusion criteria is required in order to participate in this study analysis:

1. Provision of signed and dated informed consent form
2. Ability to read and understand English
3. Stated willingness to comply with availability for the duration of the study
4. Males and females; Age 18 years and older
5. Self-report as current users of vaping products (>3x in the past 30 days)
6. Willingness to adhere to the study intervention regimen
7. Enrolled full-time within a registered Canadian university during the 2020-2021 school year
8. Access to necessary resources for participating in a technology-based intervention (i.e., computer, smartphone, internet access)
9. Willingness to stop (or at least decrease the frequency of) vaping

The following exclusion criteria will effectively terminate your inclusion in this study and prevent your data from contribution to study analysis:

1. Currently practicing in behaviour therapy treatment specific to vaping or attending a rehab centre
2. At the time of signing/submitting this consent form you are under the legal age of 18
3. Failure to complete and submit completed questionnaires within the 7-day study timeframe, starting the day that set of surveys is emailed to you by the student investigator

Participants will be notified immediately by the SI, via emails provided by individual participants, of their ineligibility or exclusion from the study and the immediate termination of their study data.

As a thank you for participating, you will have the opportunity to submit your e-mail into a draw after submitting all three surveys for a chance to win one of three gift cards to Subway Restaurants.

If you are interested in participating, please contact the student-investigator at [REDACTED] for further instruction.

Sincerely,

Dr. Harry Prapavessis, PhD
Principal Investigator
Western University

Babac Salmani, MA
Student-Investigator
Western University

Letter of Information

Letter of Information

You are invited to participate in a study that aims to determine whether information about risks associated with vaping can serve as a source of intention for behaviour change in adult youth. Your participation in this study will be required for six weeks and you will have to watch a 10-minute online video and complete a purpose-questionnaire. As a participant, you will be asked to complete three self-report questionnaires over the six-week study period. The questionnaires will assess your past and current vaping behaviour, a questionnaire about your perceptions of vaping behaviour, a questionnaire about your intentions to try and reduce vaping behaviour as well as a questionnaire assessing some mood variables. This will take approximately 15-20 minutes of your time and each questionnaire will be filled out at three time points: upon entry into the study, one week later, and at the end of the study (approximately 4 weeks later).

All information will be kept strictly confidential and your name will not be included or associated with the data. You will not be identified individually in any way and all digital data will be contained under a password-protected, locked external drive on the campus of Western University.

You may decline to answer any questions or withdraw at any time. However, once your questionnaire has been submitted you cannot withdraw because there is no way to know which questionnaire was done by you.

This study has been reviewed and received ethics clearing through the Research Ethics Board at Western University. If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at [REDACTED]. Thank you for your assistance in this project. Please keep a copy of this form for your records.

If you would like a summary of the results, or would like to contact the researchers for any other reason, they can be reached at [REDACTED] or [REDACTED].

Sincerely,

Babac Salmani [REDACTED]
Dr. Harry Prapavessis [REDACTED]

Approval from Western University's HSREB



Date: 14 December 2020

To: Prof. Harry Prapavessis

Project ID: 116734

Study Title: The Effectiveness of the Protection Motivation Theory in Reducing Vaping Behaviour in a Student Population

Application Type: HSREB Initial Application

Review Type: Delegated

Meeting Date / Full Board Reporting Date: 03/Nov/2020 01/Dec/2020

Date Approval Issued: 14/Dec/2020

REB Approval Expiry Date: 14/Dec/2021

Dear Prof. Harry Prapavessis

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above mentioned study as described in the WREM application form, as of the HSREB Initial Approval Date noted above. This research study is to be conducted by the investigator noted above. All other required institutional approvals must also be obtained prior to the conduct of the study.

Documents Approved:

Document Name	Document Type	Document Date	Document Version
First Email attached to LOI:C	Email Script	10/Nov/2020	2
Recruitment Poster	Recruitment Materials	11/Nov/2020	2
Questionnaires List	Online Survey	14/Nov/2020	2
Mass Email Recruitment Script	Recruitment Materials	14/Nov/2020	2
Follow-Up for LOI:Consent Email Template	Email Script	03/Dec/2020	3
Nutrition Intervention Video	Online Survey	08/Dec/2020	2
PMT Intervention Video	Online Survey	08/Dec/2020	2
Letter of Information:Consent	Written Consent/Assent	10/Dec/2020	3
End of Study Letter	End of Study Letter	10/Dec/2020	3
Research Protocol:Plan	Protocol	11/Dec/2020	4

Documents Acknowledged:

Document Name	Document Type	Document Date	Document Version
References	References	10/Nov/2020	2
Flow Diagram	Flow Diagram	07/Dec/2020	3

No deviations from, or changes to, the protocol or WREM application should be initiated without prior written approval of an appropriate amendment from Western HSREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

~~~~~

Patricia Sargeant, Ethics Officer (psargean@uwo.ca) on behalf of Dr. Joseph Gilbert, HSREB Chair

**Note:** This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

## Letter of Information and Consent



### Letter of Information and Consent

**Study Title:** Information Interventions to Reduce Vaping in a Student Population

**Principal Investigator:**

Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University

**Co-Investigator:**

Babac Salmani, MA  
Department of Kinesiology  
Western University

#### INVITATION

You are invited to participate in a study because you have self-described yourself as someone who vapes. The purpose of this study is to determine which types of sources of information are more effective in helping university students reduce their vaping habits. You are being invited to participate in this research study because, as a student, you are part of a population in Canada where the use of vaping products is relatively higher compared to the rest of the Canadian population.

#### BACKGROUND INFORMATION

According to Statistics Canada, more than one-third of Canadian students have tried vaping products at some point in their lives with the highest rates of trying vaping being among young adults (18-24 years). These data points reinforce the trend that vaping is becoming dangerously popular among Canadians, specifically among Canadian students. The purpose of this study is to find out what effects an individual's behaviour-intention and action-behaviour and how we can potentially reduce and manage the uptake of vaping behaviour in Canadian students.

#### WHAT'S INVOLVED

Up to 150 students will participate in this study and it is expected that you will be in the study for six weeks. You will not have to pay for any of the procedures/interventions with this study. If you decide to participate then you will be "randomized into one of the groups described below." Randomization means that you are put into a group by chance (like flipping a coin). Of the two groups providing information, each will consist of different content. Participants in either group are required to complete all four sets of surveys. There is no way to predict which group you will be assigned to. You will have 1 in 2 chances of being placed in /any group. Neither you, nor the study staff can choose what group you will be in; group one will contain information regarding the risks associated with vaping to your overall health. Group two will focus on tips associated with diet choices and lifestyle. At the start of the six-week timeframe you will have to (all will be sent by the student investigator (SI) to the email you provide):

- Complete a purpose-questionnaire and self-report questionnaires regarding vaping
- Watch an 8-minute online video
- Complete three self-report questionnaires over the remaining five-weeks of the study period

The purpose of the questionnaires is to understand how your intention and desire to vape changes over time. The questionnaires will assess your past and current vaping behaviour, your perceptions of vaping, your intentions to try and reduce vaping behaviour, as well as assess some potential changes in mood. The questionnaires will be filled out at four time points: upon entry into the study (Day 1), one week later (Day 7), two weeks later (Day 30), and at the end of the study (Day 45). All questionnaires will be sent to the email you provide to the SI, following the schedule above. Each set of questionnaires will take about 15 minutes to complete.

The following exclusion criteria will effectively terminate your inclusion in this study and prevent your data from contribution to study analysis:

4. Activity restrictions that limit one's ability to engage in questionnaire testing
5. Currently practicing in behaviour therapy treatment specific to vaping or attending a rehab centre
6. At the time of signing/submitting this consent form you are under the legal age of 18
7. Failure to complete and submit completed questionnaires within the 7-day study timeframe, starting the day that set of surveys is emailed to you by the student investigator

Participants will be notified immediately by the SI, via emails provided by individual participants, of their exclusion from the study and the immediate termination of their study data.

### POTENTIAL BENEFITS AND RISKS

An understanding of what information has the greatest influence on behaviour in students will help to design more effective interventions to help reduce negative health behaviour in the future. In addition, you may learn more about the risks associated with vaping or potential nutrition and lifestyle tips, depending on which group you are in, that may have a positive influence on your health behaviour choices and overall health. A risk associated with participation in this study is the potential for preliminary stress and anxiety as a result of reflecting on behaviour through surveys. Apart from the application of intervention, as personal identifiers are being collected for this study, there is the risk of breach of privacy which may be a cause of added risk in participation. To combat this risk, we have implemented the safe storage of all identifiable data on a password-protected, encrypted Personal Vault via OneDrive to ensure participant privacy. As a participant, you may also experience no benefit from participation in this study. If you notice a greater sense of mental distress or anxiety as a result of participation in the study procedures, please contact Dr. Lisa Lee, a clinical psychologist as part of the study team, by email at [REDACTED], or by phone at [REDACTED]. In addition, the Counselling Services of London, specialized in anxiety therapy and self-esteem counselling, have offered their services as part of our study team at [REDACTED] or by phone at [REDACTED] to any participants who feel distress. Both study team resources offer online services for study participants. Lastly, please consider contacting the Centre for Addiction and Mental Health in Canada, at [REDACTED] if you feel the need for additional aid.

### SUMMARY OF TESTS AND PROCEDURES

The schedule below is a representation of procedures that will be accomplished at each study stage.

|                                                              | Pre-screening<br>(Day -30 to<br>Day 1) | Baseline<br>Day 1 (pre-<br>intervention) | Time 1 (T1)<br>Day 7 ± 7 (post-<br>intervention) | Time 2 (T2)<br>Day 30 ± 7 | Time 3 (T3)<br>Day 45 ± 7 |
|--------------------------------------------------------------|----------------------------------------|------------------------------------------|--------------------------------------------------|---------------------------|---------------------------|
| Informed Consent                                             | X                                      |                                          |                                                  |                           |                           |
| Participant Stratification                                   | X                                      |                                          |                                                  |                           |                           |
| Demographics                                                 |                                        | X                                        |                                                  |                           |                           |
| Vaping History                                               |                                        | X                                        |                                                  |                           |                           |
| Outcome Evaluation                                           |                                        |                                          |                                                  |                           |                           |
| Vaping Purpose<br>Assessment (Brief<br>Activities Inventory) |                                        | X                                        | X                                                |                           |                           |
| Randomization                                                |                                        | X                                        | X                                                |                           |                           |
| PMT Questionnaire                                            |                                        | X                                        | X                                                | X                         | X                         |
| Action Planning Questionnaire                                |                                        | X                                        | X                                                | X                         | X                         |
| Coping Planning Questionnaire                                |                                        | X                                        | X                                                | X                         | X                         |
| Motivational Self-Efficacy                                   |                                        | X                                        | X                                                | X                         | X                         |
| Pre-Actional Self-Efficacy                                   |                                        | X                                        | X                                                | X                         | X                         |
| Coping Self-Efficacy                                         |                                        | X                                        | X                                                | X                         | X                         |
| Recovery Self-Efficacy                                       |                                        | X                                        | X                                                | X                         | X                         |
| Profile of Mood States                                       |                                        | X                                        | X                                                | X                         | X                         |
| State Trait Anxiety Inventory                                |                                        | X                                        | X                                                | X                         | X                         |

### CONFIDENTIALITY

All information you provide is considered confidential; all identifiable information collected during this study will be kept confidential and will not be shared with anyone outside the study unless required by law. You will not be named in any reports, publications, or presentations that may come from this study. Data collected during this study will be stored on an encrypted, password-protected, locked external drive in a secure and confidential location for 7 years, as per Western's data retention policy. Once the data retention period is over, the data will be analysed by the student investigator for significance and will be stored on a password-protected, encrypted Personal Vault via OneDrive. Access to this data will be restricted to the principal investigator and student investigator. Western University Health Sciences Research Ethics Board may require access to the study records to

monitor the conduct of the research. The type of personal information that will be collected is age, gender, and ethnicity. Contact information of the participants will also be collected for this study. A description of this study will be available by contacting the student investigator at [REDACTED]. You can contact the student investigator via email, at any time, regarding any questions and/or concerns related to this study.

#### VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study without effect on academic standing. Further, without effect on academic standing, you may also decide to withdraw from this study at any time. If you do wish to no longer be included in the study or you are removed as a participant and wish to withdraw your past questionnaires from the study, you should tell the Principal Investigator, Dr. Harry Prapavessis, who will ensure no future data will be collected, the data related to your participation in the study will be removed, and you will no longer receive questionnaires from the study staff. You as a participant may be taken off the study if you are unable to tolerate the study intervention, if you are unable to complete all required study procedures, or if the research ethics board withdraws permission for this study to continue. If this happens, it may mean that you would not receive the study intervention for the full period described in this consent form. If you are removed from this study, the study staff will discuss the reasons with you.

It is important to recognize that email is not secure. Email data can be stolen as it travels over the network and could be stored on mail servers, internet mail relays, as well as end devices. If, at any point, you feel unsafe or choose to no longer communicate on this platform, please email the student investigator and they will withdraw you from further study procedures and protocols. You will receive a copy of this letter of information and signed Informed Consent.

#### PUBLICATION OF RESULTS

Results of this study may be published in professional journals and presented at conferences. Feedback about this study will be available approximately 6 months after the completion of the study. If you wish to receive the results of the study, please provide either your email or mailing address: \_\_\_\_\_

#### CONTACT INFORMATION

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Human Research Ethics [REDACTED], email: [REDACTED]. The REB is a group of people who oversee the ethical conduct of research studies. The HSREB is not part of the study team. Everything that you discuss will be kept confidential. Thank you for your assistance in this project. Please keep a copy of this form for your records.

#### CONSENT FORM

**Study Title:** Information Interventions to Reduce Vaping in a Student Population

This study has been explained to me and any questions I had have been answered.

I know that I may leave the study at any time. I agree to take part in this study.

|                                  |           |                   |
|----------------------------------|-----------|-------------------|
| _____                            | _____     | _____             |
| Print Name of Participant        | Signature | Date (DD-MM-YYYY) |
| _____                            | _____     | _____             |
| Name of Person Obtaining Consent | Signature | Date (DD-MM-YYYY) |

## Recruitment Poster

Western  HealthSciences Version 2

**DO YOU VAPE?**  
**PARTICIPANTS NEEDED!**



- 1) Full-time university student in Canada?
- 2) 18 years of age or older?
- 3) Vaped in the past month?
- 4) Fluent in English?

You may be eligible to participate in our  
6-week behaviour change study

FOR MORE INFORMATION, EMAIL 

**THE STUDY IS  
COMPLETELY VIRTUAL  
JOIN NOW!** 

Principal Investigator: Harry Prapavessis  
Phone:   
Email:   
School of Kinesiology  
University of Western Ontario



## Appendix B

## Exclusion from Study Explanation



### Exclusion from Study Explanation

**Study Title:** Information Interventions to Reduce Vaping in a Student Population

**Principal Investigator:**

Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University  
[REDACTED]

**Student-Investigator:**

Babac Salmani, MA  
Department of Kinesiology  
Western University  
[REDACTED]

Date: [Insert Date]

Dear Student:

Hello, my name is Babac Salmani and I am the Student Investigator (SI) in the 6-week study on vaping behaviour among students at Western University. As part of the research investigation, participants are responsible for completing 12 self-report questionnaires on three separate time-points within the 6-week study period. Although 7 additional days are provided to participants to submit their questionnaires from the day they are received, because you have failed to successfully submit your questionnaires on-time, you have been removed from the study. Since all submitted questionnaire responses are anonymous, we are unable to recover any past data, however your data will continue to remain unidentified.

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. Confidentiality of all participants will be maintained. The data will be kept secure and password protected.

Any additional questions regarding the project can be directed to me, Babac Salmani at [REDACTED]

Respectfully,

Babac Salmani  
Student Investigator  
Western University

## Follow-up Email for Missed Questionnaire

# Western HealthSciences

### Follow-up Email for Missed Questionnaire

**Study Title:** Information Interventions to Reduce Vaping in a Student Population

**Principal Investigator:**

Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University  
[REDACTED]

**Student-Investigator:**

Babac Salmani, MA  
Department of Kinesiology  
Western University  
[REDACTED]

Date: [Insert Date]

Dear Student:

Hello, my name is Babac Salmani and I am the Student Investigator (SI) in the 6-week study on vaping behaviour among university students in Canada. As part of the research investigation, participants are responsible for completing 12 self-report questionnaires on four separate time-points within the 6-week study period.

I am emailing to remind you to complete a questionnaire that has not been successfully submitted on <https://www.surveymonkey.com>. 7 additional days are provided to participants to submit their questionnaires from the day they are sent out; in order to remain as a participant in the study, these questionnaires must be complete and submitted within the next 3 days or you may be withdrawn from the study. Please take a moment and complete the questionnaires linked below:

[Insert links to qualtrics.com questionnaire(s)]

We are excited to gather your feedback to help expand the understanding around vaping behaviour.

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. Confidentiality of all participants will be maintained. The data will be kept secure and password protected.

Any additional questions regarding the project can be directed to the SI, Babac Salmani at [REDACTED]

Respectfully,  
Babac Salmani  
Student Investigator

## Follow-up Email for LOI/Consent

# Western HealthSciences

### Follow-up Email for LOI/Consent

**Study Title:** Information Interventions to Reduce Vaping in a Student Population

**Principal Investigator:**

Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University  
[REDACTED]

**Student-Investigator:**

Babac Salmani, MA  
Department of Kinesiology  
Western University  
[REDACTED]

Date: [Insert Date]

Dear Student:

Hello, my name is Babac Salmani and I am the Student Investigator (SI) in the 6-week study on vaping behaviour among university students in Canada.

As a valued participant in our study, we are excited to gather your feedback to help expand the understanding around vaping behaviour. As the popularity of vaping products in Canada continue to rise, the purpose of this study is focused on finding out what effects an individual's behaviour-intention and action-behaviour and how we can potentially reduce and manage the uptake of vaping behaviour in Canadian students. As you have shown some interest in involvement, please take a few minutes and review the Letter of Information/Consent attached to this email and submit a signed copy to the SI email shown here: [REDACTED]

7 additional days are provided to participants to review and submit their acknowledgment of the study considerations and interventions from the day they are sent out; in order to become a participant, the Letter of Information/Consent form must be complete and submitted within this time. This is a follow-up email; failure to submit a signed copy to the SI within 4 days from this email being sent, will result in the termination of your potential participation.

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. Confidentiality of all participants will be maintained. The data will be kept secure and password protected.

Any additional questions regarding the project can be directed to me, Babac Salmani at [REDACTED]

Respectfully,

Babac Salmani  
Student Investigator  
Western University

## Day 1 (Baseline) Email



**Study Title:** Information Interventions to Reduce Vaping in a Student Population

**Principal Investigator:**

Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University  
[Redacted]

**Student-Investigator:**

Babac Salmani, MA  
Department of Kinesiology  
Western University  
[Redacted]

Date: [Insert Date]

Dear Student:

Hello, this is Babac Salmani, the Student Investigator (SI) in the 6-week study on vaping behaviour among students at Western University. This form is being sent to you because you have reached the **Day 1 (Baseline)** of the study protocol. As part of the research investigation, participants are responsible for completing 12 self-report questionnaires on three separate time-points within the 6-week study period.

As a valued participant in our study, we are excited to gather your feedback to help expand the understanding around vaping behaviour. Can you take a few minutes and complete the self-report questionnaires? I have included the links below:

[Insert links to qualtrics.com questionnaire(s)]

7 additional days are provided to participants to submit their questionnaires from the day they are sent out; in order to remain as a participant in the study, these questionnaires must be complete and submitted within this time.

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. Confidentiality of all participants will be maintained. The data will be kept secure and password protected.

Any additional questions regarding the project can be directed to me, Babac Salmani at  
[Redacted]

Respectfully,

Babac Salmani  
Student Investigator  
Western University

## Day 7 (T1) Email



**Study Title:** Information Interventions to Reduce Vaping in a Student Population

**Principal Investigator:**

Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University  
[Redacted]

**Student-Investigator:**

Babac Salmani, MA  
Department of Kinesiology  
Western University  
[Redacted]

Date: [Insert Date]

Dear Student:

Hello, this is Babac Salmani, the Student Investigator (SI) in the 6-week study on vaping behaviour among students at Western University. This form is being sent to you because you have reached the **Day 7 (T1)** of the study protocol. As part of the research investigation, participants are responsible for completing 12 self-report questionnaires on four separate time-points within the 6-week study period.

As a valued participant in our study, we are excited to gather your feedback to help expand the understanding around vaping behaviour. Can you take a few minutes and complete the self-report questionnaires? I have included the links below:  
[Insert links to qualtrics.com questionnaire(s)]

7 additional days are provided to participants to submit their questionnaires from the day they are sent out; in order to remain as a participant in the study, these questionnaires must be complete and submitted within this time.

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. Confidentiality of all participants will be maintained. The data will be kept secure and password protected.

Any additional questions regarding the project can be directed to me, Babac Salmani at  
[Redacted]

Respectfully,

Babac Salmani  
Student Investigator  
Western University

## Day 30 (T2) Email



**Study Title:** Information Interventions to Reduce Vaping in a Student Population

**Principal Investigator:**

Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University  
[REDACTED]

**Student-Investigator:**

Babac Salmani, MA  
Department of Kinesiology  
Western University  
[REDACTED]

Date: [Insert Date]

Dear Student:

Hello, this is Babac Salmani, the Student Investigator (SI) in the 6-week study on vaping behaviour among students at Western University. This form is being sent to you because you have reached the **Day 30 (T2)** of the study protocol. As part of the research investigation, participants are responsible for completing 12 self-report questionnaires on three separate time-points within the 6-week study period.

As a valued participant in our study, we are excited to gather your feedback to help expand the understanding around vaping behaviour. Can you take a few minutes and complete the self-report questionnaires? I have included the links below:

[Insert links to qualtrics.com questionnaire(s)]

7 additional days are provided to participants to submit their questionnaires from the day they are sent out; in order to remain as a participant in the study, these questionnaires must be complete and submitted within this time.

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. Confidentiality of all participants will be maintained. The data will be kept secure and password protected.

Any additional questions regarding the project can be directed to me, Babac Salmani at  
[REDACTED]

Respectfully,

Babac Salmani  
Student Investigator  
Western University

## Day 45 (T3) Email



**Study Title:** Information Interventions to Reduce Vaping in a Student Population

**Principal Investigator:**

Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University  
[REDACTED]

**Student-Investigator:**

Babac Salmani, MA  
Department of Kinesiology  
Western University  
[REDACTED]

Date: [Insert Date]

Dear Student:

Hello, this is Babac Salmani, the Student Investigator (SI) in the 6-week study on vaping behaviour among students at Western University. This form is being sent to you because you have reached the **Day 45 (T3)** of the study protocol. As part of the research investigation, participants are responsible for completing 12 self-report questionnaires on three separate time-points within the 6-week study period.

As a valued participant in our study, we are excited to gather your feedback to help expand the understanding around vaping behaviour. Can you take a few minutes and complete the self-report questionnaires? I have included the links below:

[Insert links to qualtrics.com questionnaire(s)]

7 additional days are provided to participants to submit their questionnaires from the day they are sent out; in order to remain as a participant in the study, these questionnaires must be complete and submitted within this time.

Participation is voluntary and there are no consequences for choosing not to participate or withdrawing from the study. Confidentiality of all participants will be maintained. The data will be kept secure and password protected.

Any additional questions regarding the project can be directed to me, Babac Salmani at  
[REDACTED]

Respectfully,

Babac Salmani  
Student Investigator  
Western University



## Appendix C

## Demographics Questionnaire

Please answer the following questions to the best of your ability and as truthfully as possible.

1. What is your age?

: \_\_\_\_\_

2. What year are you in?

1<sup>st</sup> Year                       3<sup>rd</sup> Year                       Other  
 2<sup>nd</sup> Year                       4<sup>th</sup> Year

3. What is your gender?

Male                       Other  
 Female                       Prefer not to say

5. What is your ethnicity:

Caucasian                       Asian/Asian American  
 African/African American                       Aboriginal Peoples of Canada  
 Hispanic/Hispanic American                       Other

6. What is your approximate household income?

Under \$25,000                       \$60,000-\$100,000                       Prefer not to answer  
 \$25,000-\$60,000                       \$100,000-\$150,000

7. What is your current employment status while in school?

Employed Full-Time (>40 hrs/wk)                       Employed Part-Time (<40 hrs/wk)  
 Unemployed                       Self-Employed

8. Which Canadian university are you currently enrolled under?

: \_\_\_\_\_

9. What is your study number?

: \_\_\_\_\_

## Youth Vaping Questionnaire (YVQ-A)

1. How old were you when you first tried vaping?  
 10 or younger                       10-15  
 16-18                                       19 or older
  
2. Do your parents or another family member regularly vape at home?  
 Yes                       No
  
3. How many of your four closest friends vape?  
 None                                       One  
 Two                                         Three  
 All Four
  
4. If one of your friends were to offer you a vape, would you smoke it?  
 Definitely yes                       Definitely not  
 Probably yes                         Probably not
  
5. During the past 30 days, how many times did you vape?  
 0                                               1-5  
 5-15                                         16-29  
 More than 30
  
6. During the past 30 days, how did you get your own vaping pods?  
 I did not buy or vape                       I bought them myself  
 I had someone else buy them for me    I borrowed them  
 I got them some other way
  
7. Have you ever used chewing tobacco, cigarettes, cigars, cigarillos, or little cigars?  
 Yes                       No                       Prefer not to say
  
8. What is your study number?  
 : \_\_\_\_\_

## PMT Questionnaire I

### Instructions

The following questions ask you about your perceptions of vaping-related health risks, the severity of those risks, and the potential link between the two. There are no right or wrong answers. All we ask is that you provide honest responses. All responses are completely confidential and will never be used in any way that could link them to you. It is important to complete all questions so that we can include your responses in our analyses. If you have any questions about completing the questionnaire, please email the research assistant.

Please complete each question using the scales that are provided. Circle the number that best represents your choice.

1. Personally, I feel vulnerable to developing health problems at some point because of vaping.

|                      |   |   |   |   |   |   |   |   |                   |
|----------------------|---|---|---|---|---|---|---|---|-------------------|
| 1                    | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                |
| Strongly<br>Disagree |   |   |   |   |   |   |   |   | Strongly<br>Agree |

2. I feel that my chance of developing health problems at some point because of vaping is:

|                  |   |   |   |   |   |   |   |   |                   |
|------------------|---|---|---|---|---|---|---|---|-------------------|
| 1                | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                |
| Extremely<br>Low |   |   |   |   |   |   |   |   | Extremely<br>High |

3. I think it is likely that I will develop health problems at some point because of vaping.

|                      |   |   |   |   |   |   |   |   |                   |
|----------------------|---|---|---|---|---|---|---|---|-------------------|
| 1                    | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                |
| Strongly<br>Disagree |   |   |   |   |   |   |   |   | Strongly<br>Agree |

4. Compared to the average person, I feel that my chance of developing health problems is:

|               |   |   |   |   |   |   |   |   |                |
|---------------|---|---|---|---|---|---|---|---|----------------|
| 1             | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10             |
| Much<br>Lower |   |   |   |   |   |   |   |   | Much<br>Higher |

5. I feel that it would be very serious for me to develop health problems if I continue to vape.

|                      |   |   |   |   |   |   |   |   |                   |
|----------------------|---|---|---|---|---|---|---|---|-------------------|
| 1                    | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                |
| Strongly<br>Disagree |   |   |   |   |   |   |   |   | Strongly<br>Agree |



## PMT Questionnaire II

### Instructions

The following questions ask you about your perceptions of vaping-related health risks, the severity of those risks, and the potential link between the two. There are no right or wrong answers. All we ask is that you provide honest responses. All responses are completely confidential and will never be used in any way that could link them to you. It is important to complete all questions so that we can include your responses in our analyses. If you have any questions about completing the questionnaire, please email the research assistant.

Please complete each question using the scales that are provided. Circle the number that best represents your choice.

1. How effective do you feel reducing the amount you vape would be for lowering your risk of health problems?

|            |   |   |   |   |   |   |   |   |      |
|------------|---|---|---|---|---|---|---|---|------|
| 1          | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10   |
| Not At All |   |   |   |   |   |   |   |   | Very |

2. I feel that the evidence linking vaping abstinence to health problem reduction is very strong.

|                      |   |   |   |   |   |   |   |   |                   |
|----------------------|---|---|---|---|---|---|---|---|-------------------|
| 1                    | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                |
| Strongly<br>Disagree |   |   |   |   |   |   |   |   | Strongly<br>Agree |

3. For me, reducing the amount I vape or remaining abstinent from vaping to decrease my risk of developing health problems would be:

|                        |   |   |   |   |   |   |   |   |                   |
|------------------------|---|---|---|---|---|---|---|---|-------------------|
| 1                      | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                |
| Extremely<br>Difficult |   |   |   |   |   |   |   |   | Extremely<br>Easy |

4. If I wanted to, I could easily reduce the amount I vape or remain abstinent from vaping to reduce my risk of developing health problems.

|                      |   |   |   |   |   |   |   |   |                   |
|----------------------|---|---|---|---|---|---|---|---|-------------------|
| 1                    | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                |
| Strongly<br>Disagree |   |   |   |   |   |   |   |   | Strongly<br>Agree |

5. How much control do you have over reducing the amount you vape and your ability to remain abstinent from vaping to reduce your risk of developing health problems?

|                        |   |   |   |   |   |   |   |   |                     |
|------------------------|---|---|---|---|---|---|---|---|---------------------|
| 1                      | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                  |
| Very Little<br>Control |   |   |   |   |   |   |   |   | Complete<br>Control |

6. How confident are you that you are capable of reducing the amount you vape and your ability to remain abstinent from vaping to reduce your risk of developing health problems?

|            |   |   |   |   |   |   |   |   |            |
|------------|---|---|---|---|---|---|---|---|------------|
| 1          | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10         |
| Not At All |   |   |   |   |   |   |   |   | Completely |
| Confident  |   |   |   |   |   |   |   |   | Confident  |

7. How likely is it that preventing health problems would motivate you to reduce vaping?

|           |   |   |   |   |   |   |   |   |           |
|-----------|---|---|---|---|---|---|---|---|-----------|
| 1         | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10        |
| Extremely |   |   |   |   |   |   |   |   | Extremely |
| Unlikely  |   |   |   |   |   |   |   |   | Likely    |

8. Would you seriously consider starting a structured program designed to help you reduce or quit vaping to decrease your risk of developing health problems?

|            |   |   |   |   |   |   |   |   |           |
|------------|---|---|---|---|---|---|---|---|-----------|
| 1          | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10        |
| Not At All |   |   |   |   |   |   |   |   | Very      |
|            |   |   |   |   |   |   |   |   | Seriously |

9. Do you plan to start a structured program designed to help you quit vaping and reduce your risk of health problems in the near future?

|            |   |   |   |   |   |   |   |   |            |
|------------|---|---|---|---|---|---|---|---|------------|
| 1          | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10         |
| Definitely |   |   |   |   |   |   |   |   | Definitely |
| Not        |   |   |   |   |   |   |   |   |            |

10. What is your study number?

## Debriefing Letter

### The Effectiveness of the Protection Motivation Theory in Reducing Vaping Behaviour in a Student Population

#### Thank you for your participation!

Thank you for taking the time to participate in our study on using information interventions to reduce vaping in a Canadian student population! You were randomly assigned to one of two groups: the first received an educational video about the perceived vulnerability and severity of vaping behaviour and its role on overall health; the second group received the same video format but focused on features of nutrition and lifestyle information and they're subsequent health impact. The study aimed to examine whether information about specific vaping-related health problems can serve as an effective strategy to reduce and potentially quit the habit, and whether providing educational outlets focused on perceived vulnerability or severity would contain a difference in benefits between the two threat narratives.

Quitting any negative-health habit is not without its challenges and finding the time, motivation, and adherence to remain abstinent from the behaviour can be particularly difficult during this period of life – especially if you have negative influences around you! Trying to overcome the barriers associated with stress and anxiety can lead to worse habitual behaviours.

For this reason, you are invited to look into the resources at Health Canada at <https://www.canada.ca/en/health-canada/services/smoking-tobacco/vaping/smokers.html> or by contacting their support and advice line at [REDACTED]. If you notice a significantly greater sense of mental distress or anxiety as a result of participation in the study procedures, please contact Dr. Lisa Lee, a clinical psychologist as part of the study team, by email at [REDACTED], or by phone at [REDACTED]. In addition, the Counselling Services of London, specialized in anxiety therapy and self-esteem counselling, have offered their services as part of our study team at [REDACTED] or by phone at [REDACTED], to any participants who feel distress. Both study team resources offer online services for study participants. Lastly, please consider contacting the Centre for Addiction and Mental Health in Canada, at [REDACTED] if you feel the need for additional aid. These resources may provide suggestions to help answer questions about vaping and eliminate some of the stress associated with trying to quit a negative habit.

In addition, please keep the Letter of Information/Consent in the case that you wish to contact the researchers or request a copy of the results.

Once again, thank you very much for you time.

Sincerely,

**Principal Investigator:**  
Dr. Harry Prapavessis, PhD  
Department of Kinesiology  
Western University  
[REDACTED]

**Co-Investigator:**  
Babac Salmani, MA  
Department of Kinesiology  
Western University  
[REDACTED]



## Curriculum Vitae for Babac Salmani

### POST-SECONDARY EDUCATION AND DEGREES

*Western University*

London, Ontario, Canada

**Bachelor of Arts**, Faculty of Health Sciences, Honours Specialization Kinesiology  
2019

*Western University*

London, Ontario, Canada

**Master of Arts (Thesis)**, Kinesiology, Exercise and Health Psychology  
2021

### HONOURS AND AWARDS

Ontario Graduate Scholarship Master's Award  
2020 – 2021

Dean's Honour List Undergraduate Award  
2017 – 2019

### CONFERENCE POSTERS AND PRESENTATIONS

**Salmani, B.** (2020, February). *The Effectiveness of the Protection Motivation Theory in Reducing Vaping Behaviour in a Student Population*. Oral Presentation at the Health & Rehabilitation Sciences Graduate Research Conference (online).

**Salmani, B.** (2021, April). *The Effectiveness of the Protection Motivation Theory in Reducing Vaping Behaviour in a Student Population*. Oral Presentation at the Kinesiology Graduate Student Research Conference (online).

**Salmani, B.** (2021, May). *The Effectiveness of the Protection Motivation Theory in Reducing Vaping Behaviour in a Student Population*. Oral Presentation at London Health Research Day Conference (online).

**Salmani, B.** (2021, August). *The Effectiveness of the Protection Motivation Theory in Reducing Vaping Behaviour in a Student Population*. Oral Presentation at 35<sup>th</sup> Annual Conference of the European Health Psychology Society (online).

## TEACHING EXPERIENCE

*Kinesiology 1070A* (Psychology of Human Movement Science), School of Kinesiology at Western University. Teaching Assistant.  
2019

*Kinesiology 2993B* (Lifestyle, Individual, Fitness, & Exercise), School of Kinesiology at Western University. Teaching Assistant.  
2019

*Kinesiology 3339A* (Exercise Nutrition), School of Kinesiology at Western University. Teaching Assistant.  
2020

*Kinesiology 2994Y* (Specific Populations, Healthy Engagement, Rehabilitation, & Exercise), School of Kinesiology at Western University. Teaching Assistant.  
2021

## ADDITIONAL RESEARCH EXPERIENCE

*Co-Investigator*, Physical Activity and COVID-19 across all age groups  
Western University, Exercise and Health Psychology Laboratory  
Contact: Wuyou Sui, Ph.D.  
2021

Project Description: This study investigates the cross-sectional associations between physical activity and COVID-19 across three age groups: adults, children/adolescents, and older adults (> 60 years of age).

*Co-Investigator*, Sedentary Behaviour and Cognitive Function  
Western University, Exercise and Health Psychology Laboratory  
Contact: Siobhan Smith, MD.  
2020

Project Description: This study investigates the associations between domain specific sedentary behaviour (i.e., reading, writing, TV time, puzzles, etc.) and cognitive function (Montreal Cognitive assessment, measure of executive function, working memory, processing speed).

*Co-Investigator*, Physical Activity during COVID-19  
Western University, Exercise and Health Psychology Laboratory  
Contact: Teran Nieman, Ph.D.  
2020

Project Description: This cross-sectional study investigates the determinants of physical activity during the COVID-19 pandemic amongst university students in Canada, exploring the relationships between student mental health, coping resources, and access to mental health services on campus across Canada.

*Co-Investigator, Effects of NTD's in Rural Countries*  
 Public Health Insight, Public Health Insight (NGO)  
 Contact: Gordan Thane, MPH.  
 2019

Project Description: This study investigates the presence and strategies for effective attrition of neglected tropical diseases (NTD's) in rural countries to bridge the gap between communities and practitioners in Canada in the field of global and public health.

*Research Associate, Physical Activity and Cognitive Arousal for Intention*  
 Western University, Exercise and Health Psychology Laboratory  
 Contact: Lauren Crutchlow, M.A.  
 2018

Project Description: This study is a quasi-experimental pilot study determining whether restricting television-watching to treadmill walking below the ventilatory threshold improved affective valence, perceived activation, enjoyment, attentional focus, and intention to bundle television-watching with exercise.

#### ADDITIONAL QUALIFICATIONS

*Standard First Aid CPR/AED Level C*  
 Canadian Red Cross

*Designing and Implementing Population Health Interventions Certificate*  
 Dalla Lana School of Public Health

*Public Health Governance: Leadership in Integrated Health Systems Certificate*  
 Dalla Lana School of Public Health

#### RECENT EMPLOYMENT HISTORY

*Graduate Teaching Assistant, Western University, London, Ontario*  
 2019-2021

Facilitate discussion sessions and tutorials, hold weekly office hours, keep records, prepare answer keys and supplementary notes, grade exams and assignments, program projects, and oversee more than 100 students

*Fitness Advisor, GoodLife Fitness, London, Ontario*  
 2018 – 2021

Supervise individual members and advise them on best-practice exercises for them to complete determined by specific goal intentions and physical limitations

*Fitness Center Attendant*, Western Student Recreation Centre, London, Ontario  
2017 – 2019

Supervise individual exercise sessions and motivate gym members through safe and enjoyable aerobic and resistance advisory

*Summer Financial Analyst*, TD Investment Bank, London, Ontario  
2016 – 2018

Exercised Microsoft Excel skills to organize and classify information while diligently completing operations audits to increase efficiency of production

## VOLUNTEER EXPERIENCE

*Fitness Coach*, Health-e-Steps, Vancouver, British Columbia  
2020-2021

Assisted in the evaluation and implementation of fitness program for older adults by conducting individual sessions with members and recommending physical fitness plans

*Lead Project Manager*, Public Health Insight, London, Ontario  
2020-2021

Led a team of researchers to create partnerships within the city of London, devise fact sheets for public consumption regarding NTD's, and collect data regarding NTD's internationally

*General Attendant*, University Hospital, London, Ontario  
2017-2019

Responsible for interacting with patients, rounding on patient's rooms, charting medical records, assisting in discharges, assisting nursing staff with errands

*Event Coordinator*, Western Kinesiology Student Council, London, Ontario  
2017-2019

Team leader for the organization and implementation of events within the program of Kinesiology at Western. Oversaw the organization of three events during each academic year with an annual budget of \$10,000

*Event Supervisor*, Free the Children Movement, London, Ontario  
2014-2017

Responsible for organizing planning budgets, booking venues, liaising with suppliers and clients, managing logistics, and presenting post-event reports