TESTING ASSOCIATIONS BETWEEN PERSONAL NETWORKS, VAPING OUTCOME EXPECTANCIES, AND PERCEPTIONS OF ANTI-VAPING ADVERTISEMENTS

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ABSTRACT

Joshua Owen Barker: Testing associations between personal networks, vaping outcome expectancies, and perceptions of anti-vaping advertisements: A dissertation
(Under the direction of Adam J. Saffer)

American young adults are among the cohorts most at risk of using electronic cigarettes. Despite the prevalence of use, there have thus far been no dedicated national campaigns aimed at curbing young adult vaping. This dissertation sought to examine how the composition and structure of a young adult's social network as well as their baseline beliefs about e-cigarettes were associated with both young adult susceptibility and vaping frequency as well as their reactions to anti-vaping advertisements.

Data for this dissertation comes from over 2,000 young adults recruited from online survey panels. Egocentric network data, baseline usage, susceptibility, quit intentions and vaping outcome expectancies were collected before respondents viewed one of two anti-vaping advertisement conditions and answered perceived message effectiveness items. Finally, post-exposure quit intentions, susceptibility, and vaping risk beliefs were assessed.

Results indicate strong support for the associations between both the composition (attitudes, behaviors) and the structure (density, size) of young adults' social networks with vaping outcome expectancies, usage, and perceptions of anti-vaping advertisements. Theoretical and empirical implications for message testing and anti-vaping campaigns are discussed.

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To anybody reading this, know that a dissertation is by no means a finished product. Time constraints, methodological considerations, and the pains of being an early career researcher certainly limit this work. My network helped give me a dataset that is currently better than my ability to analyze it. I welcome the challenge.

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LIST OF ABBREVIATIONS

Aad	Attitude towards the ad theory
ARB	Addiction risk beliefs
FDA	Food and Drug Administration
HDN	Health discussion network
HRB	Health risk beliefs
OE	Outcome expectancies
PME	Perceived message effectiveness
PSA	Public service announcement
SIN	Social interaction network

CHAPTER 1: INTRODUCTION

The young people on the screen look mostly normal, except for the micro-USB slots where their mouths should be. They walk down the street holding skateboards, pick up muted bowling balls in a dark bowling alley or look distracted while their friends talk at a coffee bar. One in an alleyway inserts a vape into her USB mouth. As her eyes glaze over with static fuzz, a narrator describes the addictive nature of e-cigarettes, claiming they can hack the user's brain (US Food and Drug Association, 2018b). Released on the video sharing network YouTube in October of 2017, "Hacked" represented the first foray of *The Real Cost* campaign, a service mark of the United States Food and Drug Association [FDA] into persuasive messaging targeting adolescents to describe the inherent dangers of vaping.

"Hacked' was quickly joined by other persuasive messaging as part of a national multimedia campaign aimed at curbing what FDA Commissioner Scott Gottlieb termed an "epidemic" of youth e-cigarette usage (U.S. Food and Drug Administration, 2018b). The use of the word "epidemic" to describe the rise in the increase in adolescent e-cigarette usage may have seemed sensationalist, there were hard data to support it. In 2011, fewer than 1 in 20 adolescents had ever used e-cigarettes. By 2018, more than 1 in 5 had at least experimented with vaping (Cullen et al., 2018). FDA's "Hacked" message, like its companion persuasive message "An Epidemic is Spreading" (US Food and Drug Association, 2018a), was chosen in part because of its performance in pre-testing, in which youth respondents rated the advertisement as likely to be effective (Crosby, Delahanty, & Walker, 2018). Results from the pre-testing of respondents' perceptions of the message's likely effectiveness [PME] met the selection criteria for the FDA

(Crosby et al., 2018). Previous research using the same PME selection measures on anti-smoking advertisements suggested that these two advertisements would likely elicit positive changes in intentions to use e-cigarettes and, ultimately, deter adolescents from using e-cigarettes (Davis et al., 2017; Davis, Nonnemaker, Duke, & Farrelly, 2013).

However, unlike previous campaigns against cigarette smoking, which were released widely across networks and other media platforms, "Hacked" and other persuasive messages about e-cigarettes were only to be distributed to narrowly targeted media outlets in which the age of each viewer could be confirmed (U.S. Food and Drug Administration, 2018a). The purpose of this strategy was to limit the exposure of older viewers to the persuasive anti-vaping messages in order to reduce the potential that the advertisements may lead them to equate the inherent dangers of using e-cigarettes with using combustible cigarettes (Crosby et al., 2018). Previous *Real Cost* national campaigns, despite targeting adolescents, were ultimately viewed and recognized by older cohorts (Hall, Saffer, & Noar, 2019). One of the most often cited reasons for adults to use e-cigarettes is to transition away from smoking combustible cigarettes (Glantz & Bareham, 2018). This is reflected in media depictions of e-cigarettes, particularly social media, in which the products are often portrayed as tobacco cessation devices (van der Tempel et al., 2016) despite mixed evidence as to the efficacy of using the products to move away from using combustible cigarettes (Berry et al., 2019; Kalkhoran & Glantz, 2016).

Because of the FDA's aversion to inadvertently convincing adults that e-cigarettes and cigarettes are equally harmful, the anti-vaping messages they created were released in a manner that purposefully did not expose young adults, a key secondary audience that had been exposed to previous *Real Cost* ads, remembered them, and in some cases had discussed the messages with members of their personal networks (Hall et al., 2019), to the new anti-vaping messages. This

decision was made despite the increased likelihood of transitioning to combustible cigarette smoking from e-cigarette use (Primack, Soneji, Stoolmiller, Fine, & Sargent, 2015; Soneji et al., 2017; Spindle et al., 2017), which predictive models have suggested will likely cancel out any potential health benefits e-cigarette use may have over traditional combustible cigarettes (Soneji, Sung, Primack, Pierce, & Sargent, 2018). In short, there is a considerable lack of evidence examining whether excluding young adults (ages ~18-25), an age cohort that makes up the highest proportion of adult e-cigarette users (Mirbolouk et al., 2018), in an attempt to negate perceptions of risk equivalence between e-cigarettes and combustible cigarettes is a worthwhile long-term public health strategy.

Alternative sources of information-media

When the FDA decided against distributing anti-vaping messages to young adults, the agency chose to cede the topic of benefits and associated harms of e-cigarettes to other sources. This is not to say that the FDA would have been the first source of information within the media landscape to discuss vaping products. Unlike combustible cigarettes, there are currently no restrictions on e-cigarette marketing in the United States (Mantey, Cooper, Clendennen, Pasch, & Perry, 2016). Eight years before the FDA launched "Hacked" and the rest of its youth e-cigarette initiative, e-cigarette advertisements were broadcast on cable networks, with young adult exposure to television advertisements for e-cigarettes increasing by over 300% between 2011 and 2013. Beyond television advertisements, there is a significant amount of e-cigarette related content proliferating across social media platforms, retail stores, and newspaper and magazines (Marynak, Gentzke, Wang, Neff, & King, 2018). This proliferation is due in no small part to a surge in promotional budgets for vaping devices (Kornfield, Huang, Vera, & Emery, 2015). JUUL, a leading vape brand, managed to capture 40% of the American e-cigarette market

share within three years of its release due in no small part to its ability to efficiently market across social media platforms such as Twitter and YouTube (J. Huang et al., 2018). By 2018, nearly 30% of young adults in one study recognized the JUUL product regardless of whether they were e-cigarette users (Willett et al., 2018).

E-cigarette companies like JUUL are able to capitalize on the ability of social media to help spread messages about the brand in three key ways. First, e-cigarette companies can benefit from established digital networks to spread their messages among individuals who likely have a baseline interest in vaping. One study examining the marketing strategies of Blu from a network perspective suggests that the reach of Blu tweets promoting the brand exponentially grew over time as each new person who retweeted the brand passed the information to a median of 187 followers, suggesting a high likelihood that interested users commonly pass along sponsored content to non-using friends (Chu et al., 2015). Second, research has suggested that the person tagging or the use of a username to tag a second person in a post about an e-cigarette brand is one of the most common ways in which e-cigarette related information is spread across social media (Allem, Dharmapuri, Unger, & Cruz, 2018). Finally, evidence suggests the presence of social bot networks promoting e-cigarettes as smoking cessation devices or promoting new devices (Allem, Ferrara, Uppu, Cruz, & Unger, 2017), topics which Allem and colleagues (2017) suggest are spread more frequently from automated Twitter accounts than through human-controlled accounts.

These diffusion methods have been demonstrated to be impactful to the way in which adults conceptualize the potential harms and benefits of e-cigarette use. Exposure to celebrity endorsements of e-cigarettes on social media has been linked to increased positive attitudes towards e-cigarette brands (Phua, Jin, & Hahm, 2017). Recent research suggests exposure to

advertisements about e-cigarettes has an additive negative effect on adult e-cigarette users' perceptions of the product, such that greater exposure to more types of persuasive messages in favor of vaping (e.g., traditional advertisements, branded social media, and/or user testimonials), resulted in more negative attitudes toward quitting and fewer intentions to quit using e-cigarettes (Phua, 2018). In short, many young adults are consistently exposed to pro-vaping messages about the health or social benefits of using e-cigarettes and a number of studies demonstrate that exposure to these types of messages may contribute to more positive attitudes towards vaping or e-cigarette brands as well as greater susceptibility of e-cigarette use or less likelihood of attempting to quit using e-cigarettes.

Alternative sources of information-networks

Outside of media depictions of e-cigarette use, members of a person's social network can serve as sources of information about tobacco. Network researchers have theorized that social networks, or the individuals with whom one interacts, can have a causal relationship on attitude adoption and maintenance (Erickson, 1988). Within the tobacco literatures, one of the most common findings among tobacco users is that they tend to have more smokers or tobacco users within their close personal networks (Saari, Kentala, & Mattila, 2014; Simons-Morton & Farhat, 2010; Stojanovic-Tasic, Grgurevic, Trajkovic, & Pekmezovic, 2016). Longitudinal examinations of this phenomenon have suggested that this is likely attributable to selection as well as social influence factors (G. C. Huang, Soto, Fujimoto, & Valente, 2014; Mercken, Snijders, Steglich, Vartiainen, & De Vries, 2010; Mercken, Steglich, Sinclair, Holliday, & Moore, 2012). Over time, individuals who are closer to others that use a tobacco product are more likely to initiate using that product. Additionally, as time passes, tobacco users and non-users often seek out and

establish connections with others who share their tobacco usage or non-usage, increasing the proportion of individuals within networks that have similar behaviors (Mercken et al., 2012).

Network researchers have posited that networks can influence individuals' attitudes by exerting normative pressure on individuals to conform with those of a reference group of people in their surroundings (Perry, Pescosolido, & Borgatti, 2018). One longitudinal study examining adolescent tobacco outcome expectancies, or the attitudes people hold about what is likely to happen as a result of using a tobacco product, suggests social comparison to others in their school moderated the effects of positive outcome expectancies on smoking adoption (Wilkinson et al., 2009). Students who held positive attitudes about cigarettes and perceived themselves as moderately low in the social hierarchy of their school were more likely to start smoking at follow-up, while those who held a higher perception of their subjective social status were not more likely to start smoking, despite holding similar attitudes about tobacco use (Wilkinson et al., 2009). Additionally, non-vaping students in schools with more e-cigarette users have been shown to be more curious and susceptible to future vaping than non-vaping students in schools with fewer vaping students, suggesting that prevalence of the behavior in the social environment may increase normative attitudes about vaping (Lippert, 2016).

While there have not been many studies examining how networks directly influence beliefs about tobacco products, network researchers have theorized that risk perceptions (which would include the potential risks associated with vaping) are relationally influenced. Similar to how tobacco use has been demonstrated to be a product of both selection and social influence, Scherer and Cho (2003) hypothesize that individuals congregate and sociosyncratically build upon existing baseline risk perceptions about particular behaviors. This theoretical understanding combined with Erickson's assertion about the relational basis for attitudinal

creation suggests a need for deeper understandings about how the individuals a person is surrounded by contribute to their beliefs about the potential harms or benefits of using e-cigarettes. Understanding this process is vital for two key reasons: First, theories of reasoned action (Ajzen, 1991; Fishbein & Ajzen, 1975, 2011) posit that existing attitudes play a key role in influencing intentions to perform or not perform a behavior. Within the scope of e-cigarettes, this has been demonstrated by a number of studies associating young adults' positive attitudes towards e-cigarette use with increased likelihood of using e-cigarettes (Pokhrel, Little, Fagan, Muranaka, & Herzog, 2014). If the goal of anti-vaping messaging is not only to encourage use cessation, but also to stop initial use, it is important to understand the extent to which characteristics of a person's network are associated with baseline attitudes that would likely influence intentions and subsequently e-cigarette behaviors. Second, the effectiveness of an advertisement in shifting opinions has long been theorized to be influenced by existing attitudes about a product or behavior (Shimp, 1981).

Should network characteristics be associated with individual baseline attitudes about e-cigarettes, understanding which aspects of a network are influential could provide valuable data about the likely moderators of the effectiveness of an anti-vaping advertisement or campaign. As of yet, no study has examined the role of personal networks in forming attitudes about the likely effects of using e-cigarettes and how those attitudes may influence reception of anti-vaping messages. Considering the scope of e-cigarette use among young adults and the need to understand how anti-vaping messages are likely to be interpreted by this age cohort, researchers should seek to understand how a new campaign targeting this audience may interact with existing attitudes about that behavior as well as relevant social environmental factors that could contribute to the formation of these baseline attitudes.

The following chapter will provide an extensive examination of relevant literatures upon which this study was based and to which it hopes to contribute. It will begin by describing the theories and methods by which audience perceptions of the likely effectiveness of an advertisement (PME) have been assessed. Next, the chapter will examine the theoretical and current literatures about outcome expectancies, or detailed attitudes about the likely effects of performing an action (like using e-cigarettes). Finally, the chapter will conclude with a detailed examination of research examining personal networks (egocentric network research) and situate this study's usage of the theories and methods underlying egocentric research within the theories of reasoned action and social learning theories that have historically guided much of the tobacco literature.

CHAPTER TWO: LITERATURE REVIEW

Evaluating likely effectiveness of tobacco campaigns

The costs associated with producing and fielding persuasive messages targeting tobacco behaviors is considerable. Weir and colleagues' (2018) evaluation of the *FinishIt* program, a campaign from the Truth Initiative that ran between 2014 and 2016 aimed at preventing smoking initiation in youth and young adults suggests the total costs of producing, distributing, and evaluating the campaign exceeded $160 million. Beyond the costs at the federal level, states have spent considerable sums producing and distributing anti-tobacco advertising. The state of California spent over $20 million on anti-tobacco advertising between the years 2000 and 2012, and New York spent over $10 million per year each year between 2003 and 2006 (Harris, 2012). Despite these costs, there is evidence that anti-tobacco advertisements have been effective in curbing key health-related outcomes such as attitudes, risk perceptions, and intentions or smoking behaviors (Brennan, Durkin, Wakefield, & Kashima, 2013; Davis et al., 2017; Davis et al., 2013; Farrelly et al., 2002; Noar, 2006). Due to the extreme costs associated with tobacco-related comorbidities, analysis of the *FinishIt*, campaign's associated costs suggest that, if the campaign deterred just over 900 individuals from smoking initiation, the $160 million national campaign could be considered cost effective (Weir et al., 2018).

The high costs associated with producing, distributing, and evaluating the effectiveness of tobacco campaigns has led to an increase in the amount of research attempting to predict the likely overall effectiveness of an anti-tobacco message before the message is fully released.

Increasingly, researchers have turned to target audience ratings of perceived message effectiveness [PME] to help select messages that are most likely to resonate with the intended audience (Bigsby, Cappella, & Seitz, 2013; Dillard, Weber, & Vail, 2007; Yzer, LoRusso, & Nagler, 2015). Previous research has utilized PME as a measure of a respondent's perceptions of a message's likely effectiveness that might function as a predictor of the message's overall effectiveness at reducing significant outcomes—e.g. intentions to begin smoking, quit intentions, or quitting behaviors—(see Brennan et al., 2013; Davis et al., 2017). Measures of PME have been prevalent in tobacco literatures and its use in evaluating messages is increasing. Noar and colleagues' (2018) systematic review of experimental anti-smoking studies found 75 studies that had used measures of PME, with 56 percent of those studies having been published in the last eight years.

2.1 Perceived message effectiveness

Recent research has employed PME to guide the development and evaluation of national anti-smoking campaigns (Davis et al., 2017; Davis et al., 2013) as well as advertisements warning adolescents against the use of e-cigarettes (Duke et al., 2016). Studies examining PME in the context of tobacco have often found that tobacco users, especially those who are less willing to quit at baseline or who hold pro-tobacco attitudes are more likely to perceive anti-tobacco advertisements as less effective (Biener, McCallum-Keeler, & Nyman, 2000; Bigsby, Monahan, & Ewoldsen, 2017; Davis et al., 2013) and females tend to rate ads more positively than their male counterparts (Biener, Ji, Gilpin, & Albers, 2004; Bigsby et al., 2013).

Brennan and colleagues (2013) provide a good case study of an experimental anti-tobacco messaging PME study. The authors asked 231 daily smokers (adults) to complete baseline measures of quit intentions. After completing these measures, each subject was asked to

watch an anti-smoking commercial and rate that commercial using a PME scale consisting of six items (e.g., "this advertisement made me stop and think"). Following assessment of the advertisement, each respondent completed post-exposure quit intention measures. After two weeks, respondents were contacted by telephone and asked about tobacco cessation behaviors that may have occurred in the interim (e.g., if they had changed or thought about changing their smoking behavior in the past week). During the data analysis, the authors ran a factor analysis on the six-item measure and found two distinct factors: a message perceptions scale (e.g., "this advertisement made a strong argument for quitting") and a message effects scale (e.g., "this advertisement made me concerned about my smoking"). The authors found that the message effects scale was more reliable in predicting changes in quit intentions and smoking cessation behaviors than the message perceptions scale. While not all PME studies follow this template, the basic moving parts (baseline beliefs, introduction of persuasive message stimuli, subsequent beliefs) are representative of a number of key studies in the literature.

It is important to note that variables of interest in the majority of anti-tobacco messaging studies are susceptibility to use a tobacco product (e.g., Hall, Saffer, & Noar, 2019), quit intentions (Davis et al., 2013) and tobacco cessation behaviors (Brennan et al., 2013). Research investigating the motivations behind using tobacco is often guided by theories of reasoned action (Ajzen, 1991; Ajzen & Fishbein, 1977, 1980; Fishbein & Ajzen, 2011), which emphasize the role of relevant attitudes and perceived norms about a behavior in determining intentions to perform that behavior and subsequent behavioral patterns. Perceived norms about the social acceptability of a behavior like using e-cigarettes as well as perceptions of the popularity of the behavior have been demonstrated as key drivers of intentions to use tobacco products (Christakis

& Fowler, 2008; Hébert et al., 2017; J. Liu, Zhao, Chen, Falk, & Albarracín, 2017; Saari et al., 2014).

In order to more fully understand the scholarly literature that has examined PME and its utility in assessing the likely effectiveness of anti-vaping advertising, this section will next examine the theoretical roots of PME measurement, its conceptual and measurement structures to date, as well as address a number of scholarly criticisms of its continued use. Finally, this section will conclude with an argument for Yzer and colleagues' (2015) conceptual definition of PME and describe how this study will contribute to empirical and theoretical understanding of PME and its associations with e-cigarette intentions and behaviors.

Theoretical roots of PME

Before a detailed examination of theoretical traditions that have informed PME-related anti-smoking and e-cigarette advertisement studies can begin, there are a number of caveats that must be explained. This chapter will more fully describe the variety of operationalizations within the relevant literatures after describing relevant theories. This description is key to understanding how PME has been employed as previous researchers have drawn from a diverse set of theories to justify examining PME. Similarly, specific measurement names and conceptual definitions of PME have been described in a number of ways (e.g., "Perceived effectiveness," "perceived message effectiveness," "perceived persuasiveness"). Noar and colleagues (2018) describe a wide arrange of theories that have guided PME research in experimental evaluations of antismoking advertisements alone, including (but not limited to) the elaboration likelihood model (Petty & Cacioppo, 1986), reasoned action approach (Fishbein & Ajzen, 2011) and social cognitive theory (Bandura, 1986). Thus, any examination of theories relevant to PME evaluations is unlikely to truly describe the corpus of theoretical roots pertaining even to a subset

of PME uses. With this limitation in mind, the rest of this section will examine the role that attitude toward the ad theory (A_{ad}) (Mitchell & Olson, 1981; Shimp, 1981) and functional attitude theory (Hullett & Boster, 2001), have performed in guiding the conceptual definitions of researchers employing PME in ways that are most in line with this study's specific aims. Central to both of these theories is the concept of an attitude, which, for the purposes of this study, will adopt Katz's (1960) definition of an attitude as:

> "the predisposition of the individual to evaluate some symbol or object of his world in a favorable or unfavorable manner […] [attitudes] include both the affective, or feeling core of liking or disliking, and the cognitive, or belief, elements which describe the object of the attitude, its characteristics, and its relations to other objects" (p. 168).

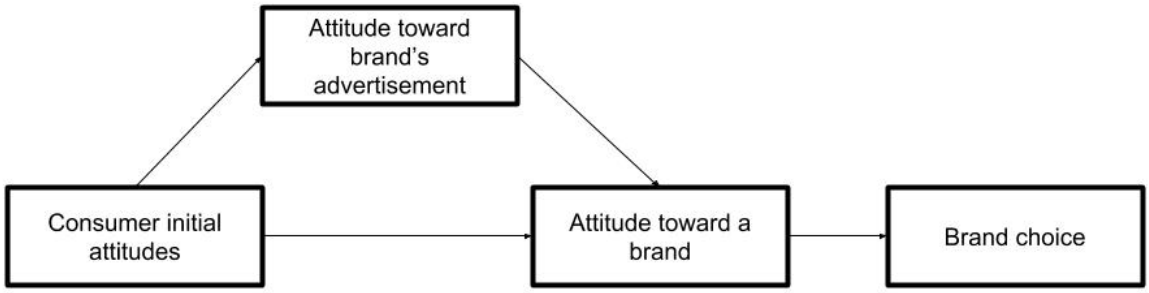
The adoption of this definition allows the rest of this section to explore how both the affective and cognitive dimensions of attitude have shaped pertinent theoretical understandings of PME, as well as how the need to reconcile the dimensionality of attitude evaluation has led to measurement and conceptual issues that have dogged the growth of theory supporting PME and its empirical operationalization.

Attitude toward the ad theory

Attitude toward the ad refers to the overall evaluation a respondent makes of a persuasive message under consideration (Mitchell & Olson, 1981). The theory stems from market research that sought to examine how audience perceptions of advertisements affected choice and evaluation of brands (Mitchell & Olson, 1981; Shimp, 1981). One of the key tenets of A_{ad} is that, the more positively audiences rate an ad, the more they tend to transfer that positive evaluation to the respective brand the advertisement promotes (Shimp, 1981). Shimp's (1981) conceptual map of A_{ad} suggests a respondent's attitude toward an advertisement is a mediating factor in attitudes toward a brand and, subsequently, the choice of whether or not a consumer

selects a brand (see Figure 1). Research in assessing adolescent attitudes towards advertisements of cigarettes and beer have demonstrated that assessments of these advertisements mediated adolescent's attitudes toward the brands the advertisements promoted, which in turn mediated the effects of the ad on the respondents' attitudes toward the product category (K. J. Kelly, Slater, & Karan, 2002).

Figure 1. Attitude toward the ad model (Shimp, 1981)



In 2000, Dillard and Peck adapted the basic A_{ad} framework to examine how audience attitudes toward a public service announcement (PSA) might influence their attitudes toward the behavior or attitude highlighted by the PSA. The authors noted a key qualitative difference between measurements of audience perceptions of a brand's advertisement and similar perceptions of a PSA, notably that, the outcome of interest necessitated different approaches to creating evaluative measures. As explained in Dillard et al. (2007), the outcome of interest in traditional A_{ad} research is traditionally brand choice, operationalized as whether or not consumers chose to purchase that brand over its competitors. However, when evaluating perceptions of PSA's, researchers have to contend with the fact that the purpose of a PSA is often to detract or warn audience members away from various outcomes. As a result, Dillard and Peck (2000) examine audience perceptions of the likely effectiveness of a given PSA in promoting or dissuading audience members from the behavior or attitude in question (see Figure

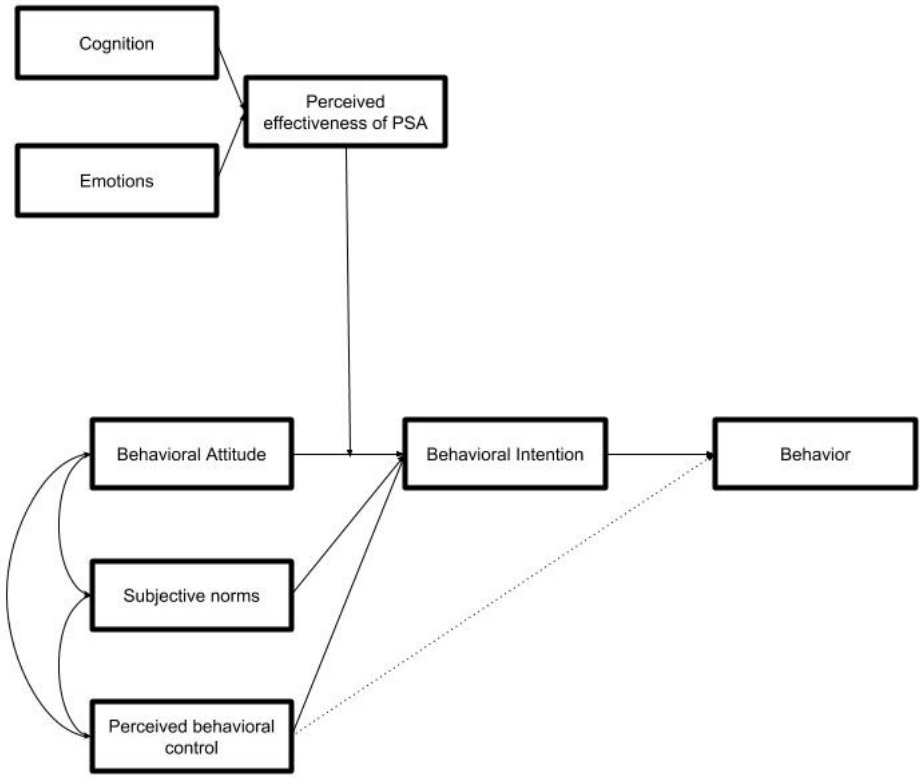
2). In this conceptualization, PME is considered a causal antecedent of attitudes toward an issue that is influenced by cognitions and emotions aroused by the stimulus material.

Incorporating theoretical insights from A_{ad} into behavioral models such as the theory of planned behavior (Ajzen, 1991) and theory of reasoned action (Fishbein, 1979), Dillard and Peck (2000) conceptualize PME as an integral causal antecedent in the attitude, intention, behavior change model. According to this theoretical understanding, perceptions about an anti-vaping advertisement's effectiveness would have a mediating effect on attitudes about e-cigarettes, which should influence intentions to use e-cigarettes and, ultimately lead to behavioral outcomes. Davis and colleagues (2013) provide a good example of this theory in action. Through a longitudinal study of over 3,400 adult smokers, the authors found higher baseline PME of anti-tobacco advertisements were causally antecedent to positive outcomes related to attitudes toward smoking and expectations for quitting, as well as increased quit intentions.

Studies, like Davis et al. (2013) building upon A_{ad} and theories of reasoned action models often operationalize PME by assessing the extent to which an advertisement is perceived as *persuasive*, *credible*, or *likable*. For example, Dillard and Ye (2008) included PME measures examining the extent to which respondents found a message to be *convincing*, *logical*, or *rational*. These studies provide functional examples of a recurring narrative in PME studies. Researchers often incorporate instrumentation Katz (1960) would describe as both affective (*likable*) and cognitive (*credible*) dimensions of attitude within the same instrument. Although this approach can result in survey instruments that are able to assess multiple potential dimensions of respondent effectiveness perceptions, the inclusion of different dimensions within the same scale has led to justifiable criticisms about PME's conceptual clarity. Before discussing these conceptual issues in greater detail, however, it is important to desribe a second

theoretical pillar upon which modern PME research has been constructed. As previously stated, A_{ad} theory posited that greater respondent preference for an e-cigarette ad would lead to greater positive perceptions of the brand that message advertised. Functional attitude theory's (Hullett & Boster, 2001) contribution, however, posits that the perceptions a respondent has towards an e-cigarette advertisement are influenced by existing or *baseline attitudes* the respondent may hold about either the behavior (vaping) or the specific brand being advertised.

Figure 2: Model adapted from Dillard et al. (2007) and Ajzen (1991)



Functional attitude theory

In addition to the role of attitude toward the ad theory in guiding a number of studies examining PME's role in influencing intentions and behaviors, functional attitude theory has played a large role in shaping the types of measures used to assess PME. Specifically, the notion that messages are most effective when their content matches as much as possible the pre-existing attitude of the audience (Hullett & Boster, 2001). This theoretical assertion can be traced back to Katz's (1960) functional aproach to reconciling psychological conflict. Shavitt (1989) describes Katz's theorization that attitudes served a *knowledge* function, which worked to structure an individual's psychological environment so as to provide cognitive and affective consistency as well as a *utilitarian* function which sought to minimize the cognitive and affective punishment individuals received from external stimuli (p. 312).

As individuals seek to maintain their current attitudes, messages that largely match these attitudes are, thus viewed as high-quality advocacies (Dillard et al., 2007, p. 615). This perception of quality of the message is theoretically linked to shaping attitudes toward the issue involved in the PSA. Dillard and colleagues (2007) note that studies employing functional attitude theory seek to examine the extent to which audience members find a PSA *plausible*, *compelling*, or *reasonable* (p. 615). Davis and colleagues (2013) point out that, much like studies examining PME through the lens of A_{ad}, scholars utilizing functional attitude theory perspectives often seek to examine whether or not a PSA is *persuasive*, *credible*, or *likable*. Much like A_{ad}, functional attitude theory situates both cognitive and affective attitudes toward an advertisement as precursors to attititudinal, intentional, and behavioral changes.

Despite the conceptual and operational agreement between research employing functional attitude theory and A_{ad} in situating and measuring PME, the dichotomy between affective and

cognitive aspects of attitudes has led to instrumentation examining both aspects within the same scales. For example, Jasek and colleagues (2015) utilized a 13-item measure of PME that assessed both affective items (e.g., whether the ad was "boring" or "terrible"), as well as cognitive items (e.g., "made me stop and think"). Cognitive and affective items were combined with message effects items similar to those employed by Brennan and colleagues (2013) (e.g., whether the advertisement "made me want to quit smoking" or "made me want to smoke"). Jasek and colleagues (2015) demonstrated adequate alpha reliability for the scale (p. 364), but never assessed whether the disparate items assessing multiple potential dimensions of message perceptions and effects loaded onto a single factorial dimension. Instead, the authors reported the 13-item scale as a single dimension labeled "perceived effectiveness." The confluence of numerous theoretical traditions influencing PME studies has led to a lack of theoretical clarity or agreement among scholars assessing PME. This, in turn, has led to justifiable criticism about the conceptual underpinnings of PME measurement.

Conceptual ambiguity in PME studies

Table 1 describes a number of conceptual definitions that have been employed to describe PME. Conceptual ambiguity in PME measurement was the impetus behind Dillard and Ye's (2008) concept explication and examination of the underlying dimensionality within PME assessments. The authors described PME at the time as a "conceptual primitive" that had previously operationalized either as a global evaluation of message impact through the use of items assessing a respondent's perceptions of a message's "persuasiveness" or "effectiveness" or through instruments examining how "logical" or "reasonable" a respondent rated a message (Dillard & Ye, 2008, p. 150). The authors adopted Grillova's (2002) description of measures examining a messages *impact* (e.g. persuasiveness, effectiveness) or its *attributes* (how logical

its arguments were or how likable the advertisement was) as key dimensions that had previously been explored in PME research. Through a factor analysis of 255 respondent evaluations of PSAs, Dillard & Ye (2008) suggest that PME is likely structured in a second-order factor model in which two factors (*impact* and *attribute*) are present, but with significant correlation between the clusters. From these findings, they suggested that applied researchers, such as those who would seek to examine which anti-tobacco or e-cigarette message is likely to be most effective, should construct instruments capable of examining perceptions of both message attributes and message impact (Dillard & Ye, 2008, p. 163).

Dillard and Ye's (2008) call for researchers to construct instruments capable of examining multiple underlying dimensions is similar to other scholarly forays into examining the factor structures underlying PME. In two assessments of heterosexually active young adults' evaluations of PSAs promoting safe sex, Noar et al. (2010), the authors suggest that the high rates of intercorrelation between all of the variables used to assess perceptions of the message was indicative of a broad, unidimensional factor underlying PME. Based off of this assertion, the Noar et al. (2010) suggest that PME "could be better assessed through a multiple item scale including items assessing cognitive reaction, emotional reaction, and personal utility, among others (p. 41). This suggestion echoes Dillard and Ye's (2008) call for applied researchers to create measures that are able to examine perceptions beyond a single structural dimension.

Whereas Dillard and Ye (2008) (and, arguably Noar et al., 2010) conceptualize PME as composed of perceptions of *impact* and *attributes* of an advertisement that are highly correlated with one another, Yzer et al. (2015) question whether assessments of the *attributes* of an advertisement (e.g. strength of an argument, pleasantness of a message) are antecedents of a singular PME dimension composed of measures examining respondent perceptions of the likely

impact of a message. To examine this potential, Yzer and coauthors (2015) call for empirical tests to examine the underlying factorial structure of PME measures and the potential for differential impacts on intentions and behaviors.

Table 1: Conceptual definitions of PME

Author	**Definition**
Brennan et al., 2013	The extent to which a message has been favorably received and evaluated
Davis et al., 2013	Audience reactions from viewing an ad
Dillard & Ye, 2008	An estimate of the degree to which a persuasive message will be favorably evaluated by recipients of that message
Yzer et al., 2015	The extent to which a message recipient believes that a health message will affect him or her personally in terms of the particular message objectives

While still relatively scant, there have been studies examining differential impacts of PME factors. Brennan, Durkin, Wakefield, and Kashima (2013) promote a factor structure that is similar to that proposed by Dillard and Ye (2008), in which perceptions of advertising *attributes* (e.g. strong argument for quitting; taught me something new) loaded onto a factor the authors labeled *ad-directed perceived effectiveness* and perceptions of the advertisement's *impact* on respondents (e.g. made me concerned about my smoking; made me motivated to try to quit) loaded onto a second factor labeled *personalized perceived effectiveness* (p. 2). Although the authors initially conceptualized the two factors as a single scale, analysis of the separate factors indicated differential predictive validity with *impact* measures outperforming *attribute* measures in predicting quit intentions and smoking cessation behavior changes. Finally, Yzer and

colleagues (2011) demonstrated two underlying factors of PME in their assessment of 190 adolescents' assessments of anti-drug television messages. Similar to Brennan and colleagues (2013), the two factors had differential utility in explaining variance in the way adolescents processed the messages. The authors identified the first factor as perceptions of an advertisement's *convincingness* (e.g., "To me this ad was convincing"). The second factor described perceptions of the *pleasantness* of the advertisement (e.g. "To me this ad was negative; positive") and explained more variance in predicting adolescent message processing than the *convincingness* factor.

The confluence of numerous theoretical traditions and conceptualizations in the PME literature have led to a number of studies employing composite measures examining PME. These measures are often presented as unidimensional, despite research suggesting differential predictive validity between measurement dimensions. Similar to Brennan et al., (2013), Baig and colleagues (2018) found that *effects perceptions* (similar to *impact* or *personalized perceived effectiveness* items) outperformed *message perceptions* (similar to *attribute* or *ad-directed perceived effectiveness items*) in explaining key tobacco-related outcomes, despite significant correlation between the two types of items. In order to ease further reading, this study will adopt Baig and colleagues' nomenclature and henceforth refer to PME items as either *effects* or *perceptions* measures. To account for the potential discrepancies between measurement dimensions, this study will employ a *perceptions* measure of PME that has been previously validated to assess anti-tobacco messages (Davis et al., 2013) as well as an adapted version of a message *effects* PME measure that has recently been validated to assess anti-tobacco messages among young adults (Baig et al., 2018).

The inclusion of both *perceptions* and *effects* items in this study is important in assessing young adult receptivitiy to anti-vaping messages for two reasons. First, there is a current lack of research examining audience reactions to anti-vaping messages. Preliminary evidence suggests that the same attitude-matching findings that have been shown with anti-tobacco messages (in which smokers rate anti-tobacco ads more negatively than non-smokers) is present in PME of e-cigarette advertisements (Duke et al., 2016). However, little evidence has been published about the utility PME responses to anti-vaping messages predicting changes in e-cigarette use intentions.

Second, there have not been any studies examining whether *effects* or *perceptions* dimensions of PME have differential effects in predicting changes in relevant e-cigarette outcomes. Empirical data investigating the potential for differential importance of *effects* or *perceptions* dimensions could provide both conceptual support to the underlying structure of PME across different product types as well as provide vital data for designing subsequent scales to assess the likely impact of antivaping messages. In order to provide this data, factor analysis of PME items in this study sought to determine the underlying dimensionality of the measure used and any differential predictive validity between the dimensions. Considering the evidence presented above of the presence and differential impact of PME dimensions, this study posited the following hypotheses:

H1: *Analysis of respondent PME of anti-vaping messages will yield a two-factor measure including perceptions and effects dimensions.*

H2: *Effects items will have greater validity in predicting change in respondent susceptibility and quit intentions than perceptions items.*

Beyond debating the dimensions associated with PME, there has been recent and important criticisms about measures used to assess PME. The following sections will describe measurement variations in assessing PME as well as respond to scholarly criticisms of both theoretical and empirical use of PME and finally argue for its utility in assessing the likely effectiveness of antivaping messages.

Measurement variety in PME studies

Variations in conceptual and theoretical understanding of PME could be assumed to produce highly disparate methods of measuring PME. Unsurprisingly, researchers have previously noted the diverse set of instrumentation that has been used to assess anti-tobacco PME (Noar, Barker, & Yzer, 2018; Noar, Bell, et al., 2018; Yzer et al., 2015). Noar and colleagues (2018) suggest that the first use of a PMdE scale to evaluate the likely effectiveness of an anti-tobacco message was Gelb and Pickett's (1983) single-item examination of the relative effectiveness of two cartoon advertisements in persuading respondents to "consider giving up smoking" (Gelb & Pickett, 1983, p. 38). The use of a single-item scale assessing motivation to act is not too far out of line with the majority of studies that have utilized PME scales in anti-smoking literatures. Noar and colleagues (2018) suggest that over 60 percent of previous research using PME to assess antismoking advertisements relied on a single item and that the majority of scales assessing PME have used either a single item or a combination of items assessing a respondents' perceptions of an advertisement's argument strength, cognitive elaboration, personal relevance, credibility, or motivation to act (p. 12). The variety of measures is also apparent in the naming of scales measuring perceptions of a message's effectiveness (Noar, Bell, et al., 2018; Yzer et al., 2015). For example, scales measuring PME have been called "perceived convincingness" (Rhodes, Roskos-Ewoldsen, Edison, & Bradford, 2008),

"quitting preparedness" (Perl et al., 2015), "overall attitude toward the ad" (Shanahan, Hopkins, & Carison, 2008) and "perceived effectiveness" (Allen et al., 2015; Brennan et al., 2013; Davis et al., 2016; Davis et al., 2017; Davis et al., 2013; Davis, Nonnemaker, Farrelly, & Niederdeppe, 2011).

In addition to the different concepts and scalar constructions that have been used to assess PME, a number of scholars have described a lack of consistency in establishing a referent, or a focal point in PME items (e.g. asking whether a message is "effective," "effective for me," or "effective for someone who uses e-cigarettes") (Dillard et al., 2007; Yzer et al., 2015). Dillard et al. (2007) explicitly described the lack of referents in a number of PME measures as a potential confounding variable that could affect the overall validity of PME measures' association with actual message effectiveness. By not specifying who the respondent should be thinking of when answering a PME item, the authors posit that individuals rating messages may rate them based on how others might react to the message rather than how they reacted personally (p. 626). Research into the use of referents in PME has demonstrated differential perceptions of effectiveness of an advertisement based on who exactly a respondent was thinking of when answering PME measures (Dillard & Ye, 2008). Dillard & Ye (2008) demonstrated that respondents answering PME measures without a specified referent may think of themselves, another person, numerous other people, or nobody at all. The variance in who respondents considered when answering PME measures biased results such that referent choice influenced "not only the magnitude of the [PME] evaluation, but also its direction" (p. 164).

The potential negative effects of not specifying a referent are troublesome. Especially considering the number of anti-tobacco PME measure that neglect to include them. Noar et al. (2018) found that, among experimental anti-tobacco advertising studies, 30 percent of all PME

measures lacked any specified referent and, among those measures that did include a referent, 13 percent used multiple referents within the same measure (e.g. “effective for me and others like me). The inconsistent use of first-person referents, or questions that ask respondents to respond to how effective a message is likely to be to them, calls into question the extent to which the social distance corollary might influence the validity of a number of studies employing PME measures (Perloff, 2009). According to the social distance corollary, the potential bias associated with this personal belief about what constitutes effectiveness or persuasiveness is likely to be amplified by asking an individual to answer questions on behalf of other people (Perloff, 2009). In effect, the greater social distance between two people, the greater expected bias and error associated with data generated from that question.

PME measures that ask respondents to describe the likely effectiveness of an e-cigarette advertisement for people with whom they share less in common, would thus be expected to be more biased than those measures asking respondents to only answer on behalf of themselves. However, as previously described (Dillard et al., 2007; Noar et al., 2018; Yzer et al., 2015), measures that do not specify referents may also be biased as researchers are less able to confidently describe who exactly respondents may be imagining when answering PME questions. The concerns raised with assessing PME measures without a referent are well-founded in the tobacco literature. One of the key scales for assessing anti-tobacco advertisement PME that has been used to justify choices in *Real Cost* campaigns (Zhao et al., 2016) uses a referent on only one of its six items (Davis et al., 2013). It is key to this study to examine a validated anti-tobacco instrument’s effectiveness in predicting changes in intentions or susceptibility due to exposure to anti-vaping messages. The limitations of the Davis PME scale related to a lack of referents are duly noted, however its importance in the selection process of anti-vaping ads by

the FDA justifies its presence in the construction of this study's PME measure. However, this study will seek to address the issues of potential social distance biasing by supplementing the Davis PME scale with an adaptation of three *message effects* items that all include first-person referents (Baig et al., 2018).

Beyond issues of conceptual dimensions within PME measurements, scalar construction, and use of referents, there have been a number of scholarly criticisms about theoretical and empirical validity behind employing messages of perceived effectiveness as predictors of actual message effectiveness. The following sections will describe these scholarly debates before responding to them, justifying the use of PME to assess the likely effects of anti-vaping advertisements, and finally defining specific PME hypotheses this study will seek to address.

Theoretical and empirical criticisms of PME

One of the most vocal scholarly critics of PME has been O'Keefe (1993; 2018). O'Keefe's argument against measuring respondent's perceptions is buoyed in two ways: (1) the nature of lay interpretations of persuasive material and (2) a concern with the pooled effect sizes from a meta-analysis on PME's predictive validity. Theoretically, O'Keefe's (1993) major criticism with employing audience assessments of prediction is two-fold.

First, in keeping with some of the major theoretical pillars of attitude toward the ad theory (Shimp, 1981), O'Keefe argues that respondents hold existing attitudes about what makes something persuasive in ways that may or may not correspond to the underlying mechanisms that constitute influential persuasive messages. For example, if a respondent believes that messages that are delivered from an authority figure are inherently more persuasive than those that are not delivered by an authority figure, they are likely to assess health messages delivered by a doctor

as spokesperson to be more persuasive or effective than those delivered by a peer as spokesperson. O'Keefe's (1993) theoretical criticism of evaluating lay assessments of persuasion is predicated on the need for researchers to not simply report potentially biased or unscientifically formed perceptions of what is persuasive, but to probe into the underlying mechanisms that might influence the actual effectiveness of a persuasive message.

Second, O'Keefe (2018) has argued that assessments of PME have little utility in predicting actual effectiveness of that message. Through an analysis of 151 message pairs (PME and corresponding actual message effectiveness measures) across 35 studies, O'Keefe determined that selecting a message based solely off of a higher PME score than a rival message would only result in a message that is actually more effective 58% of the time. According to his results, if two hypothetical e-cigarette messages were being considered for distribution, and the choice of which message to air was made solely off which message scored more highly on PME, the "right" message to send out would only be selected just over half the time. Based off of these findings, the author suggested "message designers might dispense with questions about expected or perceived persuasiveness (PME), and instead pretest messages for actual effectiveness" (O'Keefe, 2018, p. 135). While the lack of empirical support found in O'Keefe's meta-analysis is concerning, a separate meta-analysis of PME studies suggests a more positive association between PME and actual effectiveness. Dillard et al. (2007) examined effect sizes from 40 studies of PME and subsequent actual message effectiveness and found a considerable correlation between PME and actual effectiveness ($r = .41$). The authors interpreted their results as substantial evidence for an association between PME and actual effectiveness (Dillard et al., 2007).

Beyond the conflicting results of the two meta-analyses, O'Keefe's (2018) analysis has been criticized by a number of researchers. Noar, Barker, and Yzer (2018) critiqued the design of a number of studies that comprised the corpus of O'Keefe's (2018) meta-analysis, specifically commenting on the lack of correspondence between PME and actual message effectiveness respondents. For example, the inclusion of one study that explored the effectiveness of a stairwell warning sign by assessing perceptions of its effectiveness among safety experts and subsequently observing individuals walking up and down the stairs (Piccolino, 1966). Noar and colleagues (2018) also point out that O'Keefe interpreted PME measurements as failing to predict actual effectiveness even in instances in which the average PME score for two advertisements was insignificant (e.g. means of 3.07 vs 3.09).

Evidence from assessing anti-tobacco messages has provided some of the most empirically sound rebuttals to O'Keefe's (2018) assertions. In separate critiques of O'Keefe's (2018) meta-analysis, Cappella (2018) and Davis and Duke (2018) demonstrated a number of rigorous studies—including nationally-representative examinations of PME's validity in predicting actual tobacco intentions and behavior outcomes—demonstrating acceptable predictive validity for PME measures. Finally, a meta-analysis of PME's longitudinal predictive validity in anti-tobacco message selection suggests the utility of PME measures in predicting changes in respondent tobacco use quit intentions and tobacco cessation behaviors (Noar, Barker, Bell, & Yzer, 2018). FDA anti-tobacco messages are commonly tested on a standardized measure of PME (Davis et al., 2013) and those with adequate scores are selected based on previous validations of the measure's ability to predict positive changes in intentions and behaviors (Davis et al., 2017; Zhao et al., 2016). The purpose of this study is to examine associations between PME and changes in quit intentions or intentions to use e-cigarettes.

Considering the pooled effects sizes as well as nationally representative data that have demonstrated the utility of PME measures in predicting changes in tobacco outcomes such as quit intentions and cessation behaviors, this study proposed the following hypotheses:

> ***H3***: *Higher PME of anti-vaping messages will be associated with more positive changes in quit intentions for e-cigarette users following exposure to anti-vaping advertisements.*
>
> ***H4:*** *Higher PME of anti-vaping messages will be associated with more positive changes in susceptibility for e-cigarette non-users following exposure to anti-vaping advertisements.*

However, due to the pre-test/post-test nature of this study and the relatively short intervention window the methodology allows, it is unclear whether the intervention to be tested would achieve any appreciable effects on respondents' quit intentions or susceptibility. From a reasoned action and social learning theoretical standpoint, e-cigarette use intentions and susceptibility (intentions to potentially use) are the product of attitudes that form from continued exposure to a social environment (Ajzen, 1991; Bandura, 1986). Considering this possibility, this study employed risk beliefs about e-cigarettes as a proxy measure to examine the potential for brief exposure to anti-vaping messages to influence a precursor to intentional and behavioral change by testing the following hypothesis:

> ***H5:*** *Higher PME of anti-vaping messages will be associated with more positive risk beliefs about the inherent risks associated with e-cigarette use.*

Recent research has also suggested that higher PME scores are associated with fewer negative reactions to an advertisement (Baig et al., 2018; Hall et al., 2017). These findings are important to consider as individuals who react negatively to a health message are theorized to be

less likely to accept the underlying premise or suggestions of that message (J. W. Brehm, 1966; S. S. Brehm & Brehm, 2013; Witte, 1994). Negative reactance to a health message includes three key elements: perceived threat to freedom, anger, and counterarguing. These dimensions are captured through self-report items that include both negative cognition (feeling restrained or manipulated) as well as emotional (feeling angry or annoyed) reactions to a persuasive message. Considering higher PME scores are hypothesized to predict greater effectiveness of a message, and reactance has been historically associated with limiting the effectiveness of a message, this study proposed the following hypothesis:

> ***H6:*** *PME of anti-vaping messages will be negatively correlated with negative reactance to anti-vaping messages*.

Individual- and message-level PME utility

O'Keefe describes a final criticism of PME in a forthcoming article (in press), arguing that much of the literature used to validate PME as a predictor of actual effectiveness relies on individual-level rather than message-level indicators of effectiveness. This assertion describes the propensity for higher individual scores of messages to be linked with higher individual likelihood of positive outcomes of interest. This criticism calls into question some of the conclusions drawn in pooled effects analyses of PME (e.g, Noar et al., 2018; Dillard, et al., 2007), particularly these publications' description of the literature's findings about PME's utility as a tool to select individual messages. Although this study is not designed to provide data to test this assertion, it should be noted that other research design into the utility of PME as an individual message selection tool have produced similar effects as those described in the aforementioned meta-analyses (see Bigsby et al., 2013 as an example).

That is not to say that this study did not examine key assertions of PME. It just did not test the measure's utility in selecting a single message. Rather, this study hoped to add empirical evidence to two key aspects of PME. First, this study sought to answer a call made in O'Keefe's forthcoming article regarding the potential validity of PME measures in delineating audiences who might be especially receptive or dismissive of persuasive messages. In this operationalization, PME is considered a dependent variable at the individual-level and its score should be impacted by the same covariates that influence behavioral intentions and behaviors (e.g., baseline attitudes, perceived behavioral control). For example, at the individual level, PME is a valid predictor of actual effectiveness if, after seeing one type of message about the dangers of e-cigarette use, an individual is more likely to both indicate that the message will be effective and the individual is more likely to actually be affected in some way by that message. Second, this study sought to add empirical evidence to the validity of PME in assessing the differential impact of types of anti-tobacco advertisements. In this operationalization, PME is still considered a dependent variable, but is measured at the message level to determine which types of advertisement may be most impactful in achieving the message's specific aims.

Davis and colleagues (2013) provide an adequate representation of these types of validity. The authors completed a longitudinal study examining the predictive validity of PME measures of two types of advertisements (ads giving instructions on how to quit vs. ads depicting reasons to quit smoking) on over 3,400 smokers' tobacco-related outcomes (e.g., feelings about smoking, expectations for quitting, confidence in quitting) after two weeks. Higher PME scores predicted a number of outcomes including decisional balance and quit intentions at the individual level, meaning people that rated the ads more favorably were more likely to demonstrate those positive outcomes. However, the authors also measured motivational reactions to the

advertisements by asking how much each advertisement may have motivated the individual towards a positive smoking advertisement. Importantly, these measures were not considered a part of the *perceptions* PME scale Davis and colleagues used, but could be indicative of an *effects* item as conceptualized in this study (despite not referencing specific smoking behavioral outcomes). These motivational questions were predictive of quit attempts made at follow-up, and differed significantly between how-to-quit and why-to-quit ads, with the former outperforming the latter, despite why-to-quit ads demonstrating higher *perceptions* PME scores (p. 469).

The findings from Davis and colleagues (2013) support O'Keefe's call for PME to be used as a metric for identifying receptive audiences for an anti-tobacco measure, but also provide empirical justification for the predictive validity of PME in message choice between distinct types of messages. At the individual level, Davis and colleagues (2013) were able to demonstrate that *perceptions* measures of PME were a usable proxy for predicting actual changes in a number of smoking outcomes, but did not assess PME as an individual-level dependent variable. In other words, the authors did not drill down into the type of smoker who may have been more or less receptive to different types of anti-tobacco appeals. However, at the message level, the authors employed what I argue is a form of *effects* perception and found significant differences between the two message types and also validity in selecting the message type (how-to-quit) that significantly predicted quit attempts after two weeks. In the discussion, the authors note that *perceptions* PME and items assessing the specific details or aims of the messages should be employed in tandem to select the most appropriate anti-tobacco messages.

The Real Cost campaign messages to be used in this study are examples of high sensation value messages. Palmgreen and colleagues (1991) define sensation value as "the degree to which formal and content audio-visual features of a televised message elicit sensory, affective,

and arousal responses" (219). Recent research has suggested that the high sensation value of The Real Cost messages campaign may contribute to the campaigns' success in discouraging tobacco usage (L.-L. Huang et al., 2017). These findings support previous research suggesting anti-drug messages are judged to be most effective when using dramatic representations and negative outcomes associated with the behavior (Fishbein, Hall-Jamieson, Zimmer, Von Haeften, & Nabi, 2002). Davis and colleagues (2013) study found that high sensation value why-to-quit graphic messages were most likely to be rated highly on their *perceptions* PME scale, but were not rated as highly on motivational reactance and did not ultimately predict quit attempts after two weeks as well as less graphic how-to-quit messages. The impact of high sensation value e-cigarette messages on young adults has yet to be determined, but based on previous research, this study examined the following hypotheses:

> ***H7:*** *Higher sensation value messages (Real Cost ads) will be perceived as more effective than lower sensation value messages (Control).*

In conclusion, the decision for this study to employ measures of a respondent's perceptions of an anti-vaping advertisement to assess the effectiveness of the advertisement is backed by numerous studies and pooled effects within the anti-tobacco literature. The construction of the measure to be used, which employed both *effects* and *perceptions* items, was made to reflect both the inclusion of adapted validated scales that have been used to assess young adult responses to anti-tobacco advertisements as well as to examine the underlying dimensions that may contribute differently the predictive validity of PME measures. Furthermore, the inclusion of perceptions of the advertisement's *effects* and *perceptions* demonstrates theoretical ties to Katz's (1960) attitude dimensions, attitude towards the ad (Shimp, 1981), and functional attitude theories (Hullett & Boster, 2001; Shavitt, 1989).

The inclusion of referents and the correspondence of *effects* items within the PME measure this study used serve to address potential third-person effect biases (Dillard et al., 2007) by including first-person referents as well as follow best practices for aligning the focus of inquiry of PME measures with the specific aims of the anti-vaping advertisements to be used (Yzer et al., 2015). Increasing correspondence between PME items and the stated purpose of the advertisement also helps situate this within theories of reasoned action (Fishbein & Ajzen, 1975). Specifically, the *effects* items in this study (e.g., "this message discourages me from wanting to use e-cigarettes") are designed to correspond with the context, target, and action of the e-cigarette behaviors or attitudes demonstrated in the persuasive messages (Fishbein & Ajzen, 1975; Armitage & Christian, 2003, p. 189). These decisions are made to provide the best potential conditions for these measures to provide valid individual-level and message-level predictions.

In order to more fully assess the likely effects of anti-vaping persuasive messages on young adults this study must go beyond utilizing PME measures that are likely to be valid in their assessment of links between respondent assessments of an advertisement and subsequent changes in quit intentions or susceptibility. Theories in which PME research is rooted as well as theories of reasoned action both posit the importance of existing attitudes on the reception and actual effectiveness of a persuasive message (Fishbein & Ajzen, 1975; Hullett & Boster, 2001; Shimp, 1981). Armitage and Conner (1999) note that attitudes about a behavior underlie and contribute significantly to behavioral intentions. One of the key aspects of these behavioral attitudes is a respondent's evaluation of outcomes associated with the behavior. In the case of e-cigarette use, assessing the existing attitudes a respondent holds about vaping, including evaluations of outcomes that correspond with those highlighted in an anti-vaping message,

should provide key data about how the existing beliefs about vaping might influence subsequent reception of the advertisement and the overall effectiveness of the message. The next section will describe how examining respondents' outcome expectancies or expected outcomes from vaping, can provide data about the role existing beliefs about vaping influence both the reception of anti-vaping advertisements as well as the impact the messages have on changing quit intentions or vaping susceptibility.

2.2 Outcome expectancies

The previous section described the history, controversy, and potential utility of measuring audience perceptions of message effectiveness as a means of selecting persuasive messages about e-cigarettes that are likely to be effective. PME is often situated within theories of reasoned action or planned behavior within an attitude-intention-behavior model (Ajzen, 1991; Fishbein & Ajzen, 2011). These theories that have guided the design and implementation of PME have sought to examine both how perceptions of an ad's attributes and likely impact on individuals influence subsequent attitudes, intentions and behaviors (see Figure 2) (Davis, Nonnemaker, Farrelly, & Niederdeppe, 2010; Mitchell & Olson, 1981; Shimp, 1981) as well as how previously held attitudes affect processing of persuasive messages (Dillard & Ye, 2008; Hullett & Boster, 2001).

As stated above, there is room for growth in the literature in designing PME measures that more directly correspond to the outcomes of interest and the specific aims of advertisements being assessed. Likewise, there is room for growth in operationalizing two key dimensions of theories of reasoned action behavioral models in assessing the effects of anti-vaping advertisements. The rest of this section will deal with the first dimension: designing assessments of baseline attitudes that are more in correspondence with (and likely to be affected by) the

intended purpose of anti-tobacco advertisements. The following section will describe the second dimension: leveraging theories and methods from egocentric (personal network) network research to more fully understand the role an individual's social environment plays in determining baseline attitudes and subsequent reactions to anti-vaping messages.

Likewise, there is a gap in the current literature for examining post-advertisement exposure outcomes beyond quit intentions or smoking behaviors (see Bigsby et al., 2013; Davis et al., 2013; Davis et al., 2017). Measurements that allow for more detailed assessments of attitude change as outcomes of interest may provide empirically and theoretically valuable insights into the thresholds needed for a persuasive message to cascade from altering the different steps of the attitudes-intentions-behaviors models of behavior change. Previous research has examined how individuals' expectations of the outcomes (or outcome expectancies [OE]) associated with particular behaviors influence their adoption and sustained implementation of those behaviors provides. Insights from these literatures may help bridge the aforementioned gaps in PME assessments. The purpose of this section is to provide a working definition of outcome expectancies, situate them within relevant literatures, demonstrate how they have been incorporated into previous tobacco behavior literatures, and explain why outcome expectancies should be utilized as baseline examinations of relevant attitudes in assessments of anti-e-cigarette advertisements.

Conceptual definition and theoretical tradition

From a conceptual standpoint, determining the expected outcomes associated with a behavior in order to determine underlying causes or beliefs about that particular behavior has a logical elegance. Jones and colleagues (2001), in a review of expectancy theory and its relation to alcohol dependence research, invoke the concept of Occam's razor to describe how a single

measurement of outcome expectancies can assess a construct that includes multiple dimensions. This theoretical assertion, that outcome expectancies can be comprised of competing dimensions, is similar to one of the key theoretical arguments surrounding PME. As stated in the previous section, PME can assess *perceptions* of a message as well as its likely *effects*. OE scales, on the other hand, can assess a respondents' expectations about multiple dimensions associated with vaping such as *social* ("will I be ostracized?), *health* ("will vaping harm my lungs?), or *personal experience* ("will vaping help alleviate stress?") outcomes (Barker et al., 2018).

This study adapted the definition promoted by Jones et al. (2001) and consider outcome expectancies as structures in long-term memory that impact cognitive processes governing current and future behaviors associated with those structures (p. 59). The term outcome expectancy is closely related and often used in tandem with the concept of outcome expectancies (Bandura, 1986) as both concepts are theorized to mediate behavior through the assessment of anticipated outcomes associated with that behavior (Bandura, 1986; Jones et al., 2001) The concept of an outcome expectancy can, thus, be illustrated by the answer to the question: "Well, what did you *think* was going to happen?"

Outcome expectancies have their empirical and theoretical roots in social learning theories Bandura (1986; 2001). Bandura (1977; 1986) posits that the source of individual beliefs about outcomes can be traced from three main sources. The first source is symbolic thinking, or the imagined consequences that an individual believes might arise if he or she should perform a particular action (Bandura, 1977; Fouad & Guillen, 2006). An individual who decides to stay in and write a dissertation rather than going out for the evening with his or her friends has used symbolic thinking if the expected consequences of either option influence his or her behavioral

decision. Individuals can also model their behavior through vicarious experiences or models demonstrating positive or negative outcomes of a behavior.

Research into the effects of e-cigarette advertising on adolescent risk perceptions is a good example of the role vicarious observation can have on developing outcome expectancies. Results from recent studies have demonstrated exposure to e-cigarette advertising predicts more positive OE among adolescents, regardless of previous use (Phua et al., 2017; Pu & Zhang, 2017). Recent research examining the effects of pro-vaping messages on young adults suggests exposure to vaping advertisements as well as user-created social media groups promoting vaping can have negative outcomes on outcome expectancies of quitting and self-efficacy to stop using e-cigarettes (Phua, 2018).

Finally, Bandura (1977) posits that OEs can form from incentive values of an outcome or a consequence of the action. Fouad and Guillen (2006) describe how effort put into careers can be altered by environmental incentives such as compensation or perceptions of social support. Although Bandura's conceptualization of outcome expectancies includes both social and behavioral impacts associated with a behavior, other theoretical traditions contend with the likely differential impact social and behavioral outcomes may hold. Within theories of reasoned action, an individual's social support or social influences are understood as impacting underlying salient normative beliefs, while OE are examples of salient behavioral beliefs (Armitage & Christian, 2003). Thus, the social support structure or social environment in which a person is enmeshed can be understood as a causal determinant of normative beliefs about a behavior (e.g., how socially acceptable using e-cigarettes is) while outcome expectancies are representative of behavioral beliefs (e.g., what will happen to my mood, to my health, or to my social standing if I use this product). These two dimensions are understood in theories of reasoned action to

additively impact the likelihood that an individual will either choose or not choose to use an addictive substance or engage in a behavior.

Bandura's development of OE is rooted in psychological theories and models that can be traced back to Tolman's (1932) cognitive construction of expectancy. Tolman (1932; paraphrased in Fouad & Guillen, 2006) defined the cognitive aspect of learning as a mediating variable derived from animals learning about what would happen if they performed a particular action (Fouad & Guillen, 2006, p. 132). Tolman's (1932) concept of expectancy, or "purposive behaviorism" was an indicator of a paradigm shift from behaviorist psychological models to cognitive models. Fouad and Guillen (2006) interpret Tolman's learning theory as reliant on expected rewards or punishments as integral elements in facilitating learning. For example, a rat that runs through a maze over and over again, getting faster each time, is interpreted as learning the turns of the maze in tandem with a growing expectation of cheese as an outcome of finishing the puzzle.

As cognitive models of psychology overtook behaviorist interpretations, the role of OE in learning behaviors was investigated more. Stacy and colleagues (1990) describe the role that Bolles's (1972) expectancy theory played in shaping understanding of OE. Building off of Tolman's (1932) work, Bolles (1972) reviewed behaviors demonstrated by animals in clinical trials in order to arrive at his definition of an expectancy as information "about a new order of things in the environment" (p. 402). In much the same way that Tolman's (1932) hypothesis about the role of expectancies came during a transitionary period between paradigms, Bolles's (1972) expectancy theory sought to redirect the popular motivation/reinforcement theory in which individuals' behaviors were theorized to be a product of motivation altered by direct reinforcements received as a result of that behavior. For example, a student that misses school

and is punished by her principal may be less likely to purposefully miss again. Expectancy theory (Bolles, 1972) maintains many of the basic moving parts of motivation/reinforcement theory but allows for the role of outcomes that have not been experienced directly to influence behavior. To return to the truancy example above, expectancy theory would allow for the public recrimination of a student who has skipped class to influence the decision-making processes of students who see the punishment.

Jones and colleagues (2001) argue that the inclusion of indirectly observed outcomes to influence subsequent behavior allowed for the potential for outcomes that are illogically formed or misinformed to influence subsequent behaviors so long as they are held and believed by the individual under analysis. This relaxation of the etiological restraints for allowing expected results to influence motivations and, ultimately, behaviors allowed for a wider range of social circumstances to exhibit influences on outcomes of interest. As Jones and colleagues (2001) describe, this flexibility to examine both logical and illogical expected outcomes as antecedents of behaviors was a natural fit for examining the processes that instigated and supported alcoholism in the addiction literatures of the 1980s. As more scholars began incorporating expectancy theory or social learning theories into a wide array of literatures, scholars started to examine subgroups of OE and how those subgroups might correlate with particular types of behavior.

Stimulus and response expectancies

One of the most influential scholars examining OE subgroups was Kirsch (1997) whose response expectancy theory argued for a bifurcation of OE into stimulus and response expectancies. A stimulus expectancy, as Kirsch (1997) describes, is the type of expectancy that is most often examined in theories like TPB (Ajzen, 1991) or SLT (Bandura, 1977, 1986). This

type of expectancy can be likened to an adolescent's expectancy that using an e-cigarette will make her more "cool" within her social spheres. As a result of this expectancy, the adolescent might spend more time with friends who also use e-cigarettes or spend more time with friends outside of school where she can use e-cigarettes more freely. The stimulus expectancy had an effect on behavior in this case—i.e. the student uses e-cigarettes and spends more time with friends outside of school—and may have an indirect effect on the behavior's outcome—feeling more included in a social circle. Stimulus expectancies are thus expectancies about outcomes that are not fully under the individual's control (Kirsch, 1997, p. 69). In other words, the stimulus expectancy that using e-cigarettes will lead to being more popular is mediated through external factors such as the adolescent's social circle's involvement and perceptions that are outside the immediate outcomes associated with the stimulating behavior (using an e-cigarette).

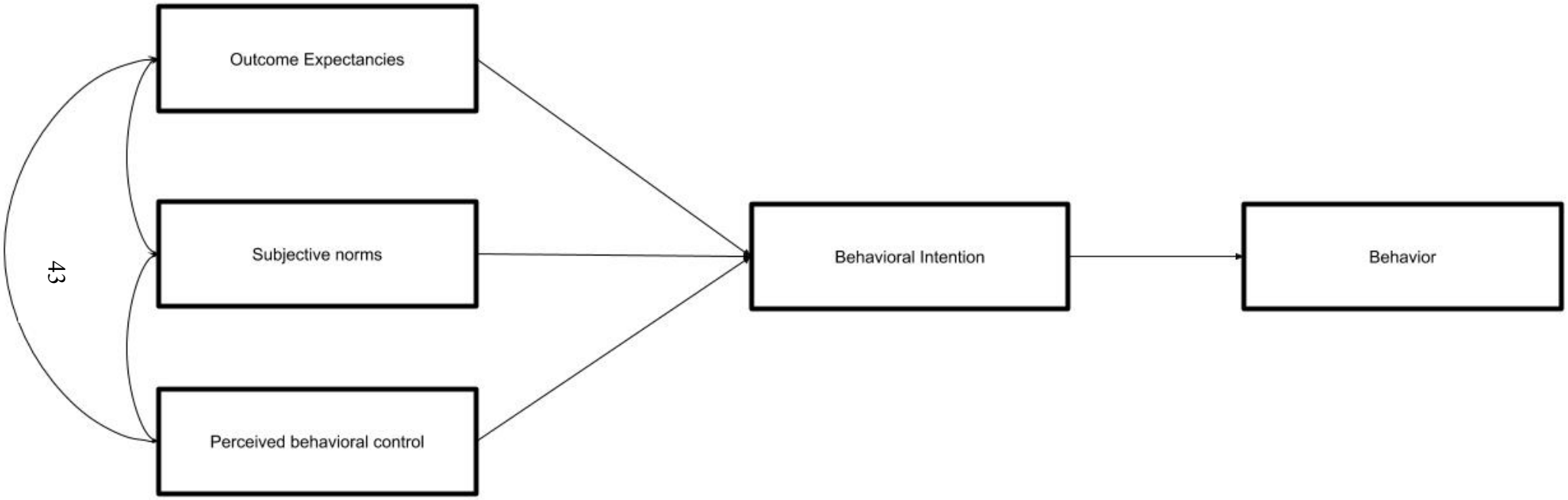
Kirsch (1997) distinguishes this type of expectancy from response expectancy, which he argues is beneficial in understanding the types of OE that can affect the ability of an individual to enter hypnosis, ascribe benefits to placebos, or seek stimulation from addictive substances (p. 70). Response expectancy is distinguishable from stimulus expectancy because the expectations are either directly confirmed or dismissed as a result of the behavior to which that outcome expectation is tied.

For example, if an individual believes that smoking an e-cigarette will give them a pleasant sensation or that drinking will make them feel more at ease, the outcome is an automatic response to the behavior that individual engages in. Once again, in keeping with expectancy theory, neither of these types of expectations need to hold logical or even realistic grounds (Jones et al., 2001). The student who believes using an e-cigarette will make her more popular (stimulus expectancy) may become more embedded within her social network because she

spends more time away from formal institutions (school) with her friends and not directly because of using e-cigarettes. Likewise, Kirsch (1997) describes empirical studies in which response expectancies are studied have demonstrated that individuals who drink caffeinated coffee or non-alcoholic beer will report "feeling" the effects of those drugs even if they contain none of the chemicals that would cause those feelings to occur.

Within the context of addictive substances literatures, OE are commonly interpreted as mediating variables within risk assessments that can significantly alter the susceptibility or usage behaviors for a variety of addictive substances (Sitkin & Pablo, 1992). This conceptualization of outcome expectancies as a mediating factor is theorized to exhibit greater influence in situations in which the "true" outcome of an action or behavior is unknown or ambiguous (Sitkin & Pablo, 1992). While not often explicated in the literature, contemporary studies often incorporate measures of both stimulus and response OE in decisional models for starting to use and continuing use of e-cigarettes. Kirsch's (1977) bifurcation of stimulus and response OE is indicative of the malleability of the concept in examining determinants of health outcomes. This malleability and ability to incorporate OE measures into theories of reasoned action as well as social learning theories were important factors in the proliferation of OE measures throughout studies of alcohol consumption in the 1980s and 1990s (see Figure 3). As previously stated above, the theories underlying PME place a priority on valid assessment of attitudes related both to products and behaviors as well as the persuasive messages either promoting or admonishing them. The theoretical examination of OE will conclude with a brief demonstration of how OE has been used as a measure of existing attitudes toward addictive substances and how this usage might better inform PME research.

Figure 3: Reasoned action model including outcome expectancies



OE and attitudes

Previous public health research into alcohol consumption in the 1980s and 1990s examined the extent to which OE were associated with existing attitudes toward drinking. The conceptual definition for OE adopted in this study: structures in long-term memory that impact cognitive processes governing current and future behaviors associated with those structures (adapted from Jones et al., 2001, p. 59) is reminiscent of descriptions of attitudes in commonly used theories of reasoned action that have been used to situate attitudes toward an advertisement within the attitude-intention-behavior model of behavioral change (Ajzen, 1991; Fishbein, 1979). Kuther (2002) asserts that both the theory of reasoned action (Fishbein & Ajzen, 1975) and theory of planned behavior (Ajzen, 1991) conceptualize attitudes as beliefs or expectations about behavioral outcomes and evaluations of behavioral outcomes.

Goldman and colleagues (1991) argue that attitude and expectancy could be examinations of the same unidimensional construct that may "merely reflect differing points of emphasis in various social/cognitive models of behavior" (p. 143). This theoretical assertion is supported by Leigh (1989), who argues predicting drinking behavior can be done "as easily and as reliably with attitudes as with expectancies" (p. 366). One of the drawbacks of incorporating OE into examinations of alcohol use at the time, the author acknowledges was that attitude research was backed by more research and theory (Leigh, 1989). This assertion has been supported by empirical data from Stacy and colleagues (1990) who demonstrated greater explanatory power for both alcohol-use intentions and subsequent behaviors by assessing relevant positive and negative outcome expectancies rather than traditional rational decision theories measures of attitudes.

The potential differential explanatory power of outcome expectancies as opposed to traditional measures of attitudes is described in detail by Kuther (2002). The author details a number of studies in which alcohol expectancies have outperformed traditional measures of attitude (see p. 39), asserting that the relative lack of specificity in the construction of a number of attitude scales informed by the theory of planned behavior compared to expectancy scales may be a reason for the differential explanatory power. Kuther (2002) accepts the theoretical similarities between outcome expectancies and attitude, but asserts that measurement differences, i.e. expectancy measurements of specific outcomes (e.g. feeling relaxed) versus Ajzen-style generalized outcome measurements (e.g. feeling pleasant/unpleasant) (p. 40).

The examination of specific outcomes associated with addictive behaviors also allows researchers an opportunity to examine respondent evaluations of salient outcomes. Stacy and colleagues (1990) describe how OE can be constructed to not only examine the likelihood of two specific outcomes (e.g. that smoking an e-cigarette will taste good; lead to addiction), these specific outcomes can also be valued by evaluations of likelihood or perceived severity. As PME is theoretically and empirically linked with how existing attitudes about behaviors or products influence perceptions of persuasive messages about those behaviors or products, OE measurements that allow for specific examinations of likely outcomes as well as their relative valuation should increase correspondence between antecedent beliefs and their subsequent changes following the introduction of a message stimulus. The final part of this section will examine selected previous research that has studied the role OE play in e-cigarette usage and explain how the current study can build off of these results.

OE and e-cigarette usage

Much like the variety of nomenclatures used for PME described in the previous section, researchers examining OE in the context of addictive substances have used a number of different titles for their measurements. In addictive substance literatures, OE have been studied within the context of risk perceptions (e.g. Agaku et al., 2018; Lippert, 2016), outcome expectations (Barnett, Lorenzo, & Soule, 2017; Wilkinson et al., 2009), and outcome expectancies (Pokhrel et al., 2014; Southwick, Steele, Marlatt, & Lindell, 1981; Stacy, Dent, et al., 1990). Information about how outcome expectancies affect adolescent and young adult usage of e-cigarettes has been gathered using a variety of methods. Qualitative interviews (Pokhrel et al., 2014), surveys (Harrell et al., 2015) and focus groups (Wagoner et al., 2016) have all been used to examine how young adults and adolescents conceptualize OE associated with e-cigarette use. Although the methods of data collection are varied, there is a historical context for using multiple methods to investigate outcome expectancies in relation to an addictive behavior. Jones and colleagues (2001) describe the wide variety of methods used to derive outcome expectancies measures in the 1980s and 1990s to study alcoholism. Studies published within that time frame included many of the data collection methods described above in an effort to cast the widest net possible to determine which OE were most correlated and most predictive of alcohol consumption behaviors.

Health outcome expectancies

Results from initial research into e-cigarettes have suggested both social and health-related outcomes may be important in mediating usage behaviors. Perhaps the broadest finding that can be extrapolated to a large number of studies is the consistent finding that individuals perceive e-cigarettes to be less directly harmful to an individual's health than traditional cigarettes. This

finding has been demonstrated in adolescents (Amrock, Lee, & Weitzman, 2016), young adults (Pokhrel, Lam, Pagano, Kawamoto, & Herzog, 2018; Pokhrel et al., 2014) and even hospitalized smokers (Hendricks et al., 2015). Previous research has suggested that OE about the relative lack of harm associated with e-cigarettes compared to traditional cigarettes could be linked to misinformed beliefs about a lack of nicotine or harmful substances in e-cigarettes (Wagoner et al., 2016). Beliefs that e-cigarette are not harmful/less harmful than cigarettes has been linked to their usage (Kong, Morean, Cavallo, Camenga, & Krishnan-Sarin, 2014; Pokhrel et al., 2014), while health concerns including addiction concerns have been linked to discontinuation or never using e-cigarettes (Amrock et al., 2016; Kong et al., 2014; Pokhrel et al., 2014).

Social outcome expectancies

Outcome expectation studies have also demonstrated social outcomes as important mediators in determining e-cigarette usage behavior. Pokhrel (2018) demonstrated how more positive social outcome expectancies, particularly about the acceptability of using e-cigarettes relative to cigarettes in social environments, predicted greater usage of e-cigarettes in young adults. For these young adults, the distasteful social aspects of traditional cigarettes (smell, stigma) were not as pronounced for e-cigarette usage. Items assessing whether or not e-cigarette use would result in someone being perceived as "cool" suggests that expectancies of outcomes associated with increased social standing are associated with e-cigarette behaviors (Kong et al., 2014; Pokhrel, Herzog, Muranaka, & Fagan, 2015; Pokhrel et al., 2018). Considering the preponderance of evidence that has linked positive outcome expectancies, this study proposed the following hypotheses:

H8: More positive outcome expectancies will be associated with greater intention to use e-cigarettes at baseline.

***H9*:** More positive outcome expectancies will be associated with greater likelihood of e-cigarette use.

Studies examining social outcome expectancies related to e-cigarettes often neglect to examine how influential media or social networks may interact with OE in predicting e-cigarette behaviors, despite preliminary evidence suggesting the potential importance of social environments in determining e-cigarette usage. Young adults who have been exposed to advertisements featuring celebrities endorsing e-cigarettes are more likely to believe e-cigarettes to be less harmful than those who have not been exposed (Phua et al., 2017). Additionally, interaction with digital communities who promote e-cigarette use has recently been associated with negative e-cigarette outcomes. In a nationally representative study of young adult e-cigarette users, exposure to user-created, pro-vaping social media groups as well as exposure to multiple forms of pro-vaping media was associated with greater negative e-cigarette outcomes including self-efficacy to quit and quit intentions (Phua, 2018). Importantly, exposure to e-cigarette media interacted with subjective norms to influence behavioral control. In short, individuals who believed using e-cigarettes was more socially acceptable were more likely to use e-cigarettes or other vaping devices in public more often following exposure to different pro-vaping messages.

These findings suggest that e-cigarette users may be more drawn toward messages that match their prevailing beliefs about the social acceptability and health ramifications of using e-cigarettes and that those messages may amplify existing outcome expectancies or behaviors. Although vital to understanding how pro-vaping messages may influence young adult users, Phua's (2018) study does not address how exposure to anti-vaping messages could impact the same outcomes. Considering the importance of baseline beliefs about a behavior in shaping the

likely reaction of a respondent to a message regarding that behavior, this investigated the following hypotheses:

> ***H10*:** More positive outcome expectancies will be associated with lower PME of anti-vaping messages.

As previously stated, one of the most common findings associated with outcome expectancies is that more positive OE predict greater tobacco use intentions and behaviors (e.g., Pokhrel et al., 2018). According to the functional attitude theory (Hullett & Boster, 2001), positive outcome expectancies should negatively influence the respondents' perceptions of advertisements [PME]. Recent research that has linked positive anti-tobacco PME assessments with subsequent changes in tobacco use intentions (e.g., Davis et al., 2013). Considering these assertions, positive outcome expectancies recorded at baseline should influence the perceptions and ultimately the effectiveness of anti-vaping advertisements. Thus, this study sought to examine the following hypothesis:

> ***H11:*** More positive outcome expectancies will be associated with lower changes in intentions to quit using e-cigarettes following exposure to anti-vaping messages.

Finally, Phua's (2018) study examines subjective norms as a unidimensional concept. Previous research situated in theories of reasoned action has suggested that behavioral attitudes are more strongly associated with behavioral intentions when the social environment is supportive of the behavior (Conner & Mcmillan, 1999). In short, outcome expectancies about e-cigarette use should be more important in predicting e-cigarette use when the respondent is embedded within a social environment they believe supports the behavior. Social environmental support for a behavior, often measured through beliefs about social norms, has been

demonstrated to be highly correlated to outcome expectancies or attitudes about a behavior when predicting behavioral intentions, but empirically and conceptually distinct (Trafimow & Finlay, 1996). Thus, it is vital to understand not only what an individual's baseline outcome expectancies about using e-cigarettes are, but also to determine how much social environmental support that respondent believes he or she has in engaging that behavior in order to understand their behavioral intentions as well as the likely impact of a message attempting to adjust those intentions.

However, Phua's (2018) operationalization of his sample's respective social environments is problematic because it does not allow the researcher to disentangle the potential differential effects that injunctive norms—e.g., beliefs about how important people in your life might react to knowing you use e-cigarettes—and descriptive norms—e.g., the number of important people in your life who use e-cigarettes—may have in influencing e-cigarette outcomes. Previous research has found that injunctive and descriptive norms can function independently to predict intentions to engage in addictive behavior (Conner & Mcmillan, 1999). It is vital to understand how these normative dimensions may relate to baseline outcome expectancies related to e-cigarettes, determine reactions to anti-vaping messages as well as influence the overall effectiveness of anti-vaping messages in influencing e-cigarette related intentions and behaviors. Considering the importance of expectancies of positive social outcomes in determining e-cigarette use, this study investigated the following hypothesis:

> ***H12:*** More positive outcome expectancies will be associated with more positive injunctive norms regarding e-cigarette use.
>
> ***H13:*** More positive outcome expectancies will be associated with more positive descriptive norms regarding e-cigarette use.

The unidimensional construction of norms utilized by Phua (2018) is not the only issue with how previous studies have assessed norms surrounding addictive behaviors. One of the key metrics for assessing injunctive norms, or the perceptions of social acceptability of using e-cigarettes is asking a respondent the valence of their close friends or family members' beliefs about that behavior. This method has been used to assess adolescents' injunctive norms about adolescent drinking (e.g., "How do most of your close friend s feel about kids of your age drinking alcohol?") (Nesi, Rothenberg, Hussong, & Jackson, 2017). It has also been employed by a number of studies examining adolescent and young adult injunctive norms related to e-cigarette use (see Gibson et al., p. 221) by asking whether a respondent believes it's "okay for people your age to use [e-cigarettes]" (p. 221) or whether the respondent's close friends or family members would approve of their use of e-cigarette or vaping products. Similarly, descriptive norms have also been assessed in relation to perceptions of addictive behaviors. In much the same way that PME has been called by a number of different scalar names, descriptive norms are often classified as "perceived prevalence" (e.g., Gorukanti et al., 2017) or "tobacco use measures" (Roditis, Lee, & Halpern-Felsher, 2016). These measures often seek to examine the number of friends or family members that use e-cigarettes or other addictive behaviors.

Although these measures have been widely used to examine perceptions of social norms surrounding addictive behaviors, this study sought to introduce a novel method of assessing social environmental factors that may influence respondents' behavioral intentions and overall receptivity to anti-vaping messages. By employing egocentric (personal network) network methods and theories established in sociological and network research, this study sought to increase the correspondence between the assessment of a respondent's perceptions of his or her social environment's acceptance of e-cigarette use, the relevant outcome expectancy dimensions,

and assessments of anti-vaping messages in order to best predict the overall effect of anti-vaping messages on young adults.

2.3 Personal networks

The previous sections of this chapter have served to lay the historical, theoretical, and empirical foundations for the use of PME and OE to examine how baseline expectancies regarding e-cigarettes may influence perceptions of persuasive messages targeting e-cigarettes and other vaping devices. As a construct, PME has been widely utilized to examine audience perceptions of anti-tobacco advertisements, despite criticisms regarding its conceptual clarity and structure as well as empirical questions as to its validity to predict actual message effectiveness. This study followed recommendations from Yzer and colleagues (2015), namely by employing *effects*-focused assessment items to achieve greater correspondence between PME and the stated goals of a persuasive message as well as post-exposure measures of actual effectiveness.

The previous sections of this chapter also sought to establish how assessing outcome expectancies toward e-cigarettes can serve to create more specific measurements of baseline attitudes than have previously been used by research informed by theories of reasoned action. This assertion is based in previous addictive behaviors research that suggests OE can benefit researchers examining addictive substance intentions and behaviors by offering specific outcomes that correspond to relevant dimensions (e.g., *health* and *social*) of those behaviors. Building from these theoretical assertions, the previous section argues that utilization of OE as baseline attitudinal assessments allows for greater correspondence between attitudes that are likely to be: (a) held by respondents about e-cigarettes; (b) targeted as specific aims of e-cigarette persuasive health messages; (c) affected in some way by viewing an e-cigarette persuasive health message stimulus. Thus, utilizing OE in this manner provides for a more

detailed examination of the likely effects of a persuasive message on a respondent and its incorporation into examinations of PME should provide greater clarity as to how PME is associated not only with intention and behavior change, but its interactions with specific baseline attitudes.

The purpose of this section is to examine how personal networks may influence the adoption and persistence of e-cigarette related OE. The need to incorporate factors outside the individual respondent when examining attitudes, intentions, and behaviors is a long-standing tenet of both theories of reasoned action as well as social learning theories (Ajzen, 1991; Bandura, 1977, 1986, 2001; Fishbein & Ajzen, 2011). Theories of reasoned action posit that perceptions of social norms are associated with both behavioral attitudes as well as behavioral intentions such that they additively interact with outcome expectancies to influence behavioral intentions and, ultimately behaviors (Ajzen, 1991; Armitage & Christian, 2003). Similarly, social learning theories suggest that the social environment in which an individual is embedded provides the opportunity for symbolic representations of behavior to be learned either through direct or mediated observation (Bandura, 1977, 2009).

Although previous research studying risk perceptions related to e-cigarettes has incorporated subjective norms (see Kong et al., 2014; Pepper et al., 2017; Pokhrel et al., 2018), measurement of the effects of the social environment in which a respondent is enmeshed have either been assessed with single items (Kong et al., 2014; Pepper et al., 2017) or, when information about a personal network is assessed, data have been collapsed into a single-item covariate in predictive use models (Pokhrel et al., 2018). The rest of this section will be dedicated to examining how assessing the structural and compositional components of a respondent's personal networks can provide valuable theoretical and empirical data regarding

social factors influencing the adoption and saliency of OE associated with e-cigarettes. The section will open with a working definition of networks as well as a brief explanation of essential network terminology, proceed into a brief history of network research and key differences in analytical approaches, and conclude with existing research that has sought to tie network factors with relevant attitude formation.

Conceptual definitions

Wasserman and Faust (1994) provide what is likely the widest conceptual definition of a social network by as "patterns or regularities in relationships among interacting units" (p. 3). Although other researchers have championed different aspects of a network within their conceptual definitions, the key elements of this overarching description are relatively constant. Networks, at their core, are comprised of individual actors (nodes) and their various connections (ties) with one another. Networks can be comprised of people, animals, businesses, information systems, or inanimate physical elements. Borgatti and Halgin (2011) provide a similar definition to Burt et al. (2012), and describe the underlying theory guiding network research of people as an examination of the "mechanisms and processes that interact with network structures to yield certain outcomes for individuals and groups" (p. 1168). This assertion as to the role of network theory in network research is enlightening as it positions the social network in which an individual is enmeshed as having a causal relationship to a host of observable outcomes. Perry, Pescosolido, and Borgatti (2018) expand upon this assertion, arguing that all network theories informing research into human subjects are based on the following premise: "social ties and interactions, rather than individual actors, represent the 'engine of action' underlying behavior" (p. 4). The common theme across these definitions is causal emphasis on the roles that patterns

of interactions among individuals within a social environment on specific behavioral or belief outcomes.

Within communication literatures, an underlying behavior often analyzed is information flow (see Monge, Contractor, & Contractor, 2003; Shumate et al., 2013). Shumate and colleagues' (2013) definition of communication networks provides a good example of how researchers in communication often describe the role of networks: networks are "relations among various types of nodes that illustrate the ways in which messages are transmitted or interpreted" (p. 97). This definition can be seen as a logical, if not purposeful, extension of Borgatti and Lopez-Kidwell's (2014) conceptualization of the network flow model, which describes how social systems function as networks through which information or resources flow from node to node along paths consisting of ties interlocked through a shared endpoint (p. 46). The network flow model serves as an abstraction of two vastly influential network studies Granovetter's (1977) strength of weak ties [SWT] and Burt's (2004) structural hole theory.

Granovetter's (1977) assessment of job-seeking behaviors in Boston's West End neighborhood led to the author's description of the outsized role that "weak" ties, or connections to individuals outside of a person's closest personal network connections, played in providing information about job opportunities to those seeking employment. Granovetter's seminal findings indicated that people with more ties to individuals outside of their core networks (or those people with whom they interacted the most) were often more successful in finding employment due to access to novel information sources. These findings echo Perry, Pescosolido, and Borgatti's (2018) description of the role of social ties and interactions as a causal engine for specific outcomes. The *structure* of some networks, specifically those that had access to novel

information through weak ties, as well as the *interaction* or activation of those ties had a direct impact on the success of an individual's job search.

Burt's (2004) analysis of brokerage and social capital among managers at an American electronics company suggests that managers who filled "structural holes"—i.e. acted as informational bridge between otherwise disconnected groups—were more likely to receive positive employment outcomes than those who were not similarly positioned. Borgatti and Halgin (2011) argue that, from a network flow perspective, both Burt and Granovetter's studies demonstrate the same underlying outcome: a node's access to novel information through bridging or weak ties with other nodes. Communication theories of networks would similarly highlight the beneficial outcomes as a result of access to (Granovetter) or governorship over (Burt) flows of information across a network structure. However, like the common themes of the operational definitions of what constitutes a network mentioned above, a common interpretation for the findings in both Burt (2004) and Granovetter (1977) is the influence of social ties and their corresponding interactions on specific individual-level outcomes.

Communication research and network flow theories

Although the conceptualization of networks as ties through which information or other data are exchanged is useful for a number of communication-based research questions, there are inherent limitations to this conceptualization that this study sought to overcome. Specifically, examining networks as simply conduits for the flow of information is problematic to investigating how network compositional variables can promote contagion and risk behavioral or perceptual proliferation. Shumate et al. (2013) draw a distinction between *flow* networks as delineated above and *affinity* networks, or socially constructed relationships that have either a

positive or negative valence. *Affinity* networks should be understood as not reliant on information actively being transmitted, but rather as compositional attributes into which alters can be classified. Spouses, romantic partners, friends, and members of the same organizational group would all be considered members of an ego's *affinity* network whether or not information flows through those conduits (Shumate et al., 2013).

Shumate and colleagues (2013) characterize network research in communication as an examination of ties within flow networks that send and receive messages, information, or data. Empirical research into this characterization of networks often examines the interplay between two central components of the flow model: *backcloth* or *traffic* (Borgatti & Lopez-Kidwell, 2014). The *backcloth*, or structure of a network is described as the underlying infrastructure that enables and constrains the *traffic*, or content flowing through a network such as information. An example of this characterization can be seen in Huang and colleagues' (2014) study of the interplay between friendship networks and adolescent tobacco usage and risk perceptions. In their longitudinal study, the authors found that respondents (*egos*) added friends (*alters*) on social networking sites that were similar to them in risk-taking factors such as alcohol as well as overall use of social networking sites. Increased exposure to pictures of alters' risk behaviors predicted increases in an increase in ego's likelihood to use tobacco products (Huang et al., 2014, p. e56). In this example, *structural* as well as *compositional* components of egos' networks were associated in the maintenance and change of risk behaviors, indicating the importance of the number of risk-taking alters a person is surrounded by leads to an increase in the number of risky behaviors that person is subjected to and, ultimately to greater risk of adopting those risk behaviors.

Limitations of network flow theories

By limiting the relevant parameters of a flow network in this manner, studies utilizing flow network theories place the burden of explanation on structural components of a network. For example, one's position in the network or density of alters in one's network influences some outcome variable. Researchers utilizing flow networks thus often resort to positional elements of a node within a network such as degree centrality (the number of links to and from an individual node within a network, betweenness centrality (how often a node lies along the shortest path between two other nodes), and closeness centrality (average distance between a node and all other nodes in a network) (Freeman, 1978; W. Liu, Sidhu, Beacom, & Valente, 2014). Flow network researchers have also examined how network dynamic variables such as transitivity (e.g. the likelihood that a friend of yours will become your friend) or reciprocity (e.g. the likelihood that someone you describe as a friend will also describe *you* as a friend) can affect individual outcomes (G. C. Huang, Soto, et al., 2014; Shumate et al., 2013). Common across all variables analyzed by flow network researchers is the assertion that differential outcomes (behavioral, perceptual, etc.) at the group or individual level stem from different configurations of social networks (Shumate et al., 2013, p. 106).

This theoretical decision can leave key data about the compositional attributes of a network unexplained. Returning to Huang and colleagues (2014) longitudinal analysis of risk behaviors among adolescents, the authors position their findings in a prototypical flow research analysis. Greater transitivity and presence among similar risk-takers yields greater proclivity of risk-behavior content through network conduits and, thus, greater behavioral outcomes among egos analyzed. While this choice provides valuable information about the outcomes of interest and the structural composition of networks associated with that outcome, the study divorces how

an alter's attributes (beyond risk and social media usage behaviors) may influence the flow of information from one node to another. By consistently making this theoretical and operational decision, researchers run the risk of trivializing variables that may be important in describing how individual beliefs, attitudes, perceptions, or behaviors are adopted and spread.

This study sought to help inform the scholarly literature by investigating the extent to which networked social influence is associated with variance among respondents' outcome expectancies about using e-cigarettes as well as their responses to anti-vaping advertisements. Networked social influences studies are theoretically linked to Erickson's (1988) assertion that individuals obtain guidance about the various norms surrounding attitudes and behaviors by comparing their personal attitudes or behaviors with those of a reference group. For example, a respondent's attitudes may be in part formed by comparing initial thoughts about e-cigarettes to those attitudes espoused by their network members or (in keeping with theories of social learning) adjusted by repeated exposure to network members using vapes or other e-cigarette devices.

Marsden and Friedkin (1993) posit that social network influence studies should consider the content of a network (here called the *compositional* attributes or the types of people within a network) as well as the social proximity (here called the *structural* attributes or the pattern by which individuals are connected within a network) in order to understand how networks can influence the attitudes and behaviors of the members who compose the network (p. 127). Thus, this study breaks from normative network flow studies by considering the mutually reinforcing influence of network composition on attitudes and behavior. In short, the types of alters within a network can influence both the structure or potential conduits for information, but also the overall composition of a network as individuals seek to include those who share similar attitudes

or behaviors within their networks and potentially exclude those with whom they share less in common. Within this framework, both the pattern of ties among nodes (*structural* attributes) as well as the attributes of the nodes themselves (*compositional attributes*) are key to understanding the potential for a respondent's network to influence his or her attitudes about e-cigarettes and potentially influence his or her reactions to anti-vaping advertisements.

Key to understanding the need for compositional attribute variables in assessing network influences on attitudes and behaviors is Perry and colleagues (2018) description of people as neither puppets of their social structure, nor as purely rational, calculating individuals. Rather, people are understood as 'sociosyncratic' both shaping and reacting to networks in their environment—interdependent rather than independent. Kadushin (2012) provides a similar theoretical argument about the role of networks, positing that, although the "social system structures patterns of relationships between people, the social network does not necessarily determine the outcomes of that structure" (p. 57). Within structured patterns, people exert agency. Rather than a network's structure dictating individual outcomes, Perry and colleagues (2018) suggest that a network influences the individual through the interaction of four separate dimensions that may be differentially impactful depending on the outcome of interest (see Table 2).

Table 2: Network dimensions (Perry et al., 2018)

Network dimension	**Definition**
Structure	Presence and patterns of network linkages
Function	Types of exchanges, services, or support available through ties to an alter
Strength	Intensity and duration of bonds between an ego and alter
Content	Attitudes, opinions, and beliefs among actors in a network

Flow networks, as conceptualized by Shumate and colleagues (2013) describe structural components of a network as the causal mechanism for individual outcomes across the other dimensions. However, this decision trivializes the ability for an individual to sociosyncratically influence the network's role. Changes in a respondent's smoking behavior is, thus, conceptualized as ultimately the result of the structure of their network rather than the differential impact that certain alters within that network may exercise in changing attitudes, beliefs, or behaviors relative to others or that intervening factors such as the length of time someone has known one alter over another or the closeness they feel to some alters in their network may play in influencing key outcomes.

Previous research examining how the composition of a person's social environment suggests the need for scholarly focus on the composition of personal networks rather than just the overall structure. The composition of a person's network, particularly the number of tobacco users who constitute a person's friend group or family has been shown to be largely influential in determining key tobacco related outcomes. Smoking initiation (J. Liu et al., 2017; Mason et al., 2017) and smoking rates (Saari et al., 2014; Stojanovic-Tasic et al., 2016) have been associated with greater presence of tobacco using friends or family members within a person's social environment. Additionally, individuals with a greater density of tobacco users within their social environment have been shown to be less efficacious in quitting smoking (Steinmetz-Wood, Gagné, Sylvestre, & Frohlich, 2018). Longitudinal analyses of smoking within friendship networks indicates that the composition of a personal network can exude social influence that leads to greater tobacco use risk and that the composition of a network can shift over time to be more homophilous (G. C. Huang, Soto, et al., 2014; Mercken et al., 2012). These findings indicate that the composition of a social environment may be sociosyncratic in terms of its effects on smoking behaviors. In other words, smokers within a person's social environment may influence his or her decision to start smoking and, over time, that person may choose to surround himself or herself with more people who share the same behavior or attitudinal beliefs about smoking.

Considering the conceptual definitions previously considered and the stated intention of this study to examine potential interactions across relevant dimensions that might influence the formation of baseline attitudes about e-cigarettes, this study adapted a number of existing network definitions in order to define a personal network henceforth as an individual set of actors or nodes, ties, and corresponding dimensional attributes (structure, function, strength, and

content) act as a bridge between macro and mezzo levels of society to causally impact outcomes of interest at the ego level (Borgatti & Halgin, 2011; Chua, Madej, & Wellman, 2011; Perry et al., 2018). This working definition seeks to expand the breadth of explanatory variables and causal mechanisms from previous research into communications networks (e.g., Shumate et al., 2013) while also situating personal networks as an antecedent to relevant attitudes and behaviors associated with e-cigarettes rather than an outcome. This following section will situate this conceptualization within long-standing network approaches, define the egocentric network approach to be undertaken in this study, and finally argue for the inclusion of egocentric network methods as important mezzo-level indicators of the social environment that may influence outcome expectancies and, thus, perceptions of a persuasive anti-e-cigarette advertisement's likely effectiveness.

Durkheim and network approaches

Network research is rooted in over 150 years of theoretical and empirical examinations into the mechanisms behind individual and group beliefs, attitudes, and behaviors. Berkman, Glass, Brissette, and Seeman (2000) provide a useful description of early influences on the network perspective, tracing its roots to the 1830s and Comte's call for *social physics* explanations for social phenomena. Researchers have also described the role Moreno's analysis of friendship networks in relation to runaway girls as well as the rise of matrix algebra and graph theory have played in propelling network research into a number of different literatures and research applications (Borgatti, Mehra, Brass, & Labianca, 2009). A complete reckoning of the historical roots of network research is beyond the scope of this study, but a brief examination of Durkheim's (1897) *Suicide* demonstrates the empirical and theoretical roots behind two of the dominant analytical paradigms in contemporary network research.

Durkheim's 1897 examination of suicide rates across different countries and its theoretical justifications for its empirical findings can be argued as charting the course for both *sociocentric* (whole network) and *egocentric* (personal network) network analysis paradigms that continue to this day (Berkman et al., 2000; Borgatti et al., 2009). In *Suicide*, Durkheim describes how destabilized norms due to national-level political and economic dysfunction can negatively impact social integration and, thus, influence negative individual health outcomes like suicidal behavior. Considering macro-level (national economic disruption) effects on mezzo-level networks (interpersonal networks) situated as causal variables leading to micro-level individual outcomes (integration into communities and suicidal behaviors) is a theoretical premise that is still being explored by network researchers (Berkman et al., 2000; Durkheim, 1951). Beyond extrapolating national-level network effects on individuals, Durkheim's study has been theoretically explored as early evidence about the "goldilocks" zone of integration into mental health outcomes. Perry et al. (2018) point to *Suicide* as an example of early personal network theory-building in its assertion that too little social integration engenders feelings of isolation while too much embeddedness has a stifling, constrictive effect on the individual that can also lead to deleterious health outcomes.

These two analytical approaches to interpreting *Suicide* combine to sketch the bones of Berkman and colleagues' (2000) structural theoretical network model of the cascading, reciprocal network effects of societal/cultural, interpersonal or community mezzo and individual health beliefs and behaviors micro effects published over 100 years after Durkheim's original study. This model of cascading and reciprocal effects has been measured through sociometric as well as egocentric approaches. Although the two approaches differ in many respects, both sociocentric and egocentric network analysts assume that, to varying extents, an individual's

beliefs, behaviors, and attitudes are influenced by his or her position relative to, interaction with, or information/resources shared with others within their social environment. From this starting theoretical assumption, the two analytic domains diverge mainly in the types of research questions each poses and the data collection and analysis methods each employs in order to answer those questions.

Egocentric and sociocentric network analysis

Both sociocentric and egocentric network analysts assume that, to varying extents, an individual's beliefs, behaviors, and attitudes are influenced by his or her position relative to, interaction with, or information/resources shared with others within their social environment. From this starting theoretical assumption, the two analytic domains diverge mainly in the types of research questions each poses and the data collection and analysis methods each employs in order to answer those questions. The ties among nodes can thus be analyzed to determine how information might move through the network. Similarly, because the ties between each node are expressed (in theory), each node's position within a network can be examined in order to determine the potential for a particular node to hold an advantageous position in terms of bridging different elements of a social network or occupying a structural hole (Burt, 2004) that could allow a node to act as a gatekeeper for information between to otherwise disconnected portions of the network. Additionally, because each node in the network provides data for the analysis, network concepts relating to reciprocity, or the extent to which attributes attributed to one node (e.g. friendship) by another are reciprocated, can be included in models in an attempt to control for biased perceptions among respondents.

Valente's (2003) work in school-based tobacco intervention is indicative of the types of research questions and outcomes that sociocentric network analysis are able to explore.

Following a diffusion of innovation theoretical perspective (Rogers, 2003) that dates back to Ryan and Gross's (1950) study of genetically modified field corn among Iowa farmers and is informed by theories of opinion leadership and the two-step flow of information from communications scholarship (E. Katz, 1957), Valente has performed multiple studies examining how health-based interventions disseminate throughout bounded networks (such as public schools) and how to best select opinion leaders to improve behavioral and attitudinal outcomes targeted by the interventions (Valente & Fosados, 2006; Valente et al., 2003; Valente & Saba, 1998). By analyzing the structure of the school network for individuals who exhibit greater centrality, betweenness, or fill structural holes, Valente (2003) was able to identify opinion leaders to champion the message within a number of schools. These schools then performed better in terms of positive attitudinal and behavioral outcomes in a longitudinal analysis than opinion leaders selected at random in control groups.

Egocentric network approaches

Whereas sociocentric approaches attempt to create a bounded whole network, egocentric approaches shift the unit of analysis to the micro-level communities constructed by individuals. This shift in analytical focus follows a steady change in the conceptual meaning of what it means to be a part of a "community" within network literatures. In a chapter examining personal networks, Chua and colleagues (2011) traced this conceptual evolution through the lens of technological change, arguing that rigid geographic definitions of community began to shift when instantaneous contact with another person could be achieved through the radio or telephone and have continued to shift into a less localized and more integrated network constructed by both those who surround ego in a geographic sense but also by those to whom ego can reach out to in a number of media at any time to pass along information, resources, or

support. Thus, egocentric methods define the unit of analysis as the alters an ego may name when asked various questions related to discussion, emotional/functional support, or cognitive recognition, regardless of geographic or group co-affiliation. Wellman (2007) describes the egocentric approach as an attempt to stand in the middle of a single person's networks and analyze who he/she is connected to and how those connections influence his/her life (p. 111).

Examples of egocentric data collection include Perry and Pescosolido's (2010) examinations of the discussion networks of mental health patients in Indianapolis. After conducting in-depth interviews with the patients, the authors asked a standard name generator question regarding who each patient may discuss "important matters" with as well as a generator question asking who each patient may discuss their "health matters" with. The authors describe how patients tended to discuss different subjects with different people, albeit with significant levels of overlap between the two networks. Patients who had close ties within their health discussion networks reported better beliefs about their future as well as better experiences with the health system overall. Ramadhanan and colleagues (2017) also employed health discussion networks in a social influence study of how graphic health warnings influenced discussion and subsequent intention and behavior change among smokers. The authors describe how the introduction of graphic health warnings can activate health discussion networks and facilitate the flow of information about the intervention, citing a small but significant relationship between negative emotional discussions about the graphic health warnings and changes in smoking intentions and behaviors at follow-up. Having defined the egocentric approach as a concept and demonstrated how it has been employed to answer health-related research questions in previous research, the following sections will discuss how egocentric methods can aid in examining the

structural and compositional aspects of a person's network that likely influence e-cigarette behavioral intentions.

Structural and compositional benefits of egocentric network research

One of the key benefits of employing egocentric methods is the ability to allow more respondent autonomy in building the structure of the social network. Due to the nature of constructing a whole network, sociocentric data collection methods are often limited in their ability to describe the impact of alters outside a single foci of action (e.g. a single school or organization). Ultimately, sociocentric data elects to examine how all nodes within a single school might interact to influence a student's attitudes toward e-cigarettes, whereas egocentric methods would focus on how the people with whom each student discusses work problems might influence his or her productivity, regardless of whether the conversation partners work in that office building or not.

In his critique of this limitation, Feld (1981) described one of the primary drawbacks for then-current network analysis was its inability to account for the limited capabilities of individuals to exercise autonomy in their selection and activation of networks. Feld situates this critique within an explanation of the different foci of action that restrict individual autonomy. The vast majority of people have little autonomy over the people who make up the network they spend that time with. Individuals with children or spouses may then go to either their children's school events, or to an event hosted by their romantic partners. Each of these social events, whether a workplace, a soccer game, or a baby shower represents exposure to a network that an ego may not have chosen. Although all of these foci might be where an individual spends the most amount of their respective time, they may provide differential opportunities to form meaningful ties that can be activated to discuss health issues or provide social support.

In order to more directly examine an individual's preferred sources of information that are relevant to forming norms about e-cigarette use and influencing use intentions, it is important to allow each respondent the autonomy to describe which ties among their network truly matter when thinking of that subject. Although a person might spend 40 hours a week at work, their discussion of their health might only include one very close work friend as well as a host of friends and family who have been in their life for a long time. Additionally, examining personal networks through an egocentric area allows for the possibility that weak ties outside workplaces, schools, or friend/family groups might influence key beliefs by bringing novel information to the respondent. Egocentric methods allow for the collection not only of preferred sources of information about various topics, but also provide the flexibility to measure incidental sources. Recent research indicates that individuals often turn to people they would not normally rely on for information when what they need is not characterized by technical skill or expertise (Small & Sukhu, 2016).

In other words, egocentric methods allow the researcher to set the parameters of the discussion networks to most closely match the behavior under question (e.g., e-cigarette use) and then allow respondents the autonomy over the structure of that network by describing which ties across multiple types of networks they might activate to share or receive information or support regarding those behaviors. Research employing this method to examine adolescent cigarette use has demonstrated how the presence of tobacco-using alters in personal networks, through a series of selection and social influence, can longitudinally increase the likelihood that an ego will start using or continue using tobacco products (G. C. Huang, Soto, et al., 2014; Mercken et al., 2010; Mercken et al., 2012). By examining friendship networks, these studies allowed respondents to select only those alters with whom they were most closely associated, regardless of the foci of

action in which the alters composing their networks might be situated (school friends, recreational league friends, etc.).

Whereas network flow models within communication have long situated network structure as a causal determinant of attitudes and behaviors, as yet, there has been scant research examining how personal network structure affects tobacco use intentions. Because the majority of research examines perceptions of social norms through single-item measures examining the proportion of a respondents' friends or family members who use tobacco, detailed personal network data are largely lacking from the literature. The absence of network structure within previous research examining how social environments influence tobacco use intentions and behaviors leaves a number of key questions open. As demonstrated in Granovetter (1977) and Burt (2004), the structure of a person's network influences the amount of novel information that is accessed. Social learning theories (Bandura, 1977) assert the importance of repeated exposure to behaviors or attitudes in the formation and maintenance of an individual's beliefs and behaviors. Egocentric network researchers theorize that very dense networks, in which alters know almost all or all of the other alters within the ego's network can be highly supportive, but also restrictive (Perry et al., 2018).

Within the context of tobacco, one study conducted by Mason and colleagues (2017) suggests that adolescents with close friends who use cigarettes and offer them cigarettes over the course of two years were more likely to transition into tobacco use. However, because the researchers limited the data to only three close friends representing the personal network, it is unknown how the density of each adolescent's network may have impacted the likelihood that they transitioned into tobacco users. Network theories, social learning theories, and theories of reasoned action all contend that the social environment is an important factor in forming or

reinforcing attitudes including outcome expectancies. Longitudinal research examining adolescent smoking indicates that structural components provides interesting data about the long-term potential effects of network structure on smoking behaviors. Mercken and colleagues (2010) describe three key structural components of personal networks that correlated with smoking behaviors through selection processes. Transitivity, or a measure of interconnectedness within a personal network (e.g., the friend of my friend is also *my* friend), reciprocity of friendship ties (e.g., my friend and I both indicate that we are friends), and outgoing friendship ties (e.g., the total number of friends I select) were all significantly correlated with smoking status (Mercken et al., 2010, p. 6). These data suggest the importance of matching smoking behaviors when initiating or maintaining friendships at least among adolescents. The evolving network structure, or the progression toward greater behavioral homophily in turn impacted the compositional effects of these networks on the cumulative social influence the network exerted on an ego. Research examining American adolescents disputes the role of network influence on smoking initiation, but supports the role of network alters' longitudinal effects on behavioral maintenance and increase (Huang et al., 2014), though a similar study among British adolescents (Mercken et al., 2012) supports the notion that both peer selection and peer influence exhibit predictive effects on smoking behaviors.

In short, these studies suggest that as a network evolves to include more alters who match behaviors (like using e-cigarettes), e-cigarette users will become a higher proportion of the network composition. Repeated exposure to alters who use e-cigarettes, according to social learning theories, would be expected to increase the likelihood that an ego would develop more positive outcome expectancies about e-cigarette use. Likewise, the increased prevalence of e-cigarette use within a social environment, would lead researchers employing theories of reasoned

action to hypothesize that there would be a higher likelihood that ego would develop more positive social norms and attitudes about e-cigarette use, leading to greater likelihood of intentions to use and, ultimately, using e-cigarettes. Because of the reciprocal nature of the structure and composition of personal networks demonstrated in previous research (e.g., Mercken et al., 2010), assessing the potential role of personal network structure should provide key data that could improve the literature's understanding of how the interconnectivity of alters who use tobacco within a respondents' network attenuates the impact of their presence on respondent tobacco attitudes, intentions, and usage.

One potential explanation for the lack of structural network data in the tobacco literatures is a proclivity for egocentric researchers to examine the compositional aspects of an ego's network. Compositional aspects of the network within this study refer to the attributes of an alter or the alter-ego relationship (e.g., how close the ego feels to the alter or how often they communicate). Both within and outside of tobacco studies, more attention is typically paid to the attributes of an ego's alters than to the structure in which those alters are enmeshed (Mccarty, 2007). Within the tobacco literatures, this is typically demonstrated by assessments of the number of tobacco using alters within a person's network often assessed by a single-item asking about friends or family members who use tobacco. Simons-Morton and Farhat (2010) have demonstrated that a greater density of smokers in personal networks is associated with a greater chance that an ego will be smokers.

A key compositional consideration when examining the structure of an individual's network is the strength of the ties within that network. Strength dimensions in egocentric analysis have been associated with key health outcomes. Closeness of risk-taking alters has consistently been linked with ego risk-permissive attitudes and risk behaviors. This has been

obliquely described in tobacco literatures. For example, research has demonstrated in the increase in smoking rates among people who live with smokers (Stojanovic-Tasic et al., 2016). More direct evidence for the importance of strong ties in influencing tobacco behaviors has been found in studies examining adolescents. Two longitudinal studies have linked adolescents who are closer with tobacco using peers with increased tobacco usage compared to those who did not have as strong of ties with tobacco users (J. Liu et al., 2017; Mason et al., 2017).

Compositional aspects of a network can also include the supportive functions each alter provides to the ego. One way this has been studied is examining whether an alter functions as a discussion partner for multiple different topics. Perry and Pescosolido (2010) examined functional specificity, or the extent to which people directed specific topics of discussion to specific alters, in an analysis of newly admitted mental health system patients. Respondents in the study tended to have individuals in their networks that functioned as discussion partners for either health matters, important matters, or both. Having someone who functioned as a health discussion partner was associated with greater health outcomes than either having only people with whom respondents discussed important matters or having people with whom respondents discussed both. Southwell (2013) also describes the functional component of personal networks in his review of research into popular understandings of health and science, suggesting that the lack of alters with functional knowledge of those topics is a likely driver of inequality across a number of health outcomes.

Functional specificity of topics related to tobacco use is nearly wholly absent from the tobacco literatures. One study has examined whether graphic health warnings on cigarette packs sparked conversation among discussion networks, but the name generator was limited to five names with whom ego discussed health matters (Ramanadhan, Nagler, McCloud, Kohler, &

Viswanath, 2017). Additionally, beyond measures of closeness, there have been no specific supportive functions that have been assessed in relation to how those attributes of an alter may exert greater influence on an ego's e-cigarette attitudes, intentions, or behaviors. This gap is important to consider in the current literature. Compositional content of a network has been linked to convergent attitudes among personal networks. In a longitudinal study examining social norms regarding HIV/AIDS, researchers demonstrated substantial causal convergent effects of personal networks on both risk behaviors but also risk perceptions related to the disease and prevention (Kohler, Behrman, & Watkins, 2007). Similarly, Scherer and Cho (2003) posit that risk perceptions are focused and potentially created through personal network ties.

The interactions between the dimensions described above should be considered vital in understanding how an individual's personal network can influence their existing attitudes (OE) about risk behaviors including e-cigarette use. Although previous research has examined how network components such as density (G. C. Huang, Soto, et al., 2014) and strength of ties (J. Liu et al., 2017) can influence tobacco usage among egos, there is a paucity of research examining the role interactions across the dimensions demonstrated above play in determining levels of influence in creating baseline attitudes toward e-cigarettes and, ultimately e-cigarette behavior. Considering these gaps in the literature, this study sought to answer the following research questions:

> ***RQ1:*** How are the *compositional* (e.g., proportion of e-cigarette or tobacco users) and *structural* characteristics (e.g., network size or density) of an ego's health and social support discussion networks associated with ego's outcome expectancies regarding e-cigarette use?

RQ2: How are the *compositional* and *structural* characteristics of an ego's health and social support discussion networks associated with ego's e-cigarette behavioral intentions?

As the previous section has demonstrated, personal networks have been demonstrated to influence attitudes, or baseline beliefs about the inherent outcomes associated with a behavior. Additionally, the theoretical traditions underlying PME posit the importance of baseline attitudes towards a behavior in influencing respondent reactions to an advertisement. However, considering the lack of research that has examined the role personal networks play in influencing reactions to persuasive messages, this study sought to answer the following research question:

***RQ3*:** How do the *compositional* and *structural* characteristics of an ego's health and social support discussion networks (proportion of e-cigarette users, size and closeness) relate to ego's perceived effectiveness of anti-vaping advertisements?

Having described the theoretical and empirical traditions that have informed this study, the next chapter will introduce the specific procedures, methods, and data analysis that was conducted in order to answer the research questions and hypotheses listed above.

CHAPTER 3: METHODS AND DATA ANALYSIS

The purpose of this chapter is to describe the overall methodology and specific measures and analyses that were run in order to answer the aforementioned research questions and hypotheses. This chapter is presented in three major subsections. The first section provides a rationale for the study's chosen method and describes the overall data collection procedure. The second section defines the instrumentation and stimuli to which each respondent responded and links each instrument with its associated research question or hypothesis. The final section provides a data analysis plan that was used to test specific research questions and hypotheses.

3.1 Randomized-control message testing rationale

In order to answer the aforementioned research questions and hypotheses, this study incorporated a cross-sectional, randomized control study. The decision to utilize this method was informed by previous message testing research (Fishbein et al., 2002; Zhao et al., 2016). Previous research investigating PME has utilized comparisons of aggregated assessments of one message's effectiveness against another's (Bigsby et al., 2013). Bigsby and colleagues (2013) showed respondents four randomly chosen anti-tobacco advertisements from a corpus of 100 ads, ensuring that no respondent got the same dosage of advertisements as any other. Aggregated average PME scores were then assessed to determine whether higher PME scores for each advertisement were indicative of positive changes in individual smoking outcomes immediately post-exposure. Other research examining PME has examined individual's assessments of different advertisements from the same source (e.g., *The Real Cost* campaign ads)

(Davis et al., 2017). Davis and colleagues (2017) showed respondents one or more ads from the *Tips* campaign, assessed PME and then examined whether individual PME scores were associated with longitudinal likelihood of attempts to quit smoking. Finally, Zhao and colleagues (2016) exemplify a third course of PME assessment in which adolescents either viewed one of 14 *Real Cost* anti-tobacco advertisements or were part of a control group that did not view any advertisements. Respondents' smoking-related beliefs and attitudes were assessed post-exposure to determine whether there was any association between assessments of the advertisements and more positive smoking-related outcomes.

This study's method sought to incorporate benefits from both Bigsby and colleagues' (2013) study as well as Zhao and colleagues (2016) study. Like Bigsby et al., (2013), this study sought to study the differential impact of advertisements from different sources. Previous tobacco research has established the source of an advertisement (Wakefield et al., 2005) as well as its attributes (Noar et al., 2010) can impact assessments of an anti-tobacco advertisement. However, due in part to the relatively new nature of the rise in e-cigarette usage, there is not currently a large backlog of health organization anti-vaping advertisements that would be required to replicate Bigsby's (2013) study. Zhao et al. (2016) provide an example of a way to assess PME without examining large numbers of advertisements. Against a no-exposure control, the researchers found significant differences in post-exposure respondents' smoking attitudes and beliefs.

While this procedure allowed researchers to examine how campaign exposure influenced smoking-related outcomes, they were unable to collect data examining whether the campaign advertisements the respondents saw were effective relative to other campaign appeals. Research has demonstrated widespread awareness of *The Real Cost* campaign as a source of anti-tobacco

messages (Hall et al., 2019). *Real Cost* anti-tobacco advertisements often utilize graphic or high-sensation messages, which have been demonstrated to produce higher PME scores (Davis & Duke, 2018; Davis et al., 2013). The utility of PME to predict changes in intentions and behaviors has been theorized to be limited among experiments that examine assessments of a small number of strong advertisements (Cappella, 2018). Essentially, testing messages from a consistently strong source, such as *The Real Cost* may not produce the variation in assessments that could indicate whether higher PME scores could predict subsequent changes in tobacco outcomes. Zhao and colleagues (2016) as well as other researchers who have examined the effectiveness of different ads from the same campaign (e.g., Davis et al., 2017) have thus far been unable to determine whether campaign messages are effective in changing outcomes compared to another message source rather than against not seeing any anti-tobacco message. This study sought to build upon the previously mentioned studies by employing a randomized control study in which two *Real Cost* anti-vaping advertisements were assessed alongside two health messages from other health organizations.

3.2 Procedure:

Respondents were 2,591 young adult Americans recruited through Qualtrics respondent pools. As the goal of this study is to determine what the potential effects personal networks and baseline outcome expectations have on young adults' perceptions of persuasive messages against vaping, as well as susceptibility or intentions to use e-cigarettes after viewing these advertisements, this study restricted its respondent pool to include only individuals who are between 18 and 25 years of age. This age range is in line with previous conceptualizations of young adults in anti-tobacco literatures (Primack et al., 2015; Soneji et al., 2017; Spindle et al., 2017). Because the stimuli the respondents were presented as well as the instrumentation they

completed are in English, respondents were required to be English-speakers. Additionally, in order to best assess young adults who are most likely to view a persuasive advertisement produced and distributed by the FDA, respondents were required to be citizens or residents of the United States.

Respondents who fit the eligibility requirements were presented with a brief online description of the study and be invited to participate. The brief online description described the study as an examination of advertisements about e-cigarettes as well as provide the amount of money that is to be provided to each respondent. Each respondent was paid approximately $4.00 for their time, which lasted between 25 and 35 minutes. The amount of time each respondent spent on this study is based off the median time of completion for a survey of 300 undergraduates completed in 2018 that utilized a similar survey instrument. Within that sample, respondents completed the survey in a median time of just over 15 minutes (Barker & Saffer, working paper). An additional ten minutes was added to the estimated completion time to account for the addition of two 30-second advertisement stimuli per respondent as well as subsequent PME questions about each advertisement. Professional online survey respondents have been shown to complete surveys in a more rapid manner than respondents from other recruitment pools (S. M. Smith et al., 2016). However, in order to assure adequate remuneration for the study's respondents, the conservative estimate of 25 minutes for completion was used to calculate compensation.

Eligible respondents who chose to participate in the study were provided with an anonymous link to a Qualtrics survey instrument. The survey instrument began with required IRB documentation informing each respondent of the potential risks associated with participation. After viewing this documentation, eligible respondents were provided informed

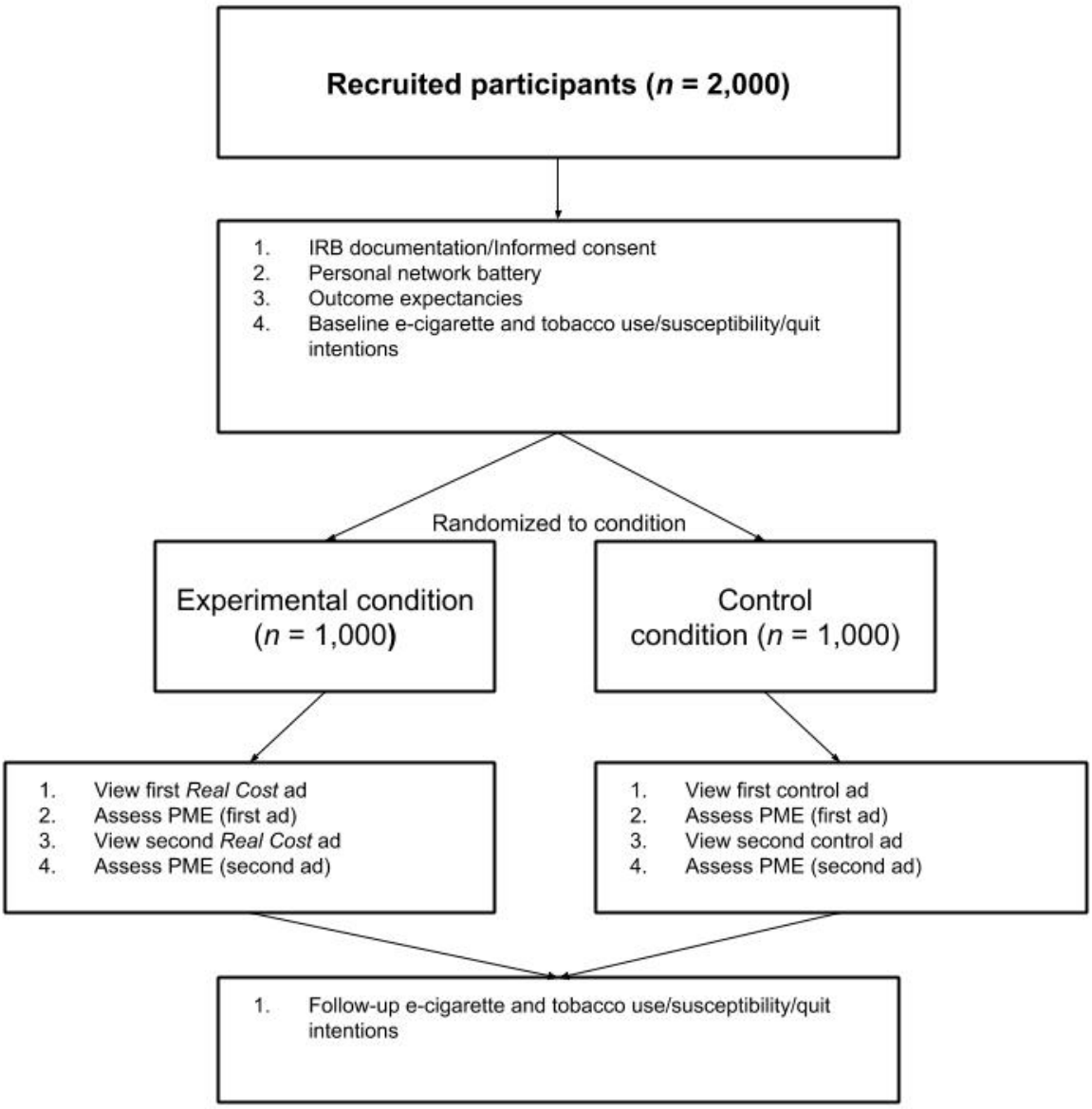
consent to begin the survey. Following informed consent, each respondent completed three survey blocks before being randomized to a condition (see Figure 3). All respondents responded to an egocentric network survey instrument adapted from previous research (Perry & Pescosolido, 2010) as well as adapted from PhenX Toolkit version 24.0 (PhenX Measure: Social Networks #211100). Following completion of the network instrument, respondents reported their baseline outcome expectancies in an instrument adapted from previous outcome expectancy research (Barker et al., 2018; Pokhrel et al., 2018; Pokhrel et al., 2014) before providing baseline e-cigarette and tobacco usage, comparative harm beliefs, susceptibility, and quit intentions (Davis et al., 2013; Hershberger, Karyadi, VanderVeen, & Cyders, 2017; Pu & Zhang, 2017).

After discussing their baseline e-cigarette outcome expectancies and tobacco behaviors, respondents were randomized to one of two conditions. The first condition viewed two FDA *Real Cost* campaign 30-second anti-vaping persuasive messages (US Food and Drug Association, 2018a, 2018b), while the second viewed one 30-second anti-vaping message from the CDC (Centers for Disease Control and Prevention, 2016) and one from Mayo Clinic (Mayo Clinic, 2018). After each message, respondents answered PME items adapted from previous research (Baig et al., 2018; Davis et al., 2013). Following the final stimulus, respondents provided follow-up comparative harm beliefs, e-cigarette susceptibility (for non-users) and quit intentions (for e-cigarette users). Respondents were compensated regardless of level of completion, although Qualtrics policy assured a complete sample of over 2,000 completes.

The previous two sections have discussed the rationale for utilizing a randomized-control study method to examine young adult responses to *Real Cost* stimuli as well as laid out the procedures that were followed in order to collect the data for this project. The next section will describe the specific instrumentation that was used to collect data for this study. This section

will justify the choice of instrumentation as well as describe the specific hypotheses and research questions that were answered by each instrument's inclusion.

Figure 4: Procedural flow chart



3.3 Measures

Discussion networks

Following standards of egocentric network research (Burt et al., 2012; Marsden, 1990; Merluzzi & Burt, 2013), each respondent was asked to provide information about the structure and composition of their personal networks. Respondent identified members of their personal networks through a series of name generators and describe those "alters" with whom they discuss health matters as well as with whom they regularly socialize with through a series of name interpreter questions. This study examined health discussion networks based on the content of the stimuli to be presented, previous research into health-related matters, and common findings in risk perceptions related to e-cigarettes. The common theme for each stimulus across both the control and *Real Cost* conditions is the negative health effects these products can have on users (Centers for Disease Control and Prevention, 2016; Mayo Clinic, 2018; US Food and Drug Association, 2018a, 2018b). Perry and Pescosolido (2010) posit that studies should use discussion networks related to the study's outcomes of interest. The correspondence between tobacco media and personal networks has been examined in previous research investigating the role of personal networks in eliciting conversation about tobacco warnings (Ramanadhan et al., 2017). Additionally, previous research into attitudes related to e-cigarettes has consistently demonstrated that individuals view the products as less harmful to a user's health than traditional cigarettes (Hershberger et al., 2017; Pokhrel et al., 2018). For these reasons, this study examined the role health discussion networks may play in shaping baseline beliefs and outcomes of interest.

Although there has not been direct examination of the role of social support discussion networks in relation to e-cigarette use or beliefs, this study included social support discussion

network measures due to a significant amount of research that has examined the role of social environments on tobacco outcomes. Previous research has linked the presence of tobacco users among an individual's friend and family networks as key indicators of tobacco use (G. C. Huang, Soto, et al., 2014; G. C. Huang, Unger, et al., 2014; Stojanovic-Tasic et al., 2016). Additionally, social aspects of e-cigarette use have been cited as key outcomes related to young adults' decision to use or not use vaping products (Gibson et al., 2018; Pokhrel et al., 2015; Pokhrel et al., 2014). Social contexts have also been linked to increased nicotine craving (Huh, Cerrada, Kirkpatrick, Dunton, & Leventhal, 2016). In observance of the myriad social dimensions that may influence relevant e-cigarette outcomes, this study also included social support instruments.

The discussion network instrument this study employed is based on previous egocentric network research (Perry & Pescosolido, 2010). The adapted PhenX Social Networks tool (#211100) elicits data about four key dimensions of a respondent's personal network: 1.) *composition* (e.g., the number of tobacco and/or e-cigarette users within a respondent's network); 2.) *function* (types of social support offered by people in a respondent's network); 3.) *strength*, and 4.) *structure* (e.g., how densely connected a respondent's network is) (Perry et al., 2018). The network instrument in this study relies on name generators in which respondents [egos] enter the names of individuals who fit dimensions of a discussion network [alters] and then are asked to describe both their relationship to that alter as well as key attributes about that alter. Due to the level of specificity that is required to generate usable data from egocentric instruments and the repetitive nature of responding to the same questions about each alter listed in a name generator, there was a dueling concern for asking egos to name enough alters to provide quality data while limiting respondent burden at every opportunity.

Following best practices suggestions for egocentric methods (Merluzzi & Burt, 2013) as well as previous research utilizing health discussion networks (Perry & Pescosolido, 2010), this study employed multiple name generators to elicit health social support discussion network alters. Specifically, this study asked egos to name *health discussant* alters, or people with whom they discuss their physical or mental health and *health regulator* alters (alters who try to get egos to address or change their mental or physical health) (Perry & Pescosolido, 2010). These generators created a multidimensional examination of the variety of ways in which health can be discussed within a network, including both positive, supportive functions such as people whom the respondent would feel comfortable discussing his/her health issues, but also constrictive functions such as people who might constrain the respondents' behaviors by bringing up health information. In an effort to lessen respondent burden, this study restricted the number of alters who can be listed to five for each dimension (Burt et al., 2012). Additionally, as there could be overlap between the alters listed in each name generator, respondents removed duplicate names that may arise before answering any additional questions about each alter. De-duplication reduced the potential for egos to answer the same attribute and relational questions about an alter due to the alter's presence in more than one name generator.

This study examined social interaction discussion networks (Bidart & Charbonneau, 2011) by employing two social interaction name generators. The first name generator asked egos to provide the names of alters whom they are most likely to have contacted over the last six months to attend informal activities. In order to elicit a reflexive network, the following name generator asked ego to name the alters whom are most likely to have contacted ego over the same time frame to attend informal activities. Considering the importance of social contexts in young adult's tobacco usage (Huh et al., 2016; Pokhrel et al., 2014; Robillard, 2010), these name

generators provided an opportunity for the study to examine informal social relationships that might provide exert influence on ego's relevant e-cigarette beliefs and behaviors. In the same manner as the health discussion network, egos removed any duplicate names that arise within the social interaction networks as well as any duplicate names that have carried forward from the health discussion network. The number of alters for social interaction generators was also limited to five. After answering all the relevant alter-level items, egos were be asked to interrelate the alters provided, or describe which alters across health and social interaction discussion networks know one another.

Discussion network composition

The composition of ego's health and social support discussion networks was assessed by a combination of demographic and tobacco behavior questions. Egos were asked to provide the age, sex, and ethnicity of each alter as well as the nature of their relationship (e.g., Spouse, Mother, Father, etc.). Measuring network composition allowed the study to examine how network homogeneity as well as potential for network-based exposure to tobacco. Higher network homophily, or the extent that an ego's alters are similar to ego in terms of demographics and attitudes, has been linked with greater potential for supportive networks (Israel, 1982). Ego-alter homophily for categorical variables was assessed by examining the categorical similarity or proportion of alters who are the same sex, ethnicity, or tobacco use status as the ego (Perry et al., 2018). Ego-alter homophily of continuous variables was assessed by examining the Euclidean distance of the alter's age from ego's (Perry et al., 2018). Alter tobacco use was assessed by asking ego whether they know if each alter uses any of a number of tobacco products including e-cigarettes.

Discussion network function

This study assessed the function of alters within ego's networks by an item asking egos to select from one of six types of support functions each alter provides ego (e.g., listens to me, gives or loans me money, etc.). This measure was adapted from previous research examining the role of support functions in personal networks (Perry & Pescosolido, 2010) and assesses key dimensions of network support including emotional, informational, financial, instrumental, and discussion partner roles (p. 350). Social support is a key variable to assess in examining outcomes related to addictive behaviors. Positive social support has been linked to positive cessation behaviors in substance abuse (Dobkin, Civita, Paraherakis, & Gill, 2002), while networked social support has demonstrated differential impacts on tobacco use (Pokhrel et al., 2016). Egos with highly supportive networks who also use a substance could have worse addictive behavior outcomes due to outsized social influence exerted by individuals on whom they heavily rely (Longabaugh, Wirtz, Zweben, & Stout, 1998; Wills & Vaughan, 1989). In order to account for the potential that greater social support functions within a network may exert on e-cigarette outcomes, egos were allowed to select multiple support functions for each alter. Thus, the study examined the extent to which networks containing alters who fulfill multiple support roles (highly supportive networks) may differ in their effects on relevant tobacco outcomes versus those with alters who fulfill few or no support roles (low supportive networks). Supportive functions were assessed by aggregating the average number of support functions performed by each alter within an ego's network and standardizing this score (z-score). Networks one standard deviation below the average support functions, or low supportive networks would score [-1], egos with the average amount of support were scored a [0] and one SD above the mean [1]. Egos with networks two SD above the mean [highly supportive] were scored a [2].

Discussion network strength

Discussion network strength was assessed in two ways. First, by eliciting how close ego felt they were to each alter listed. This was assessed by a 10-point Likert scale anchored from "Not at all close" to "Extremely close." Previous research has associated close ties with tobacco users as a predictor of tobacco use (Robillard, 2010; Saari et al., 2014; Stojanovic-Tasic et al., 2016). Perceptions of closeness among friends, even when the perception is not reciprocal, has also been linked with negative substance use behaviors (Marschall-Levesque, Castellanos-Ryan, Vitaro, & Seguin, 2014, p. 13). Closer contact with a network alter also provides greater opportunity for social learning, in which behaviors or attitudes of the alter can influence those held by ego (Bandura, 1986). Thus, this study examined the potential for an ego's perceptions of the strength of a tie with an alter to influence relevant e-cigarette outcomes.

This study also assessed the frequency of contact respondents have with each listed alter. Frequency of contact with an alter has been often associated with the overall strength of a tie between an alter and an ego (Lakon, Godette, & Hipp, 2008; Perry et al., 2018). Although research has suggested the limited utility in using frequency of contact as a standalone measure for tie strength (Marsden & Campbell, 1984, 2012), it can be useful when assessed in tandem with other tie strength dimensions. Friedkin (1990) suggests that examining frequency of contact in addition to feelings of closeness a respondent has towards an alter can help describe the development of a strong bond between dyads (ego-alter pairs). Thus, this study asked respondents to describe how often they communicate with each alter they list in their discussion networks through an 8-point Likert scale (Never – 7 days a week/Every day). As the two measures of network strength are measured using Likert scales with different point totals, z-scores for the respective variables were calculated in all analyses.

Discussion network structure

Egos provided data about the structure of their networks in two ways. First, the number of alters each ego names in each name generator allowed for examination of network size, which has been associated with social integration, social capital, or potential avenues for social support (Berkman et al., 2000; Perry et al., 2018). Network size was operationalized by assessing the log of network size (see Perry & Pescosolido, 2010). The second way egos provided data about their individual network structures was by responding to a name interrelater. In the interrelater, egos indicated which other alters an individual alter knows. More alters who knew each other within an ego's network was indicative of greater network *density*. Network density is an important variable to examine in relation to e-cigarette beliefs and behaviors. Denser personal networks are often associated with greater propensity for social support or influence (Kohler et al., 2007; Perry et al., 2018). However, access to "weak" ties or alters who are not densely positioned within a network can allow ego a conduit to information that may be novel or important in shaping beliefs or behaviors (Burt, 2004; Granovetter, 1977). Additionally, denser networks could prove to be more restrictive or exert more influence on an ego's existing beliefs or behaviors (Perry et al., 2018). Thus, this study examined the potential impact that network structure, measured as a function of network density, may play in shaping existing e-cigarette beliefs and subsequent interpretations of anti-vaping persuasive messages.

E-cigarette outcome expectancies

This study assessed outline expectancies using a measure that has been constructed in accordance with recent best practices for constructing valid e-cigarette attitude measurement scales (Gibson et al., 2018) as well as notable previous research into young adults' attitudes and expectancies about e-cigarette use (Barker et al., 2018; Morean et al., 2019; Pokhrel et al., 2018;

Pokhrel et al., 2014). The purpose of assessing outcome expectancies about e-cigarettes for this study was to provide data about existing baseline beliefs about how respondents conceptualize the likely effects of vaping. Chosen outcome expectancies for this study must have been: 1.) consistently validated through scale development assessing e-cigarette attitudes or beliefs among young adults; 2.) correspond to the overall aims of the persuasive messages used as stimuli; and/or 3.) theoretically correspond with the chosen discussion networks (social support or health discussion). These inclusion criteria insured that the items chosen to represent likely outcome expectancies could be justifiably influenced by the networks this study uses to represent the social environment, have been validated and demonstrated effective prediction or association with e-cigarette behaviors in previous large-scale research, and can be justified as corresponding with existing attitudes that might influence the ways in which persuasive messages about vaping are received by the study's respondents.

Importantly, e-cigarette outcome expectancies are not unidimensional. The outcome expectancies measure used in this study includes represents three key outcome dimensions: health, social, and personal experience. Considering the overall theme of both control and *Real Cost* persuasive messages are about the health effects of e-cigarettes, and that one of the discussion networks employed to elicit personal network data is a health discussion network, this study will include measures examining respondent beliefs about health outcomes of using e-cigarettes. Health-related outcome expectancies have been consistently linked with e-cigarette use (Amrock et al., 2016; Hendricks et al., 2015; Hershberger et al., 2017). Though often measured in direct comparison to combustible cigarettes, young adults have consistently conceptualized e-cigarettes as safer alternatives to combustible cigarettes (Harrell et al., 2015; Hershberger et al., 2017; Soule, Rosas, & Nasim, 2016). This study will employ six measures

that have been adapted from previous scales to assess health effects of using e-cigarettes. All the outcome expectancy measures used in this study were measured on a 7-point Likert scale and begin with the stem "If I were to use an e-cigarette or other vaping device, I would…" (see Table 3). Health-related items included outcomes related to concern for health, questions about content of e-cigarette liquid, as well as potential for addiction or damage to the respondents' lungs and are adapted from previous scales (Barker et al., 2018; Morean et al., 2019; Pokhrel et al., 2018).

Social outcomes related to e-cigarettes have typically been studied in terms of how socially acceptable young adults believe products are and, by extension, product users. Young adults have expressed beliefs that e-cigarettes are able to be used more discretely and with fewer negative social stigma-related outcomes compared to combustible cigarettes (Pokhrel et al., 2015; Soule et al., 2016). Appearing socially desirable to others has also been linked with increased likelihood of usage in young adults (Pokhrel et al., 2018). Social desirability of e-cigarettes has been associated with beliefs about the inherent "coolness" of e-cigarette devices (Kong et al., 2014) or the ability to replicate popular "vape tricks" such as blowing large clouds of vapor or vapor rings (Morean et al., 2019; Pepper et al., 2017). In order to account for the potential that social perceptions may influence the interpretation of persuasive messages against vaping as well as to best correspond with personal network name generators that elicit discussion network alters with whom respondents spend informal time, this study employed 10 social outcome expectancies adapted from previously validated scales (Barker et al., 2018; Morean et al., 2019; Pokhrel et al., 2018). These items assessed respondents' perceptions of the relative social desirability of vapers or vape behaviors, the potential for concerns about smoking-related stigma, and the ability to vape discretely compared to combustible cigarettes.

The last expectancy dimension this study examined were perceptions of the likely personal experience of using an e-cigarette or vaping device. This dimension was included to account for the outsized influence this dimension has demonstrated in previous research examining the links between outcome expectancies and e-cigarette behaviors (Barker et al., 2018; Gibson et al., 2018; Morean et al., 2019). One of the most consistent findings in outcome expectancy research is that perceptions of pleasant personal experiences related to a behavior are indicative of an increased likelihood of engaging in that behavior. For e-cigarettes, beliefs about the aromas, tastes, and sensations that result from usage have all been influential in predicting e-cigarette usage (Creamer, Delk, Case, Perry, & Harrell, 2018; Morean et al., 2019; Morean & L'Insalata, 2017; Pokhrel et al., 2018; Pokhrel et al., 2014). Because of this consistent explanatory power, it is reasonable to assume that beliefs about personal experiences of e-cigarette use may influence baseline attitudes toward the behavior and also be associated with past use of e-cigarettes. Considering the importance of baseline beliefs about a product in determining reception to a persuasive message about that product, this study employed eight items assessing personal experience outcomes related to e-cigarette use. These included sensations associated with vaping (e.g., feeling less stressed) and expected enjoyment of aromas or tastes of e-liquids.

Table 3: Outcome expectancy dimensions and associated items

"If I were to use an e-cigarette or other vaping device, I would…"
Health
1. Worry about my health
2. Wonder what I was inhaling
3. Damage my lungs
4. Get addicted
5. Not get enough nicotine
6. End up using other tobacco products too
Social
7. Look more attractive
8. Feel more sophisticated
9. Fit in better with friends
10. Be able to hide my use from others (e.g., parents)
11. Be able to create vapor clouds that look cool/appealing
12. Be able to do vape tricks (e.g., blowing vapor clouds or shapes like rings)
13. Look awkward
14. Look unpleasant
15. Look like I was smoking cigarettes
16. Look like I was trying to quit smoking
Personal experience
17. Feel less stressed
18. Feel good physically
19. Like the feeling of inhaling vapor into my mouth
20. Like the feeling of creating vapor clouds
21. Like the flavor of the vapor
22. Like the smell of the vapor
23. Smell bad
24. Have bad breath

3.4 Social norms and tobacco variables

Message testing for anti-tobacco campaigns has consistently employed theories of reasoned action as a theoretical basis (Davis et al., 2017; Davis et al., 2013; Farrelly, Davis, Haviland, Messeri, & Healton, 2005; Fishbein et al., 2002). Within this framework, intentions to

use a tobacco product or tobacco use are commonly employed outcomes (Brennan et al., 2013; Chauhan & Sharma, 2017; Duke et al., 2016; Rhodes et al., 2008). Behavioral models from this theoretical tradition also commonly examine the role that descriptive or injunctive norms play in predicting these outcomes. Descriptive norms in tobacco research are commonly assessed by examining the number of friends or family members that a respondent indicates use a particular tobacco product (e.g., Joung et al., 2016). A recent meta-analysis of the role of descriptive normative influence on tobacco initiation and cessation indicates that items with more detailed referents (e.g., asking respondents to list the proportion of close friends who use e-cigarettes instead of just asking the proportion of all friends) elicit greater predictive validity in modeling social influence (J. Liu et al., 2017). Liu and colleagues (2017) propose that studies may increase the predictive validity of descriptive norm measures by employing social network metrics (p. 21). Considering the importance of descriptive norms in determining tobacco use, their relevance to theories of reasoned action, and recent calls for network metrics to be employed to improve their measurement, this study operationalized descriptive norms through detailed examination of relevant discussion networks as mentioned above.

Injunctive norms are often operationalized as a respondents' perceptions of how close friends or family members would react if they knew the respondent were using tobacco products (e.g., Liu et al., 2017). Theories of reasoned action commonly utilize injunctive norms to assess the amount of social pressure there is to perform or not perform a behavior and consider them to be a second dimension of social norms that can be assessed alongside descriptive norms (Conner & Mcmillan, 1999; McMillan & Conner, 2003). Despite mixed results for the validity of employing peer injunctive norms to predict tobacco use (Kam, Matsunaga, Hecht, & Ndiaye, 2009; McMillan & Conner, 2003), McMillan and Conner (2003) theorize that the differential

effects may be a substance-dependent (e.g., more predictive of marijuana use than tobacco use) or a result of social group identity. Additionally, when asked to provide specific alters who may approve or disapprove of a behavior, adolescent peer injunctive norms have been significantly associated with tobacco use intentions (Zaleski & Aloise-Young, 2013). Considering the theoretical importance of peer approval of a behavior as well as the dearth of research investigating young adult e-cigarette outcomes and injunctive norms, this study assessed them in two ways. First, the study employed two 7-point Likert scales in two items adapted from Gibson and colleagues (2018) that ask respondents how upset they believe their parents or close friends would be if they knew the respondent were using e-cigarettes. Second, this study built off of Zaleski and Aloise-Young's (2013) findings as well as the recommendations posed by Liu and colleagues (2017) for improving descriptive norm measurement and adapt Gibson and colleagues (2018) injunctive measure to describe via a 7-point Likert scale the extent to which each alter listed by each respondent would be upset if they knew the respondent were using e-cigarettes.

Four key tobacco-related variables were assessed in this study: susceptibility to use, tobacco product use including e-cigarettes, quit intentions, and risk beliefs about e-cigarette use including comparative harm of e-cigarettes versus traditional cigarettes. Susceptibility to use a tobacco product is often employed in tobacco research to segment audience members who may not have used a tobacco product, but may be more amenable to future use than others. Typically, susceptible individuals are more likely to become tobacco users than non-susceptible individuals (Trinidad et al., 2017). Previous health messaging research on *Real Cost* advertisements among young adults suggests that individuals who are susceptible to become combustible cigarette smokers assess anti-smoking advertisements more favorably than cigarette smokers, but not as favorably as non-susceptible non-smokers (Hall et al., 2019). Considering the importance for

future initiation and the potential effect susceptibility status may have on perceptions of anti-vaping advertisements, this study operationalized susceptibility by employing a one-item indicator adapted from previous research (G. C. Huang, Soto, et al., 2014; Pu & Zhang, 2017) in which respondents will indicate on a 7-point Likert scale (Extremely likely-Extremely unlikely) how likely they are to use e-cigarettes in the next 6 months.

One of the more consistent findings in measuring PME has been that individuals who use tobacco products tend to rate anti-tobacco messages less favorably than those who do not (e.g., Hall et al., 2019). In order to account for the role tobacco behaviors may play in existing outcome expectancies as well as assessments of anti-vaping messages, this study examined *tobacco ever use* by having individuals indicate which of a number of tobacco products including e-cigarettes they have ever used as well as *current tobacco use* which was operationalized by having respondents indicate which products they have used in the past 30 days. Current users were also asked to provide the frequency with which they used tobacco products by indicating the number of days out of the last 30 they used each tobacco product.

Respondents who indicated that they use e-cigarettes were also asked about their e-cigarette quit intentions. Positive changes in quit intentions are one of the more common outcomes of interest in gauging the actual effectiveness of a tobacco campaign (Bigsby et al., 2013; Brennan et al., 2013; Noar, Barker, Bell, et al., 2018). Within reasoned action frameworks, increased intentions to quit are theorized to indicate greater likelihood of quitting that behavior in the future (Fishbein & Ajzen, 2011; Fishbein & Cappella, 2006). This study employed an adaptation of a three-item quit intentions measure previously used to assess the effectiveness of anti-smoking campaigns (Bigsby et al., 2013). Respondents assessed on a 7-point Likert scale (Extremely likely - Extremely unlikely) how likely they are in the next three

months to quit using e-cigarettes completely, reduce the amount they vape in a day, or talk to someone they are close with (e.g., friend or family member) about quitting e-cigarettes.

The final tobacco-related variable this study utilized was respondents' perceptions of harm for e-cigarettes as well as relative harms compared to traditional cigarettes. Risk beliefs about e-cigarette use will be measured by eight items adapted from previous research into e-cigarette risk beliefs as well as young adults' tobacco risk beliefs (Brennan, Gibson, Kybert-Momjian, Liu, & Hornik, 2017; Crosby et al., 2018). These risk items assessed the extent to which respondents believe using e-cigarettes will harm their health ("damage my body"), lead to addiction ("will become addicted to vaping"), or lead to ingestion of toxic chemicals ("will inhale poisons"). As discussed in the literature review chapter, these items were included in order to examine whether exposure to messages in a brief intervention and were chosen to correspond closely with the *a priori* determined themes of the *Real Cost* advertisements. While similar in structure to a number of OE tested before exposure, the correspondence with the aims of the message differentiates these items.

Young adults have consistently indicated that e-cigarettes are less harmful to an individual's health than traditional cigarettes. However, one of the stated concerns about deploying *Real Cost* advertisements nationally has been fear that they may shift the concerns of young adults such that e-cigarettes would be seen as similarly harmful as combustible cigarettes, thus lowering the number of young adults who may transition from combustible cigarettes to e-cigarettes (Crosby et al.). In order to provide data about the potential effects on perceptions of relative harms viewing anti-vaping advertisements may have on young adults, this study asked respondents to assess on a 7-point Likert scale (Much less harmful – Much more harmful) how harmful e-cigarettes are compared to combustible cigarettes.

3.5 Reactance

Although this study was particularly concerned with determining how an individual's personal networks and baseline beliefs about e-cigarettes are associated with his or her assessments of an advertisement's likely effectiveness (PME), it is also theoretically and empirically viable to assess the extent to which these factors may influence negative reactance to anti-vaping messages. In order to assess this possibility, this study incorporated a brief negative reactance measure that has been previously validated to examine reactance in anti-vaping messages among young adults (Hall et al., 2019; Hall et al., 2017).

3.6 Perceived message effectiveness

Finally, this study examined respondent perceptions of the likely effectiveness of anti-vaping messages by utilizing a scale adapted from two separately validated PME measures (Baig et al., 2018; Davis et al., 2013). As has been discussed in the previous chapter, there is an ongoing scholarly debate about the dimensionality of PME with some scholars arguing for a unidimensional concept (Dillard & Ye, 2008) while others have suggested multidimensional theoretical constructs (Noar et al., 2010; Yzer et al., 2015). While these debates have been assessed in anti-tobacco literatures before, the existing literature showing demonstrating conceptualizations of the dangers and social utility of e-cigarettes suggests the need to examine dimensionality of PME in relation to e-cigarettes. As PME is situated in attitude towards the ad (Shimp, 1981) and functional attitude theories (D. Katz, 1960), the presence of differential attitudes toward e-cigarette use compared to combustible cigarette use may manifest itself in distinct PME dimensionality.

In order to account for this potential, this study employed a 6-item *message perceptions* scale (Davis et al., 2013) that has been widely used to test messages for previous *Real Cost* campaigns (e.g., Zhao et al., 2016) as well as a recently developed 3-item *message effects* scale (Baig et al., 2018) that has been validated for examining anti-tobacco advertisement reception among adults. The *message perceptions* scale used in this study is derived from an anti-tobacco messaging study that has proven to be one of the most influential studies in the literature in terms of conceptualizing PME (Barker, Noar, Bell, Saffer, & Morehouse, 2019) and has demonstrated validity in longitudinally predicting key changes in tobacco behavioral outcomes (Davis et al., 2017; Noar, Barker, Bell, et al., 2018). The *message perceptions* scale utilized in this study has been previously analyzed to examine a unidimensional construct (Davis et al., 2013), although evidence from comparative testing against the *message effects* scale this study employed suggests the potential for multiple dimensions (Baig et al., 2018). The scale utilized a 7-point Likert scale (Strongly disagree – Strongly agree) and asks respondents to provide information about the message such as the extent to which an advertisement grabs their attention, is informative, or is powerful (see Table 4). Utilizing the *message perceptions* scale in this study allowed for the collection of respondent perceptions using an instrument that has guided multiple FDA anti-smoking campaigns and has been highly influential in guiding the existing PME literature. This study sought to provide further empirical evidence about the utility of this measure in predicting short-term changes in intentions or susceptibility as well as contribute to the scant literature employing this measure to examine the effectiveness of anti-vaping messages (Duke et al., 2016).

Table 4: Perceived message effectiveness items

Items
Message perceptions (Davis et al., 2013) 1. This ad is worth remembering 2. This ad grabbed my attention 3. This ad is powerful 4. This ad is informative 5. This ad is meaningful 6. This ad is convincing **Message effects** (Baig et al., 2018) 1. This message discourages me from wanting to use e-cigarettes 2. This message makes me concerned about the health effects of vaping 3. This message makes vaping seem unpleasant to me

This study supplemented the *message perceptions* PME scale with a 3-item *message effects* measured on a 7-point Likert scale (Strongly disagree – Strongly agree). There are two key reasons why this study used an *effects*-based measurement to assess PME as well as a *perceptions*-based measure: 1.) evidence suggesting potentially greater explanatory power in predicting intentions and behavioral change from effects-based measures; and 2.) satisfying theoretical assertions about the need for referents and correspondence between the construction of PME measures and the overall purpose of the persuasive message they are used to evaluate. While there are few studies that have extensively explored multidimensional PME constructs, evidence from Australian assessments of a multi-dimensional PME scale suggest the utility of including message effects measures. In a 2013 study examining Australian adult assessments of anti-smoking advertisements Brennan and colleagues utilized a six-item PME measure that was eventually split into separate scales measuring message perceptions (ad-based perceived effectiveness [ADPE]) and perceptions of message effects (personalized perceived effectiveness [PPE]). In a pre-post exposure experiment, perceptions of message effects [PPE] significantly outperformed message perception items [ADPE] and were the only items that predicted changes

in quit intentions. Additionally, when contacted for a follow-up telephone interview three weeks after exposure, higher PPE scores were the only scale to predict changes in smoking behavior (Brennan et al., 2013). In addition to these findings, recent research suggests that message effects measures may provide greater conceptual clarity to respondents which manifests as greater explained variance and lower cognitive burden to respondents (Baig et al., 2018).

The adapted UNC *message effects* scale was employed in this study to more closely adhere to theoretical best practices in constructing PME scales. The use of personal referents in PME scales is an important consideration as it increases the likelihood that respondents will consider themselves the focal point of a PME item (Yzer et al., 2015). This increased correspondence increases item validity by reducing the potential for social distance effects to bias responses by asking individuals to project their personal assessments to other people (Perloff, 2009). While widely used to assess FDA campaigns, the Davis *message perceptions* scale includes only a single first-person referent within the six-item scale ("This ad grabbed my attention"). Finally, this study employed an adaptation of the UNC *message effects* scale in order to provide greater correspondence between the stimulus message's general purpose and the measurement instrument. As described in the previous chapter, researchers have called for the inclusion of both *perceptions* and *effects* items in PME measures (Dillard & Ye, 2008). Additionally, *effects* items have been theorized to be most valid when they directly address the specific aims of the advertisements that they are being employed to assess (Yzer et al., 2015). The three items adapted from the UNC *message effects* address both of these suggestions, adding key effects assessments (e.g., discouragement from wanting to use e-cigarettes) as well as items that speak to the specific aims of the messages that were tested (e.g., making e-cigarettes seem unhealthy or vaping seem unpleasant).

In conclusion, the measurements that were chosen for this study are constructed from previously validated scales addressing tobacco behaviors, beliefs, assessments of anti-tobacco persuasive messages, or personal network studies. They have been rigorously tested in previous large-scale studies and have been theoretically situated to efficiently provide empirical data that will fill in key gaps in scholarly understanding of how personal networks influence existing beliefs about e-cigarettes and, in turn, reception of anti-vaping advertisements. Each instrument has been chosen and adapted to achieve the greatest correspondence between the items within the scale as well as theoretical correspondence across data collection instrumentation. The next section will describe how the data gathered in this study is to be transformed and analyzed in order to answer the specific research questions and hypotheses stated in the previous chapter.

3.7 Data analysis

PME Descriptives

Descriptive statistics, correlations, and t-tests were computed on PME subscales and reported. Means, standard deviations, correlations, between PME subscales and respondent e-cigarette use are reported in the next chapter. Independent *t*-tests assessing differences in PME subscales for e-cigarette users and never-users are also reported. Means, standard deviations and correlations for *Real Cost* and Control stimuli and PME subscales are reported as well as independent *t*-tests assessing differences in PME subscales between stimulus groups.

H1: *Analysis of respondent PME of anti-vaping messages will yield a two-factor measure including perceptions and effects dimensions.*

In order to test this hypothesis, this study initially performed a confirmatory factor analysis on the nine items included in the PME scale. This hypothesis is based upon previous research that has indicated two dimensions within various PME scales (e.g., Brennan et al.,

2014) and utilizes items from two scales that have been demonstrated to measure two dimensions. Considering these factors, this study began with a confirmatory factor analysis. Standardized factor loadings equal to or greater than .50 were considered meaningful. Internal consistency of factors were tested via standard Cronbach's alpha reliability (alpha > .70). Should the stated hypothesis be confirmed with two factors demonstrating both external and internal validity, the scales were summed and averaged to create *message perceptions* and *message effects* PME scales. Indicators of model fit included the root mean squared error of approximation (RMSEA; 0.05 or less), Comparative Fit Index, and Tucker-Lewis Index (TLI) (both $\geq$ 0.90) (Hu & Bentler, 1999).

H2: *Effects items will have greater validity in predicting change in respondent susceptibility and quit intentions than perceptions items*.

H3: *Higher PME of anti-vaping messages will be associated with more positive changes in quit intentions for e-cigarette users following exposure to anti-vaping advertisements.*

H4: *Higher PME of anti-vaping messages will be associated with more positive changes in susceptibility for e-cigarette non-users following exposure to anti-vaping advertisements.*

H5: *Higher PME of anti-vaping messages will be associated with more positive changes in beliefs about the inherent risks associated with e-cigarette use*

In order to test these hypotheses, this study employed an analytic strategy adapted from previous research into the role of PME in predicting tobacco related outcomes (Davis et al., 2013). Quit intentions were represented by a composite scale including the average of three items (7-point Likert scales) assessing how likely a respondent believes he or she is in the next three months to quit using e-cigarettes completely, reduce the amount he/she vapes in a day, or

talk to someone about quitting e-cigarettes. Susceptibility was measured with a single 7-point Likert scale asking how likely a respondent is to use an e-cigarette in the next six months. Both quit intentions as well as susceptibility were measured both pre- and post-exposure to anti-vaping advertisements. The dependent variable for both quit intentions and susceptibility was computed by subtracting the baseline score from the post-exposure score. Risk beliefs were measured by the average of an 8-item (7-point Likert scale) composite scale assessing the extent to which an individual believes e-cigarette use may harm his or her health, lead to nicotine addiction, or cause him or her to ingest harmful chemicals. The dimensionality of this scale wasbe assessed by a CFA assuming a one-factor structure and proceeding in the same method as described for PME above.

Three hierarchical models were employed to answer this hypothesis (*Effects/Perceptions* – Intentions, *Effects/Perceptions* – Susceptibility, *Effects/Perceptions* – Risk beliefs). Hierarchical regression analyses have been noted to be an appropriate analytic method when seeking to examine how the introduction of additional variables incrementally changes the validity of a model (Gelman & Hill, 2006). Hierarchical regression models are also noted as an appropriate choice over stepwise regression models when the inclusion of variables at each step is guided by theoretical knowledge or builds off of previous empirical research (Lewis, 2007). As this study sought to examine the independent contributions of *effects* and *perceptions* PME items on explaining variance in changes of quit intentions (users) and susceptibility (non-users) following exposure to advertisements, hierarchical regression models were an appropriate choice. Each model included demographics at the first step (age, race/ethnicity, income, education, gender, marital status), previous tobacco use for the second step, *effects* PME score at the third step, and *perceptions* PME for the fourth (see Table 3).

H6: *PME of anti-vaping messages will be negatively correlated with negative reactance to anti-vaping messages*.

Reactance was measured by a 3-item (7-point Likert scale) composite scale assessing the extent to which an individual believes a message is "overblown," "attempting to manipulate [him/her]," or "annoying." Pearson's correlation test was examined to test the correlation between individual's negative reactance to anti-vaping messages and their PME scores for both *effects* and *perceptions* PME scales.

H7: *Higher sensation value messages (Real Cost ads) will be perceived as more effective than lower sensation value messages (Control)*.

To test this hypothesis, the aggregate PME scores for both *effects* and *perceptions* PME scales for *Real Cost* and *Control* messages was calculated. A series of *t*-tests tests then assessed mean differences of each scale between the messages. *T*-tests were conducted with the entire sample, only e-cigarette users, and only non-users to determine whether significant differences in effects are present for the aggregate sample as well as by e-cigarette use status.

Outcome Expectancy [OE] Descriptives

Descriptive statistics, correlations, and t-tests were computed on outcome expectancy subscales. Means, standard deviations, correlations, between OE dimensions and respondent e-cigarette use are reported in the next chapter. Independent-samples t-tests examined differences between e-cigarette users and never-users for each outcome expectancy dimension.

H8: *More positive outcome expectancies will be associated with greater intention to use e-cigarettes at baseline.*

Outcome expectancy measures were validated through initial EFA. The literature on young adult e-cigarette outcome expectancies is more extensive than anti-vaping message PME and the items used to measure OE in this study have been adapted from scales measuring similar dimensions related to vaping OE. Despite this, the large number of items included in this section and the potential for different conceptualizations of outcomes between this study's sample and previous studies' makes EFA an appropriate first step for dimension reduction (Brown, 2014). First, an EFA was conducted on OE responses from 50% of the respondents using a promax oblique rotation method. Factor selection was guided by the *Kaiser-Guttman rule* in which only dimensions that achieve eigenvalues greater than 1.0 were retained (Brown, 2014). Individual items that have high loadings on more than one factor (cross-loading) or low loadings on all factors (low communality) were eliminated from further analysis (Brown, 2014). Indicators of model fit included the root mean squared error of approximation (RMSEA; 0.05 or less), Comparative Fit Index, and Tucker-Lewis Index (TLI) (both $\geq$ 0.90) (Hu & Bentler, 1999).

Following previous research example (Pokhrel et al., 2014), items comprising dimensions retained from the EFA were tested for construct validity via a confirmatory factor analysis among the remaining 50% of respondents. Standardized factor loadings equal to or greater than .50 were considered meaningful. Internal consistency of factors were tested via standard Cronbach's alpha reliability (alpha > .70). The factors that demonstrated both external and internal validity were converted into scales. Those scales were summed and averaged to create *health concerns, social attraction, social aversion* and *personal experience* dimension scales.

Block-wise linear regression models assessed the relationship between baseline outcome expectancies and non-users' susceptibility to use e-cigarettes at baseline. This study utilized a similar block structure as that described for PME testing, with demographics and previous

tobacco use as the first two blocks, followed by each of the four OE dimensions in their own block.

H9: *More positive outcome expectancies will be associated with greater likelihood of e-cigarette use.*

OE dimensions were also employed to examine the association between e-cigarette OE dimensions and e-cigarette use. E-cigarette use will be assessed through a single item asking the number of days in the last month each respondent has used e-cigarettes. Respondents who are not users will be indicated by a "0." Dummy variables were created for low users (1 SD below the mean number of days among users), heavy users (1 SD above the mean number of days among users) and moderate users (those who fall between the number of days for low and heavy users). Thus, e-cigarette use was assessed via a constructed scale from 0 (non-users) to 3 (heavy users). A block-wise ordinal logistic regression was used to examine the extent to which individual outcome expectancy dimensions as well as cumulative outcome expectancies about e-cigarettes are associated with e-cigarette use. Respondent demographics and previous use of tobacco products other than e-cigarettes were included as controls before each OE dimension was added in its own block.

H10**:** *More positive outcome expectancies will be associated with lower PME of anti-vaping messages.*

All OE dimensions were included in two block-wise linear regression models testing the association between baseline outcome expectancies and respondent perceptions of anti-vaping advertisements. This method allowed the study to examine how baseline expectancies about health, social, and personal experience outcomes incrementally impact both *perceptions* and

effects PME items. The first block for each model included demographics as controls, followed by previous tobacco use in the second block, and finally each OE dimension in its own block.

H11: More positive outcome expectancies will be associated with lower changes in intentions to quit, changes in susceptibility for, and more negative risk beliefs about using e-cigarettes following exposure to anti-vaping messages.

This hypothesis was tested in a similar method to that which was discussed for Hypothesis 5. Three block-wise linear regression models were employed to answer this hypothesis. The first block for each model included demographics as controls, followed by followed by previous tobacco use in the second block, and finally each OE dimension in its own block.

H12: More positive outcome expectancies will be associated with more positive injunctive norms regarding e-cigarette use.

Based on previous research that has examined the ways in which variables associated with theories of reasoned action may be intercorrelated, this study examined correlations between retained outcome expectancy dimensions and injunctive norms (J. R. Smith et al., 2008). Injunctive norms were assessed via two measures:

1. A composite score averaging the extent that respondents believe that their 1.) friends and 2.) family would be disappointed if they knew the respondent used e-cigarettes (potential scores 1 – 7).
2. A composite score averaging the extent that respondents believe each alter provided in their social interactions and health discussion networks would be disappointed if they knew the respondent used e-cigarettes (potential scores 1 – 5).

Correlations between the two measures of injunctive norms and e-cigarette use are reported in the next chapter. Independent-samples *t*-tests examined differences between e-cigarette users and never-users for each injunctive norm measure. Correlations between each injunctive norm measure and outcome expectancy dimensions are also reported.

H12: More positive outcome expectancies will be associated with more positive descriptive norms regarding e-cigarette use.

In addition to assessing the associations between outcome expectancy dimensions and injunctive norms, this study sought to assess how outcome expectancies related to e-cigarette use are associated with descriptive norms, or pressure from the cumulative presence of e-cigarette users in the respondents' social environment. Descriptive norms were assessed through three measures:

1. A composite score averaging the number of friends/family respondents believe use e-cigarettes or other vaping devices (potential scores 1 – 7).
2. The proportion of alters in an ego's health discussion network who ego indicates use e-cigarettes or other vaping devices.
3. The proportion of alters in an ego's social interactions network who ego indicates use e-cigarettes or other vaping devices.

Correlations between the three measures of descriptive norms and e-cigarette use are reported. Independent-samples *t*-tests examined differences between e-cigarette users and never-users for each descriptive norm measure. Correlations between each descriptive norm measure and outcome expectancy dimensions are also reported.

Ego Network Descriptives

Descriptive statistics, correlations, and *t*-tests were computed on compositional and structural egocentric network variables (social interaction and health discussion networks). Means, standard deviations, and correlations between compositional (e.g., support, closeness, proportion of tobacco users) and structural (e.g., network size, network density) variables for social interaction and health discussion networks and e-cigarette are reported in the following chapter. Independent-samples *t*-tests examined differences across compositional and structural variables between discussion networks as well as differences between e-cigarette users and non-users for these variables. Independent samples *t*-tests also examined differences between discussion networks and outcome expectancy dimensions.

RQ1: How are the *compositional* (e.g., proportion of e-cigarette or tobacco users) and *structural* characteristics (e.g., network size or density) of an ego's health and social support discussion networks associated with ego's outcome expectancies regarding e-cigarette use?

This study included eight block-wise regression models to answer this research question. These models assessed the differential association of health discussion and social interaction network *compositional* and *structural* variables with each of the four baseline e-cigarette outcome expectancies. The first block included in the regression included the demographic variables and each ego's previous tobacco usage. The second block included *compositional* variables associated with the discussion network (e.g., support functions, closeness) and *structural* variables (e.g., network density). This analysis allowed the study to examine the associations that both *structural* and *compositional* dimensions of an ego's network have on different outcome expectancy dimensions (e.g., health concerns OEs or social aversion OEs).

***RQ2**:* How are the *compositional* and *structural* characteristics of an ego's health and social interaction discussion networks associated with ego's e-cigarette behavioral intentions?

This study included four hierarchical regression models to answer this research question. The first two models assessed the differential association of health and social interaction discussion network *compositional* and *structural* variables with baseline e-cigarette susceptibility for non-users while the second will examine the same variables and the same discussion networks' association with baseline e-cigarette quit intentions for e-cigarette users. The same control variables and block sections as were used to answer the first research question were used to assess this and subsequent research questions. This analysis allowed the study to determine the extent to which the *composition* and *structure* of an ego's discussion networks were associated with baseline intentions to quit using e-cigarettes (users) or susceptibility to use e-cigarettes in the near future (non-users).

***RQ3**:* How are the *compositional* and *structural* characteristics of an ego's health and social interaction discussion networks associated with ego's e-cigarette use?

This study included two ordinal logistic regression models to answer this research question. The two models asessed the differential association of health and social interaction discussion network *compositional* and *structural* variables with ego's e-cigarette use. As the dependent variable in this analysis is categorical, this test allowed the study to examine in more granular detail the association between different network components and the frequency with which individuals use e-cigarettes. Thus, the study was able to examine whether different network structures or compositions were likely to influence greater usage of e-cigarettes rather than binary use/non-use.

RQ4: How do the *compositional* and *structural* characteristics of an ego's health and social support discussion networks relate to ego's perceived effectiveness of anti-vaping advertisements?

This study included four block-wise regression models to answer this research question. The four models assessed the differential association of health and social interaction discussion network *compositional* and *structural* variables with ego's perceived message effectiveness of anti-vaping advertisements. Through these analyses, the study was able to assess not only the associations between personal discussion networks and baseline attitudes, susceptibility, and quit intentions regarding e-cigarettes, but also associations between the *structure* and *composition* of these networks and how egos evaluated anti-vaping advertisements. Furthermore, by separating the analyses by PME factor, this study was able to determine whether *perceptions* or *effects* PME measures are more associated with network-level variables.

The previous section has laid out the analytical strategy for this study and provided context for the variables and analyses run to answer the study's hypotheses and research questions. The following chapter will present and briefly discuss the results that these analyses produced.

CHAPTER 4: RESULTS

H1: *Analysis of respondent PME of anti-vaping messages will yield a two-factor measure including perceptions and effects dimensions.*

To test H1, a confirmatory factor analysis was performed on the nine items included in the PME scale. This test was included to confirm the presence of separate *effects* and *perceptions* dimensions of PME. As discussed in the literature review and the previous chapter, *effects* measures were adapted from the UNC e-cigarette scale (see Baig et al., 2018) and focused on the direct impacts of the message on e-cigarette behaviors or beliefs. The *perceptions* scale was adapted from a widely used anti-tobacco PME measure (see Davis et al., 2013) and focused on individual's perceptions of the advertisement such as how memorable it was or how much it garnered their attention. A two-factor model fit the data (CFI = .99, TLI = .99, RMSEA = .06). Root mean square error of approximation for this model was slightly above than ideal limits, but still met acceptable limits for good model fit (Hu & Bentler, 1999). All items included in the model demonstrated acceptable standardized factor loadings (all items $\geq$ .77).

Following confirmation of a two-factor model fit, items were tested for alpha reliability. The six items in the message perceptions model (M = 4.91, SD = 1.75) demonstrated strong alpha reliability (α= .93), as did the three items in the message effects model (M = 4.94, SD = 1.55, α= .89). Considering these results, the data supported a two-dimensional PME structure including message perceptions and message effects dimensions (see Table 5). The items included

in these dimensions were averaged to form distinct scales and will be referred two as either message perceptions or message effects scales henceforth in the discussion of the study's results. These results support H1 and confirm the presence of distinct dimensions of PME used in this study, thus allowing the study to compare whether message effects or message perception PME questions are more associated with baseline e-cigarette beliefs and quit intentions as well as whether either dimension is more useful in predicting post-exposure changes to quit intentions or respondent susceptibility.

Table 5 : PME dimensional scales

Message Perceptions (α = .93)	**Message Effects (α = .89)**
These messages…	**These messages…**
Are worth remembering (.85)	Discourage me from wanting to use e-cigarettes (.86)
Grabbed my attention (.79)	Make me concerned about the health effects of vaping (.88)
Are powerful (.86)	Make vaping seem unpleasant to me (.83)
Are informative (.77)	
Are meaningful (.84)	
Are convincing (.85)	

Note. Numbers by items indicate dimensional factor loadings.

H2: *Effects items will have greater validity in predicting change in respondent susceptibility and quit intentions than perceptions items*.

In order to test this hypothesis, an analytic strategy was adapted from previous research into the role of PME in predicting tobacco related outcomes (Davis et al., 2013). Quit intentions were represented by a composite scale including the average of three items (7-point Likert scales) assessing how likely a respondent believes he or she is to quit using e-cigarettes completely in the next three months, reduce the amount he/she vapes in a day, or talk to someone

about quitting e-cigarettes (M = 4.06, SD = 1.95, α = .76). Susceptibility was measured with a single 7-point Likert scale asking how likely a respondent is to use an e-cigarette in the next six months (M = 1.96, SD = 1.67). Quit intentions and susceptibility were measured both pre- and post-exposure to anti-vaping advertisements. The dependent variable for both quit intentions (M = -.19, SD = 1.57, n = 1,003) and susceptibility (M = -.03, SD = 1.18, n = 1,342) were computed by subtracting the baseline score from the post-exposure score.

Multivariate block-wise linear regression assessed the changes in young adult susceptibility after exposure to anti-vaping messages (See Table 6). As the variable used to describe susceptibility measured how likely an individual was to use e-cigarettes, lower scores and negative ß were more positive results in these results. Four models were employed: 1) respondent demographics, education, and HHI; 2) respondent tobacco use history; 3) respondent *effects* PME scores and 4) respondent *perceptions* PME scores. Overall, the models failed to find consistent, significant associations between higher respondent *effects* or *perceptions* PME scales and pre-post changes in susceptibility. Respondent demographics, socioeconomic status and HHI also failed to predict any significant changes. Curiously, in the second model for respondent tobacco use history the strongest negative predictor was if the respondent had ever used a cigar product (ß = .29, $p < .01$). In the third model, higher *effects* PME scores were a weak predictor of positive susceptibility change (ß = -.05, $p < .05$). However, this predictor was not significant in the final model that included *perceptions* scores. Additionally, none of the four models employed were significant overall.

Table 6: Block-wise linear regression predicting change in susceptibility; *n*=1,330

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	.02 (-.01- .05)	.02 (-.02 - .05)	.01 (-.02 - .05)	.01 (-.02 - .04)
Sex				
Male	REF	REF	REF	REF
Female	-.05 (-.18 - .08)	-.02 (-.16 - .11)	-.00 (-.04 - .13)	-.00 (-.14 - .13)
Trans/Other	.19 (-.20 - .59)	.25 (-.15, .64)	.25 (-.15 - .64)	.25 (-.15 - .64)
Race				
White	REF	REF	REF	REF
Black	-.12 (-.29 - .06)	-.14 (-.31 - .04)	-.13 (-.31 - .05)	-.12 (-.30 - .06)
Asian	.07 (.02-1.42)	.08 (-.17 - .32)	.07 (-.18 - .32)	.07 (-.18 - .32)
Mixed Race/Other	.26 (.04-1.42)	.05 (-.16 - .27)	.05 (-.17 - .26)	.05 (-.17 - .26)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.11 (-.08 - .29)	.11 (-.07 - .30)	.11 (-.07 - .29)	.11 (-.08 - .29)
SES				
Education	-.05 (-.13 - .03)	-.06 (-.13 - .02)	-.05 (-.13 - .03)	-.05 (-.13 - .03)
Family HHI	-.01 (-.04 - .03)	-.01 (-.04 - .02)	-.01 (-.04 - .02)	-.01 (-.04 - .03)
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	-.09 (-.26 - .08)	-.10 (-.27 - .07)	-.10 (-.27 - .07)
Smokeless (Ever)	-	-.12 (-.39 - .15)	-.11 (-.38 - .15)	-.11 (-.38 - .16)
Vape (Ever)		-.12 (-.29 - .04)	-.15 (-.32 - .01)	-.15 (-.32 - .01)
Cigar (Ever)	-	.30** (.09 - .51)	.29** (.08 - .50)	.29** (.08 - .50)
Hookah (Ever)	-	-.06 (-.25 - .12)	-.07 (-.25 - .12)	-.07 (-.25 - .12)
Other Tobacco (Ever)	-	-.05 (-.38 - .28)	-.05 (-.38 - .27)	-.05 (-.38 - .27)
Block 3: Ego Effects PME				
PME Effects Scale	-	-	-.05* (-.09 - -.01)	-.03 (-.10 - .04)
Block 4: Ego Perceptions Scale				
PME Perceptions Scale	-	-	-	-.03 (-.10-.04)
Model R^2	.01	.02	.02	.02
ΔR^2	-	.01	.00*	.00
Model F	1.04	1.33	1.59	1.54

Note: *p<.05, **p<.01, ***p<.001.

An additional multivariable block-wise linear regression was employed to measure changes in young adult quit intentions following exposure to anti-vaping messages (see Table 7). This regression also used four models in the same order as those used to predict changes in young adult susceptibility. The final two regression equations were found to be significant with an R^2 of .03, $F(16, 984) = 1.97$, $p < .05$. Though significant, the model indicates weak predictive changes in quit intentions. Respondent education was a consistent, negative predictor of quit intention change (ß = -.18, $p < .01$) where those with higher levels of education had greater

change in quite intention. Ever use of cigar products was again the only significant tobacco use history predictor (ß = -.28, $p < .05$). Although the final model achieved significance, neither *effects* nor *perceptions* scores were predictive of changes in quit intentions. However, when *perceptions* items were not included in the model, *effects* scores were significant and positively associated with changes in quit intentions (ß = .08, $p < .01$).

Table 7: Block-wise linear regression predicting change in quit intentions; *n*=1,001

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	.03 (-.01- .08)	.02 (-.03- .07)	.03 (-.01- .08)	.02 (-.03- .06)
Sex				
Male	REF	REF	REF	REF
Female	-.00 (-.20 - .20)	-.02 (-.23 - .19)	-.00 (-.20 - .20)	-.02 (-.23 - .19)
Trans/Other	.26 (-.49 – 1.01)	.21 (-.54 – .97)	.26 (-.49 – 1.01)	.20 (-.55 – .95)
Race				
White	REF	REF	REF	REF
Black	.13 (-.22 - .48)	.16 (-.19 - .51)	.13 (-.22 - .48)	.11 (-.24 - .46)
Asian	-.01 (-.44 - .42)	-.06 (-.50 - .37)	-.01 (-.44 - .42)	-.08 (-.51 - .35)
Mixed Race/Other	.12 (-.21 - .44)	.12 (-.21 - .44)	.12 (-.21 - .44)	.12 (-.20 - .44)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	-.16 (-.46 - .14)	-.17 (-.46 - .13)	-.19 (-.49 - .10)	-.20 (-.49 - .10)
SES				
Education	-.17* (-.30 - -.03)	-.17* (-.30 - -.03)	-.18** (-.32 - -.05)	-.18** (-.32 - -.05)
Family HHI	-.01 (-.05 - .04)	-.01 (-.05 - .04)	-.01 (-.06 - .03)	-.01 (-.06 - .03)
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	.17 (-.06 - .40)	.19 (-.04 - .42)	.19 (-.04 - .41)
Smokeless (Ever)	-	.23 (-.02 - .48)	.23 (-.02 - .48)	.23 (-.02 - .48)
Cigar (Ever)	-	-.30* (-.53 - -.06)	-.28* (-.51 - -.05)	-.28* (-.51 - -.05)
Hookah (Ever)	-	.20 (-.02 - .41)	.20 (-.02 - .41)	.20 (-.02 - .41)
Other Tobacco (Ever)	-	-.09 (-.43 - .26)	-.10 (-.44 - .24)	-.10 (-.44 - .24)
Block 3: Ego Effects PME				
PME Effects Scale	-	-	.08** (.03 - .14)	.03 (-.07 - .13)
Block 4: Ego Perceptions Scale				
PME Perceptions Scale	-	-	-	.06 (-.04-.18)
Model R^2	.01	.02	.03	.03
ΔR^2	-	.01*	.01**	.00
Model F	1.08	1.54	2.00*	1.97*

Note: *p<.05, **p<.01, ***p<.001.

Furthermore, the third model was more effective in predicting quit intentions with an R^2 of .03, $F(15, 985) = 2.00$, $p < .05$. These disparate results indicate a partial confirmation of H2. While neither *effects* nor *perceptions* measures were particularly useful in predicting changes in pre-post susceptibility change, *effects* measures were a significant contributor to a model predicting pre-post quit intentions that outperformed a model which included *perceptions* scores. The following hypotheses sought to examine whether higher PME scores were associated with positive changes in e-cigarette intentions following exposure to anti-vaping messages.

H3: *Higher PME of anti-vaping messages will be associated with more positive changes in quit intentions for e-cigarette users following exposure to anti-vaping advertisements.*

The results from the previously reported regression models indicate that higher scores for *effects* PME items were weakly, but significantly associated with positive changes in quit intentions for young adults. This result is presented with the caveat that *effects* items were only predictive of positive changes in quit intentions when *perceptions* measures were not included in the regression. Additionally, *perceptions* measures were not predictive in any model and the inclusion of these measures ultimately negatively contributed to the explanatory power of the final regression model ($\Delta R^2 = -.01$). These results offer partial confirmation of the hypothesis, such that message *effects* items were demonstrated limited predictive ability, while message *perceptions* items did not. Having established the limited utility found for assessing changes in quit intentions in a pre-post experimental design, the following hypothesis will examine whether higher PME scores were predictive of positive changes in non-user e-cigarette susceptibility.

H4: *Higher PME of anti-vaping messages will be associated with more positive changes in susceptibility for e-cigarette non-users following exposure to anti-vaping advertisements.*

Results from the previously reported multivariable block-wise regressions did not indicate significant utility for either *effects* or *perceptions* PME measures in predicting changes in young adult e-cigarette susceptibility. Despite the lack of significant models predicting these changes, *effects* measures were modesty predictive in Model 3 (ß = -.05, $p < .05$), but were not predictive once perceptions items were included in the model. It should be noted that overall, Model 3 was not significant. These results indicate that H3 must be rejected. Although disappointing, these results are not unexpected. The previous chapter described the conservative nature of a pre-post experimental condition utilizing only two 30-second advertisements to create meaningful differences in either quit intentions or susceptibility. The following hypothesis utilized a post-exposure assessment of risk beliefs about e-cigarettes to determine if there were meaningful associations between PME scores and beliefs about the risks regarding e-cigarette use individuals held after viewing the advertisements.

H5: *Higher PME of anti-vaping messages will be associated with more positive post-exposure beliefs about the inherent risks associated with e-cigarette use*

A confirmatory factor analysis was performed on the eight items included in the risk beliefs scale to test H5. A two-factor model fit the data (CFI = .98, TLI = .98, RMSEA = .08). Root mean square error of approximation for this model was slightly higher than would have been considered ideal, but CFI and standardized root mean squared residual (SRMR < .03) combined to indicate an acceptable model fit (Hu & Bentler, 1999). All items included in the model demonstrated acceptable standardized factor loadings (all items $\geq$ .80). The items comprising the two factors retained were averaged to form a three-item Addiction Risk Beliefs (ARB) scale M = 4.19, SD = 1.94, α= .88) and a five-item Health Risk Beliefs (HRB) scale (M = 5.05, SD = 1.76, α= .96). See Table 8a for ARB and HRB scale items.

Table 8a: E-cigarette risk belief dimensional scales

Addiction Risk Beliefs (α = .88)	**Health Risk Beliefs (α = .89)**
If I vape, I will…	**If I vape, I will…**
Become addicted to vaping (.86)	Damage my body (.91)
Be controlled by vaping (.87)	Harm my brain (.85)
Be unable to stop vaping when I want to (.81)	Breathe in dangerous chemicals (.93)
	Inhale poisons (.89)
	Breathe in harmful toxins (.93)

Note. Numbers by items indicate dimensional factor loadings.

As risk beliefs was comprised of two distinct factors, two separate multivariable block-wise linear regressions were constructed. Each regression included four blocks following the same construction as previously reported regressions. However, because the entire sample responded to post-exposure risk belief items, ever-use of e-cigarettes was included as a potential covariate. Block-wise linear regressions assessing associations between PME scores and post-exposure ARB found a small negative association between age and post-exposure addiction risk beliefs (ß = -.04, $p < .05$) (see Table 8b). Overall, females were more likely to demonstrate higher ARB scores (ß = .15, $p < .05$).

Table 8b: Block-wise linear regression associations in post-exposure addiction risk beliefs; *N*=2,322

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	-.02 (-.06 - .02)	-.04* (-.08 - -.00)	-.04* (-.08 - -.01)	-.04* (-.07 - -.00)
Sex				
Male	REF	REF	REF	REF
Female	.23** (.06 - .39)	.24** (.08 - .40)	.15* (.01 - .30)	.15* (.00 - .30)
Trans/Other	.05 (-.47 - .58)	.00 (-.51 - .51)	-.02 (-.49 - .46)	-.02 (-.49 - .45)
Race				
White	REF	REF	REF	REF
Black	.30* (.07 - .53)	.12 (-.11 - .35)	-.01 (-.23 - .20)	-.09 (-.30 - .12)
Asian	.30 (-.02 - .62)	.10 (-.21 - .41)	.09 (-.20 - .37)	.08 (-.20 - .37)
Mixed Race/Other	-.02 (-.28 - .24)	-.06 (-.31 - .19)	-.01 (-.25 - .22)	-.02 (-.26 - .21)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	-.03 (-.26 - .20)	-.09 (-.32 - .13)	-.12 (-.32 - .01)	-.12 (-.32 - .01)
SES				
Education	.08 (-.01 - .18)	.07 (-.03 - .16)	.00 (-.09 - .09)	.00 (-.09 - .09)
Family HHI	02 (-.02 - .06)	.02 (-.13 - .06)	.00 (-.03 - .34)	.00 (-.03 - .04)
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	.06 (-.13 - .25)	.17 (-.00 - .35)	.16 (-.02 - .33)
Smokeless (Ever)	-	.31* (.07 - .55)	.30** (.08 - .52)	.29** (.07 - .51)
Vape (Ever)	-	-.98*** (-1.16 - -.79)	-.60*** (-.78 - -.43)	-.63*** (-.81 - -.46)
Cigar (Ever)	-	-.26* (-.47 - -.05)	-.19 (-.39 - .00)	-.18 (-.37 - .02)
Hookah (Ever)	-	.01 (-.18 - .20)	.03 (-.15 - .20)	.03 (-.15 - .29)
Other Tobacco (Ever)	-	-.40* (-.72 - -.08)	-.43** (-.72 - -.13)	-.43** (-.72 - -.13)
Block 3: Ego Effects PME				
PME Effects Scale	-	-	.42*** (.37 - .46)	.22*** (.15 - .29)
Block 4: Ego Perceptions Scale				
PME Perceptions Scale	-	-	-	.27*** (.19 - .35)
Model R^2	.01	.08	.20	.22
ΔR^2	-	.07***	.12***	.02***
Model F	2.44**	13.17***	36.36***	37.49***

Note: *p<.05, **p<.01, ***p<.001.

There were mixed associations between respondent tobacco use and ARB scores. Unsurprisingly, ever use of vapes was the strongest negative association for ARB (ß = -.63, p < .001), followed by ever use of "Other" tobacco products (ß = -.43, p < .01). However, respondents who had ever used smokeless tobacco were more likely to hold higher post-exposure addiction risk beliefs (ß = .29, p < .01). Both *effects* (ß = .22, p < .001) and *perceptions* (ß = .27, p < .001) were positively associated with post-exposure ARB. The final regression model equation was significant: $F(17, 2{,}305) = 37.49$, $p < .001$with an R^2 of .22 This indicates higher

PME scores across both dimensions were significantly associated with higher post-exposure ARB.

Block-wise linear regressions assessing respondent post-exposure health risk beliefs (HRB) were constructed in the same blocks as those assessing post-exposure ARB. Unlike regressions assessing ARB, there were no significant associations between respondent age and HRB (see Table 9). Female respondents again were more likely to hold higher post-exposure HRB than males (ß = .30, $p < .001$), while black respondents were less likely to hold higher HRB than whites (ß = -.20, $p < .05$). There were more mixed results for previous tobacco usage as respondents who had ever used cigarettes were more likely to hold higher HRB (ß = .15, $p < .05$). Smokeless tobacco use was again negatively associated with post-exposure HRB (ß = -.23, $p < .01$) as was previous vape usage (ß = -.60, $p < .001$). *Effects* measures were stronger predictors of post-exposure HRB than for ARB (ß = .47, $p < .001$) and *perceptions* measures were also positively associated with post-exposure HRB (ß = .20, $p < .001$). The final regression equation was significant and strongly associated with HRB: $F(17, 2305) = 112.58$, $p < .001$, with an R^2 of .45. However, the inclusion of *perceptions* measures only slightly improved the explanatory power of the model ($\Delta R^2 = .01$) while worsening the F score ($\Delta F = -2.44$). The results of these tests confirm the hypothesis that higher PME scores were associated with higher post-exposure risk beliefs. The results from the HRB regressions also suggest that *effects* measures may have greater utility in assessing certain risk beliefs than *perceptions* measures.

Table 9: Block-wise linear regression associations in post-exposure health risk beliefs; *N*=2,322

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	.00 (-.03 - .04)	-.02 (-.05 - .01)	-.02 (-.05 - .01)	-.02 (-.04 - .01)
Sex				
Male	REF	REF	REF	REF
Female	.44*** (.30 - .59)	.43*** (.29 - .57)	.31*** (.19 - .42)	.30*** (.19 - .42)
Trans/Other	.16 (-.32 - .63)	.10 (-.35 - .55)	.07 (-.29 - .43)	.06 (-.29 - .42)
Race				
White	REF	REF	REF	REF
Black	.30** (.09 - .50)	.04 (-.16 - .24)	-.15 (-.31 - .01)	-.20* (-.37 - -.05)
Asian	.15 (-.14 - .43)	-.09 (-.36 - .19)	-.10 (-.32 - .12)	-.10 (-.32 - .12)
Mixed Race/Other	.13 (-.10 - .37)	.07 (-.15 - .30)	.14 (-.04 - .32)	.13 (-.05 - .31)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	-.00 (-.21 - .20)	-.08 (-.28 - .12)	-.11 (-.27 - .04)	-.13 (-.28 - .03)
SES				
Education	.12** (.03 - .21)	.10* (.02 - .19)	.00 (-.06 - .07)	.00 (-.06 - .07)
Family HHI	.02 (-.13 - .05)	.03 (-.01 - .06)	-.01 (-.03 - .02)	-.00 (-.03 - .02)
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	-.00 (-.17 - .16)	.16* (.03 - .30)	.15* (.02 - .28)
Smokeless (Ever)	-	-.21 (-.42 - .00)	-.22* (-.39 - -.05)	-.23** (-.39 - -.06)
Vape (Ever)	-	-1.12*** (-1.29 - -.96)	-.57*** (-.71 - -.44)	-.60*** (-.73 - -.47)
Cigar (Ever)	-	-.04 (-.22 - .15)	.06 (-.09 - .21)	.07 (-.07 - .23)
Hookah (Ever)	-	.03 (-.42 - .14)	.05 (-.08 - .19)	.05 (-.08 - .19)
Other Tobacco (Ever)	-	-.14 (-.42 - .14)	-.19 (-.41 - .04)	-.18 (-.41 - .04)
Block 3: Ego Effects PME				
PME Effects Scale	-	-	.61*** (.58 - .64)	.47*** (.41 - .52)
Block 4: Ego Perceptions Scale				
PME Perceptions Scale	-	-	-	.20*** (.14 - .26)
Model R^2	.02	.13	.44	.45
ΔR^2	-	.11***	.32***	.01***
Model F	5.94***	22.65***	115.02***	112.57***

Note: *p<.05, **p<.01, ***p<.001.

The previous PME analyses have examined PME dimensional scores' associations with positive outcomes following exposure to e-cigarette advertisements. The following hypothesis will examine whether greater PME scores were also correlated with negative reactance against the core messages of the advertisements.

H6: *PME of anti-vaping messages will be negatively correlated with negative reactance to anti-vaping messages*.

Reactance was measured by a 3-item (7-point Likert scale) composite scale assessing the extent to which an individual believes a message is "overblown," "attempting to manipulate [him/her]," or "annoying" (M = 3.65, SD = 1.64). Pearson's correlation tests were used to test the correlation between individual's negative reactance to anti-vaping messages and their PME scores for both *effects* and *perceptions* PME scales. Both *effects* and *perceptions* scales were moderately negatively correlated with reactance. *Perception* scores were slightly more negatively correlated with reactance, $r(2,344) = -.36$, $p < .001$, than *effects* scores, $r(2,344) = -.34$, $p < .001$. These results support H6 and demonstrate a more complicated picture of PME measures than the previous analyses. Higher PME scores were indicative of some positive outcomes following exposure to anti-vaping advertisements, but the high-sensation value *Real Cost* ads were also more likely to cause negative reactance against the messages than the low-sensation control advertisements respondents saw. The following hypothesis will assess whether the PME scales utilized in this study were able to determine significant differences in perceptions of the two advertisement conditions.

H7: *Higher sensation value messages (Real Cost ads) will be perceived as more effective than lower sensation value messages (Control)*.

To test this hypothesis, a series of t-tests assessed mean differences of *effects* and *perceptions* PME dimensions between high sensation value (Real Cost) and low sensation value (Control) ad conditions (See Tables 10A-10B). Independent samples t-tests assessing the entire sample's *perceptions* scores indicated that FDA ads (M = 5.02, SD = 1.60) outperformed Control ad conditions (M = 4.87, SD = 1.48): $t(2,344) = -2.14$, $p < .05$. *Perceptions* scores did

not differ significantly between FDA ads (M = 4.59, SD = .07) and Control ads (M = 4.54, SD = .07) for current e-cigarette users $t(1{,}001) = -.52$, *ns*. However, non-users scored FDA ads (M = 5.35, SD = .06) more highly on *perceptions* measures than Control ads (M = 5.12, SD = .05) $t(1{,}341) = -2.56$, $p < .01$.

The aggregate sample also preferred FDA ads (M = 5.04, SD = 1.76) over Control ads (M = 4.81, SD = 1.71) for message *effects* scores $t(2{,}344) = -2.99$, $p < .01$. Unlike *perceptions* scores, there was a significant difference for current users assessing message *effects* scores, who rated FDA ads (M = 4.44, SD = .08) more favorably than Control Ads (M = 4.16, SD = .07) $t(1{,}001) = -2.45$, $p < .01$. Finally, non-users also demonstrated higher *effects* scores for FDA Ads (M = 5.47, SD = .06) than Control Ads (M = 5.29, SD = .06), $t(1{,}341) = -2.07$, $p < .05$. These results confirm the study's hypothesis that high sensation value messages (FDA ads) would outperform low sensation value ads (Control) across different subgroups and PME dimensions.

This section has demonstrated that PME measures used in this study were able to differentiate between two advertisement conditions, were highly associated with post-exposure risk beliefs and were tenuously linked to models explaining pre-post differences in e-cigarette user quit intentions. It also presented data that demonstrates *effects* measures may be a more refined diagnostic instrument for assessing anti-vaping advertisements than *perceptions* measures. Finally, this section demonstrated an overall lack of significant change in either susceptibility or quit intentions post-exposure to either advertisement condition in this experiment. The following section will present data resulting from analyses that assessed the role baseline attitudes about e-cigarettes had in e-cigarette behaviors and reactions to anti-vaping advertisements.

Table 10A: Means, standard deviations and *t*-test comparisons between PME dimensional scores and reactance for FDA and Control ad conditions

	Control Ads (*n*=1,192)	**FDA Ads** (*n*=1,149)
Variables	*M* (SD)	*M* (SD)
Message Perceptions (total)	4.87 (1.48)*	5.02 (1.60)*
Message Effects (total)	4.81 (1.71)**	5.04 (1.76)**
	Control Ads (*n*=508)	**FDA Ads** (*n*=495)
	M (SD)	*M* (SD)
Message Perceptions (current users)	4.54 (.07)	4.59 (.07)
Message Effects (current users)	4.16 (.07)**	4.44 (.08)**
	Control Ads (*n*=684)	**FDA Ads** (*n*=654)
	M (SD)	*M* (SD)
Message Perceptions (non-users)	5.12 (0.05)**	5.35 (.06)**
Message Effects (non-users)	5.29 (.06)*	5.47 (.06)*
	Control Ads	**FDA Ads**
	M (SD)	*M* (SD)
Reactance (total)[a]	3.48 (1.57)***	3.84 (1.68)***
Reactance (current users)[b]	3.94 (1.48)***	4.35 (1.66)***
Reactance (non-users)[c]	3.13 (1.56)***	3.43 (1.61)***

Note: *p<.05, **p<.01, ***p<.001. [a] Control Ads n = 1,192, FDA Ads n = 1,149.
[b] Control Ads n = 508, FDA Ads n = 495. [c] Control Ads n = 685, FDA Ads n = 658

Table 10B: Means, standard deviations and *t*-test comparisons between PME dimensional scores and reactance for FDA and Control ad conditions by respondent vape use status

	Non-Vapers (*n*=685)	**Vapers** (*n*=508)
Variables	*M* (SD)	*M* (SD)
Control Ad Perceptions	5.11 (1.43)***	4.54 (1.48)***
Control Ad Effects	5.30 (1.56)***	4.16 (1.69)***
	Non-Vapers (*N*=654)	**Vapers** (*N*=495)
	M (SD)	*M* (SD)
FDA Ad Perceptions	5.35 (1.44)***	4.59 (1.70)***
FDA Ad Effects	5.50 (1.52)***	4.44 (1.86)***
	Non-Vapers (*N*=684)	**Vapers** (*N*=508)
	M (SD)	*M* (SD)
Control Reactance	3.13 (1.56)***	3.95 (1.48)***
FDA Reactance	3.45 (1.59)***	4.35 (1.66)***

Note: *p<.05, **p<.01, ***p<.001.

Outcome Expectancy Hypotheses

H8: *More positive outcome expectancies will be associated with greater intention to use e-cigarettes at baseline.*

Outcome expectancy measures were validated through initial exploratory factor analysis [EFA]. The literature on young adult e-cigarette outcome expectancies is more extensive than anti-vaping message PME and the items used to measure OE in this study have been adapted from scales measuring similar dimensions related to vaping OE. Despite this, the large number of items included in this section and the potential for different conceptualizations of outcomes

between this study's sample and previous studies' made EFA an appropriate first step for dimension reduction (Brown, 2014).

First, an EFA was conducted on non-vaper OE responses using a promax oblique rotation method. Factor selection was guided by the *Kaiser-Guttman rule* in which only dimensions that achieve eigenvalues greater than 1.0 were retained (Brown, 2014). Individual items that had high loadings on more than one factor (cross-loading) or low loadings on all factors (low communality) were eliminated from further analysis (Brown, 2014). Results from the EFA suggested four workable factors when allowing for covariance between factors. Indicators of model fit suggested the four-factor model was an acceptable fit to the data (CFI = .97, TLI = .96, RMSEA = .057) RMSEA was slightly higher than an ideal fit, but a small SRMR (SRMR = .03) combined with acceptable CFI and TLI indicated an acceptable fit (Hu & Bentler, 1999). Of the 24 OE items tested, fourteen demonstrated sufficient factor loadings and low enough cross-loading for retention (all items $\geq$ .60).

Following the EFA, a confirmatory factor analysis was performed using the same factor and covariance structure on current vaper OE responses. Once again, model fit estimates indicated an acceptable data fit (CFI = .94, TLI = .93, RMSEA = .06). Again, RMSEA was slightly above an ideal level, but low SRMR (SRMR = .045) suggested an acceptable fit (Hu & Bentler, 1999). Following confirmation of the model with current user responses, four factors were retained (see Table 11). Retained factors included two positive OE dimensions (personal experience α = .89; social attraction α = .83) as well as two negative OE dimensions (social aversion α = .88; health concerns α = .80) all of which demonstrated acceptable alpha reliability. The positive scales included personal experience which included four items describing the immediate personal sensations associated with vape use (e.g., "Like the feeling of inhaling vapor

into my mouth") as well as social attraction which included three items detailing how vaping may improve social standing (e.g., "Fit in better with friends"). Negative scales included social aversion, comprised of four items describing how vape use could result in negative social standing (e.g., "Look unpleasant") and health concerns, whose three items described potential negative health risks of using vaping devices (e.g., "Damage my lungs").

Table 11: E-cigarette outcome expectancy dimensional scales

Personal Experience + (α = .89)	**Social Attraction + (α = .83)**
If I were to use an e-cigarette or other vaping device I would…	**If I were to use an e-cigarette or other vaping device I would…**
Like the feeling of inhaling vapor into my mouth (.64)	Look more attractive (.79)
Like the feeling of creating vapor clouds (.68)	Feel more sophisticated (.73)
Like the flavor of the vapor (.90)	Fit in better with friends (.61)
Like the smell of the vapor (.79)	
Health Concerns - (α = .80)	**Social Aversion - (α = .88)**
If I were to use an e-cigarette or other vaping device I would…	**If I were to use an e-cigarette or other vaping device I would…**
Worry about my health (.68)	Smell bad (.80)
Wonder what I was inhaling (.61)	Have bad breath (.83)
Damage my lungs (.60)	Look awkward (.71)
	Look unpleasant (.74)

Note. Numbers by items indicate dimensional factor loadings in EFA with non-smokers (*n* = 1,305).

Pearson's correlations were performed examining potential associations between respondent vape status, retained OE scales, baseline susceptibility/quit intentions, and PME scales (see Tables 12 for current user correlations and 13 for non-user correlations). Among current users, personal experience OE was weakly positively correlated with 30-day vape

frequency $r(1{,}001) = .19$, $p < .001$, and social aversion was weakly negatively correlated with vape frequency $r(1{,}001) = -.25$, $p < .001$. Unpredictably, social attraction was also very weakly negatively correlated with increased vape frequency $r(1{,}001) = -.09$, $p < .01$, although health concerns were not significantly correlated with respondent vape frequency. Baseline quit intentions were moderately positively correlated with health concerns OE $r(1{,}001) = .36$, $p < .001$ and weakly positively correlated with social aversion OE $r(1{,}001) = .27$, $p < .001$ as well as social attraction $r(1{,}001) = -.14$, $p < .05$. Baseline quit intentions were weakly negatively correlated with personal experience OE $r(1{,}001) = -.26$, $p < .001$. Both PME dimensions were moderately positively associated with social aversion and health concerns OEs. However, only *effects* PME measures were significantly negatively associated with personal experience OE $r(1{,}001) = -.14$, $p < .001$. Oddly, both PME dimensions were significantly though weakly positively associated with social attraction OE (see Table 12).

Table 12: Bivariate correlations between current user (*n* = 1,003) vape frequency, OE dimensions, perceived norms and PME dimensions

	Variables	1	2	3	4	5	6	7	8	9	10	11	12
1	30-Day Vape Freq.	-											
2	Personal Experience OE	.19***	-										
3	Social Attraction OE	-.09**	.18***	-									
4	Social Aversion OE	-.25***	-.17***	.41***	-								
5	Health Concerns OE	-.06	.05	.07*	.35***	-							
6	Network Injunctive	-.26***	-.08*	.23***	.35***	.14***	-						
7	Ego Injunctive	-.17***	-.07*	.19***	.35***	.23***	.45***	-					
8	Network Descriptive	.21***	.05	-.00	-.13***	.00	-.29***	-.04	-				
9	Ego Descriptive	.05	.06*	.24***	.14***	.06*	.01	-.00	.29***	-			
10	Baseline Quit Intentions	-.26***	-.14***	.08*	.27***	.36***	.21***	.23***	-.06	-.04	-		
11	PME Effects	-.21***	-.14***	.12***	.36***	.48***	.30***	.32***	-.06	.12	.43***	-	
12	PME Perceptions	-.20***	-.06	.16***	.31***	.39***	.29***	.30***	-.05	-.01	.35***	.83***	-

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

Among non-users, personal experience OE was moderately positively correlated with respondent ever-use of e-cigarettes $r(1,341) = .46$, $p < .001$ as well as weakly positively correlated with baseline susceptibility $r(1,341) = .18$, $p < .001$ (see Table 13). Personal experience OE was also weakly negatively associated with both PME dimensional scales. Baseline susceptibility was moderately positively correlated with social attraction OE $r(1,341) = .54$, $p < .001$ as well as weakly negatively correlated with social aversion $r(1,341) = -.16$, $p < .001$ and health concerns OE $r(1,341) = -.21$, $p < .001$. Health concerns and social aversion OE were also weakly negatively correlated with respondent ever-use of vaping products (see Table XXX). PME *effects* scores were weakly negatively correlated with social attraction $r(1,341) = -.19$, $p < .001$ and moderately positively associated with social aversion $r(1,341) = .41$, $p < .001$ as well as health concerns OE $r(1,341) = .43$, $p < .001$. Finally, PME *perceptions* items were weakly positively correlated with social aversion $r(1,341) = .29$, $p < .001$ and, oddly, social attraction OE $r(1,341) = .29$, $p < .001$ and weakly negatively correlated with health concerns OE $r(1,341) = -.13$, $p < .001$.

Table 13: Bivariate correlations between non-user (*n* = 1,343) vape frequency, OE dimensions, perceived norms, and PME dimensions

	Variables	1	2	3	4	5	6	7	8	9	10	11	12
1	E-Cig Ever Use	-											
2	Personal Experience OE	.30***	-										
3	Social Attraction OE	.07*	.54***	-									
4	Social Aversion OE	-.29***	-.23***	-.07*	-								
5	Health Concerns OE	-.13***	-.02	-.13***	.58***	-							
6	Network Injunctive	-.31***	-.26***	-.11***	.35***	.20***	-						
7	Ego Injunctive	-.20***	-.15***	-.09**	.43***	.36***	.51***	-					
8	Network Descriptive	.23***	.16***	.19***	-.10**	-.07*	-.29***	-.10**	-				
9	Ego Descriptive	.18***	.36***	.41***	-.09***	-.08**	-.17***	-.01	.34***	-			
10	Baseline Susceptibility	.18***	.46***	.57***	-.16***	-.21***	-.11***	-.10***	.17***	.51***	-		
11	PME Effects	-.19***	-.25***	-.19***	.41***	.43***	.30***	.33***	-.12***	-.13***	-.26***	-	
12	PME Perceptions	-.14***	-.13***	-.10***	.29***	.29***	.27***	.25***	-.09**	-.06*	.13***	.79***	-

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

A series of *t*-tests was performed to examine potential differences between outcome expectancies between non-vapers and current vapers (see Table 14). Unsurprisingly, vapers in general held more positive outcome expectancies for e-cigarette use than non-vapers. Vapers held more positive beliefs about the personal experience OE (M = 5.07, SD = 1.36) than non-vapers (M = 3.31, SD = 1.80) $t(2,333) = -25.79$, $p < .001$. Vapers were also generally more positive about the social attraction outcomes (M = 3.09, SD = 1.53) associated with e-cigarette use compared to non-vapers (M = 2.35, SD = 1.53) $t(2,315) = -11.43$, $p < .001$. Non-vapers were generally more skeptical about the social aversion OE of e-cigarette use (M = 4.39, SD = 1.84) than current vapers (M = 2.81, SD = 1.48) $t(2,318) = 22.23$, $p < .001$. Additionally, non-vapers harbored more expected health concerns (M = 5.23, SD = 1.75) than current vapers (M = 4.56, SD = 1.51) $t(2,334) = 9.66$, $p < .001$.

Table 14: Means, standard deviations and *t*-test comparisons between OE dimensional scores by respondent vape use status

	Non-Vapers	**Vapers**
Variables	*M* (SD)	*M* (SD)
Personal Experience OE	3.31 (1.80)***	5.07 (1.36)***
Social Attraction OE	2.35 (1.53)***	3.08 (1.53)***
	Non-Vapers	**Vapers**
	M (SD)	*M* (SD)
Social Aversion OE	4.39 (1.84)***	2.81 (1.48)***
Health Concerns OE	5.23 (1.75)***	4.56 (1.51)***

Note: *p<.05, **p<.01, ***p<.001.

In order to determine whether higher OE about e-cigarette use was associated with greater respondent susceptibility at baseline, a series of block-wise regression models was employed. Six models were included in the regression, starting with 1.) respondent demographics and 2.) previous tobacco use before adding 3.) personal experience, 4.) social attraction, 5.) social aversion, and 6.) health concerns OEs (see Tables 15a and 15b). Although there were no significant associations between demographics and baseline susceptibility, respondent tobacco use history was largely significant. Respondents who had ever used cigarettes (ß = .24, p < .05), smokeless tobacco products (ß = .79, p < .001), or vapes (ß = .26, p < .001) were all more likely to have higher levels of baseline susceptibility. However, in keeping with previous models, respondents who had ever used cigars were significantly less susceptible at baseline (ß = -.36, p < .001).

Table 15a: Block-wise linear regression examining between OE dimensions and baseline susceptibility; *n*=1,291

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	.04 (-.01 - .08)	.19 (-.02 - .06)	.01 (-.03 - .05)	.00 (-.03 - .04)
Sex				
Male	REF	REF	REF	REF
Female	-.39*** (-.57 - -.20)	-.35*** (-.53 - -.17)	-.25*** (-.41 - -.09)	-.08 (-.23 - .07)
Trans/Other	-.23 (-.77 - .32)	-.25 (-.78 - .27)	-.16 (-.65 - .32)	-.07 (-.51 - .38)
Race				
White	REF	REF	REF	REF
Black	.50*** (.26 - .74)	.60*** (.36 - .83)	.38*** (.16 - .60)	.15 (-.05 - .35)
Asian	-.19 (-.53 - .15)	-.07 (-.40 - .26)	-.17 (-.48 - .13)	-.17 (-.44 - .10)
Mixed Race/Other	-.28 (-.58 - .02)	-.22 (-.51 - .06)	-.10 (-.36 - .16)	-.02 (-.25 - .22)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.25 (-.00 - .51)	.27* (.02 - .51)	.09 (-.13 - .31)	-.08 (-.29 - .12)
SES				
Education	.03 (-.08 - .13)	.05 (-.05 - .15)	.06 (-.03 - .16)	.05 (-.03 - .14)
Family HHI	-.00 (-.05 - .04)	.00 (-.04 - .04)	-.00 (-.04 - .04)	-.02 (-.05 - .02)
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	.57*** (.34-.79)	.36*** (.16 - .57)	.27*** (.08 - .46)
Smokeless (Ever)	-	1.01*** (.65-1.36)	.92*** (.59 – 1.24)	.75*** (.46 – 1.04)
Vape (Ever)	-	.50*** (.28 - .72)	.18 (-.03 - .38)	.30*** (.12 - .49)
Cigar (Ever)	-	-.44*** (-.71 - -.16)	-.51*** (-.77 - -.26)	-.36*** (-.59 - -.12)
Hookah (Ever)	-	-.09 (-.33 - .16)	-.15 (-.77 - -.26)	-.07 (-.27 - .13)
Other Tobacco (Ever)	-	.28 (-.15 - .72)	.32 (-.08 - .71)	.25 (-.10 - .61)
Block 3: Ego Experience OE				
OE Personal Experience Scale	-	-	.37*** (.33 - .42)	.15*** (.10 - .20)
Block 4: Ego Social Att. OE				
OE Social Attraction Scale	-	-	-	.48*** (.42 - .54)
Model R^2	.04	.12	.26	.39
ΔR^2	-	.09***	.14***	.13***
Model F	5.47***	11.97***	28.75***	48.30

Note: *p<.05, **p<.01, ***p<.001. Models 5 and 6 continued on next table (Table 15b)

Higher personal experience (ß = .16, p < .001) and social attraction scores (ß = .46, p < .001) were both associated with greater respondent susceptibility at baseline. Greater health concerns were negatively associated with respondent susceptibility (ß = -.14, p < .001) and social aversion OE were not significant in the final model. The final regression model equation was significant with an R^2 of .41, F(1, 1,271) = 46.35, p < .001), indicating more positive beliefs about personal experience and socially attractive outcomes and fewer negative health outcomes associated with e-cigarette use were positively associated with greater respondent baseline e-

cigarette use susceptibility. The following hypothesis examined whether similar patterns held for e-cigarette user vape frequency.

Table 15b: Block-wise linear regression examining between OE dimensions and baseline susceptibility; *n*=1,291

	Model 5	Model 6
	β (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos		
Age	.00 (-.03 - .04)	.00 (-.03 - .03)
Sex		
Male	REF	REF
Female	-.16 (-.21 - .09)	-.03 (-.18 - .12)
Trans/Other	-.07 (-.51 - .37)	-.07 (-.50 - .37)
Race		
White	REF	REF
Black	.14 (-.06 - .34)	.12 (-.08 - .32)
Asian	-.16 (-.44 - .11)	-.17 (-.44 - .10)
Mixed Race/Other	-.03 (-.26 - .21)	-.02 (-.25 - .22)
Hispanic/Latinx (No)	REF	REF
Hispanic/Latinx (Yes)	-.10 (-.31 - .10)	-.10 (-.30 - .10)
SES		
Education	.06 (-.02 - .15)	.06 (-.02 - .15)
Family HHI	-.01 (-.05 - .02)	-.01 (-.04 - .03)
Block 2: Ego Tob. Use		
Cigarette (Ever)	.26*** (.07 - .45)	.24* (.05 - .43)
Smokeless (Ever)	.79*** (.50 – 1.09)	.79*** (.50 – 1.09)
Vape (Ever)	.26*** (.08 - .45)	.26*** (.08 - .45)
Cigar (Ever)	-.35*** (-.58 - -.12)	-.36*** (-.59 - -.13)
Hookah (Ever)	-.10 (-.30 - .11)	-.07 (-.27 - .13)
Other Tobacco (Ever)	.19 (-.17 - .55)	.19 (-.17 - .55)
Block 3: Ego Experience OE		
OE Personal Experience Scale	.13*** (.08 - .18)	.16*** (.11 - .21)
Block 4: Ego Social Att. OE		
OE Social Attraction Scale	.49*** (.44 - .55)	.46*** (.40 - .52)
Block 5: Ego Social Avers. OE		
OE Social Aversion Scale	-.07*** (-.11 - -.03)	.01 (-.04 - .06)
Block 6: Ego Health Conc. OE		
OE Health Concerns Scale	-	-.14*** (-.19 - -.08)
Model R^2	.40	.41
ΔR^2	.01	.01***
Model F	46.52***	46.35***

Note: *p<.05, **p<.01, ***p<.001. Models 1-4 on previous page (Table 15a)

H9: *More positive outcome expectancies will be associated with greater likelihood of e-cigarette use.*

In order to test this hypothesis, this study employed an ordinal logistic regression model to assess how changes in outcome expectancies were associated with differing rates of e-cigarette use at baseline. Respondent e-cigarette use was assessed through a single item asking the number of days in the last month each respondent has used e-cigarettes. From this indicator, a four-item ordinal use measure was constructed. Respondents who were not current users were indicated by a "0." Dummy variables were created for current users. Infrequent users were indicated by a one and were designated as those individuals who used e-cigarettes fewer than 1 SD below the average number of days used per month among users. Infrequent users reported vaping an average of 2.80 days in the last month with a standard deviation of 1.55. Moderate users were indicated as those users who fell between 1 SD below and 1 SD above the mean number of days vaped per month among users (M = 16.58 days vaped in last 30, SD = 6.67). The indicator for heavy users included all users who vaped more than 1 SD above the average number of days vaped for all users. Heavy users were overwhelmingly daily users (M = 30.00, SD = .18). Thus, e-cigarette use was assessed via a constructed scale from 0 (non-users) to 3 (heavy users).

An ordinal logistic regression model was then employed to determine the extent to which a one-unit increase in a respondent's outcome expectancies was associated with the likelihood that a respondent would move from one use status to the next (e.g., from "infrequent" to "moderate" use). Respondent demographics and previous use of tobacco products other than e-cigarettes were included in the models as controls (see Table 16). Results from this analysis

indicated that higher personal experience (OR = 1.47, $p < .001$) and social attraction OE (OR = 1.23, $p < .001$) were significantly associated with higher rates of e-cigarette use, while higher social aversion OE scores (OR = .65, $p < .001$) were associated with lower rates.

Table 16: Ordinal logistic regression examining associations between OE dimensions and vape frequency; *n*=2,282

Ordered Probit Estimates: *Log Likelihood* = -2,043.45 *LR* χ^2 (18) = 1,209.79***, *Pseudo* R^2 = .23

	Odds Ratio	Standard Error	*Z*	*[95% Conf. Interval]*
Ego Demos				
Age	.83***	.02	-8.21	(.79 - .86)
Sex				
Male	REF	REF	REF	REF
Female	1.19	.12	1.76	(.98 – 1.45)
Trans/Other	.57	.19	-1.73	(.30 – 1.08)
Race				
White	REF	REF	REF	REF
Black	.40***	.06	-5.97	(.30 - .54)
Asian	.72	.14	-1.73	(.49 – 1.05)
Mixed Race/Other	.90	.14	-.68	(.66 – 1.22)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.62***	.09	-3.41	(.47 - .82)
SES				
Education	1.07	.06	1.12	(.95 – 1.20)
Family HHI	1.03	.02	1.49	(.99 – 1.08)
Ego Tob. Use				
Cigarette (Ever)	2.38***	.26	8.11	(1.93 – 2.94)
Smokeless (Ever)	1.77***	.23	4.44	(1.38 – 2.28)
Cigar (Ever)	1.17	.14	1.33	(.93 – 1.47)
Hookah (Ever)	1.66***	.18	4.71	(1.34 – 2.04)
Other Tobacco (Ever)	.92	.16	-.49	(.65 – 1.30)
Ego OEs				
OE Personal Experience Scale	1.47***	.05	11.09	(1.38 – 1.57)
OE Social Attraction Scale	1.23***	.04	5.98	(1.15 – 1.32)
OE Social Aversion Scale	.65***	.02	-11.72	(.60 - .70)
OE Health Concerns Scale	.96	.03	-1.26	(.90 – 1.02)
.cut 1	-2.48	.50	(Ancillary parameters)	
.cut 2	-1.60	.50		
.cut 3	-.33	.50		

Note: *p<.05, **p<.01, ***p<.001.

There were no significant associations between health concerns OE and vape use rate among respondents. As in previous regressions, historic tobacco use was a significant indicator of likelihood to be in higher use rate cohorts. Individuals who had ever used cigarettes (OR = 2.38, $p < .001$), chewing tobacco (OR = 1.77, $p < .001$) or hookah (OR = 1.66, $p < .001$) were all associated with a higher likelihood of greater vape use frequency. The final regression model equation was significant $\chi 2$ (df(18, 2,282) = 1,209.79, p < .001) with a Pseudo R^2 of .23. The results from these regressions suggest that more positive experiential and social beliefs about e-cigarette outcomes and harboring fewer expectations about negative social effects are all associated with a greater likelihood to use e-cigarettes more frequently. Despite the lack of significance for health concern OE, these data support the underlying hypothesis that more positive OE are positively associated with greater rates of e-cigarette usage. Having established connections between baseline attitudes about e-cigarettes and susceptibility and e-cigarette use frequency, the following hypothesis sought to examine whether these baseline attitudes had any appreciable effect on respondents' near-immediate assessments of anti-vaping advertisements.

H10**:** *More positive outcome expectancies will be associated with lower PME of anti-vaping messages.*

In order to test this hypothesis, two separate block-wise linear regression models were performed—one each for *perceptions* and *effects* PME measures. This method allowed the study to examine how baseline expectancies about personal experiential, health, and social outcomes contributed to incrementally impact the two PME dimensions the study examined. Each model included demographics as controls, followed by previous tobacco usage in the second block, and then by individual blocks for each of the four vaping OE dimensions (See Tables 17a – 17b). Thus, a total of six models were included in each regression model. Tables 17a and 17b present

results from the block-wise models examining associations between OE dimensions and *perceptions* PME items.

Table 17a: Block-wise linear regression examining associations between OE dimensions and *perceptions* PME; n = 2,282

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	-.01 (-.04 - .02)	-.01 (-.04 - .02)	-.02 (-.05 - .01)	-.02 (-.05 - .01)
Sex				
Male	REF	REF	REF	REF
Female	.18** (.05 - .30)	.17* (.04 - .30)	.16* (03 - .29)	.18** (.05 - .31)
Trans/Other	.15 (-.27 - .56)	.09 (-.31 - .50)	.05 (-.36 - .45)	.09 (-.32 - .50)
Race				
White	REF	REF	REF	REF
Black	.62*** (.44 - .81)	.48*** (.30 - .66)	.54*** (.36 - .73)	.51*** (.32 - .69)
Asian	.16 (-.09 - .41)	.01 (-.24 - .26)	.02 (-.23 - .27)	-.00 (-.25 - .25)
Mixed Race/Other	.01 (-.19 - .22)	-.03 (-.23 - .17)	-.04 (-.24 - .16)	-.05 (-.25 - .15)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.15 (-.03 - .34)	.11 (-.07 - .29)	.12 (-.06 - .30)	.12 (-.06 - .30)
SES				
Education	.13** (.06 - .21)	.12** (.04 - .20)	.11** (.04 - .19)	.11** (.03 - .18)
Family HHI	.03 (-.00 - .06)	.03* (.00 - .06)	.03* (.00 - .06)	.03 (-.00 - .06)
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	-.15* (-.31 - -.00)	-.11 (-.26 - .05)	-.12 (-.27 - .04)
Smokeless (Ever)	-	.05 (-.14 - .24)	.06 (-.13 - .25)	.05 (-.14 - .24)
Vape (Ever)	-	-.53*** (-.67 - -.38)	-.41*** (-.57 - -.26)	-.40*** (-.56 - -.25)
Cigar (Ever)	-	-.16 (-.33 - .01)	-.16 (-.33 - .01)	-.15 (-.31 - .02)
Hookah (Ever)	-	-.04 (-.19 - .12)	-.01 (-.16 - .15)	-.00 (-.15 - .15)
Other Tobacco (Ever)	-	.04 (-.21 - .30)	.04 (-.22 - .29)	.05 (-.21 - .30)
Block 3: Ego Experience OE				
OE Personal Experience Scale	-	-	-.08*** (-.12 - -.05)	-.10*** (-.14 - .06)
Block 4: Ego Social Att. OE				.04 (-.00 - .09)
OE Social Attraction Scale	-	-	-	
Model R^2	.03	.07	.08	.08
ΔR^2	-	.05***	.01***	-.00
Model F	7.36***	12.24***	13.25***	12.22***

Note: *p<.05, **p<.01, ***p<.001. Models 5 and 6 continued on next table (Table 17b)

In the final model, the only demographic variable that retained significance was the dummy-variable for black respondents (ß = .56, $p < .001$) indicating that black respondents were more likely than white respondents to rate all anti-vaping messages higher on perceptions measures.

Table 17b: Block-wise linear regression examining associations between OE dimensions and *perceptions* PME; *n* = 2,282

	Model 5	Model 6
	β (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos		
Age	-.03* (-.06 - -.00)	-.02 (-.05 - .01)
Sex		
Male	REF	REF
Female	.17** (.04 - .29)	.10 (-.02 - .22)
Trans/Other	.08 (-.31 - .48)	.10 (-.28 - .49)
Race		
White	REF	REF
Black	.53*** (.35 - .71)	.56*** (.39 - .74)
Asian	-.02 (-.26 - .21)	-.01 (-.24 - .22)
Mixed Race/Other	-.04 (-.23 - .16)	-.04 (-.23 - .15)
Hispanic/Latinx (No)	REF	REF
Hispanic/Latinx (Yes)	.15 (-.03 - .32)	.15 (-.02 - .32)
SES		
Education	.08* (.01 - .16)	.07 (-.01 - .04)
Family HHI	.03 (-.00 - .05)	.01 (-.01 - .04)
Block 2: Ego Tob. Use		
Cigarette (Ever)	-.08 (-.23 - .06)	-.06 (-.21 - .08)
Smokeless (Ever)	-.01 (-.19 - .18)	.01 (-.27 - .05)
Vape (Ever)	-.09 (-.25 - .07)	-.08 (-.13 - .16)
Cigar (Ever)	-.11 (-.28 - .05)	-.11 (-.27 - .05)
Hookah (Ever)	.05 (-.10 - .20)	.02 (-.12 - -.04)
Other Tobacco (Ever)	.03 (-.22 - .27)	.07 (-.17 - .31)
Block 3: Ego Experience OE		
OE Personal Experience Scale	-.03 (-.07 - -.01)	-.08*** (-.12 - -.04)
Block 4: Ego Social Att. OE		
OE Social Attraction Scale	-.01 (-.06 - .03)	.03 (-.01 - .07)
Block 5: Ego Social Avers. OE		
OE Social Aversion Scale	.26*** (.22 - .30)	.13*** (.08 - .17)
Block 6: Ego Health Conc. OE		
OE Health Concerns Scale	-	.24*** (.20 - .28)
Model R^2	.15	.20
ΔR^2	.07***	.04
Model F	22.72***	29.19***

Note: *p<.05, **p<.01, ***p<.001. Models 1-4 on previous page (Table 17a)

No previous tobacco products used were significant in the final model. As hypothesized, there was a small but significant negative association between personal experience OE and *perceptions* scores (ß = -.08, $p < .001$). Greater baseline OE about the potential negative social effects of vaping (social aversion OE) (ß = .13, $p < .001$) as well as greater health concerns OE (ß = .24, $p < .001$) were both significantly associated with higher *perceptions* scores. Social attraction OE were not significantly associated with *perceptions* scores. The final regression model equation was significant ($F(19, 2262) = 29.19$, $p < .001$) with an R^2 of .20.

Tables 18a and 18b present results from the regression models assessing associations between OE dimensions and *effects* PME items. In contrast to the models assessing *perceptions* items, higher levels of educational achievement (ß = .08, $p < .05$) and higher family HHI (ß = .03, $p < .05$) were both modestly associated with higher *effects* PME. Similar to regressions assessing *perceptions* scores, black respondents were significantly more likely to perceive the messages as more effective than white respondents (ß = .46, $p < .001$). Outcome expectancy results largely mirrored those in the previous analysis. Personal experience OE was once again negatively associated with *effects* PME (ß = -.17, $p < .001$) and social aversion (ß = .16, $p < .001$) and health concerns (ß = .36, $p < .001$) were positively associated with *effects* PME scores. Additionally, social attraction OE was not significantly associated with *effects* scores. The final regression model equation was significant ($F(19, 2262) = 62.89$, $p < .001$) with an R^2 of .35, indicating that OE regression model used for to examine both PME dimensions was a better explanatory fit for *effects* measures than *perceptions* measures. These results mostly support the stated hypothesis. Across four dimensions of OE, three were consistently associated with both PME dimensions such that respondents with more optimistic baseline attitudes about the likely social, health, and experiential outcomes associated with vaping were less likely to respond

favorably to either perceptual or effects measures of an anti-vaping message's likely effectiveness.

Table 18a: Block-wise linear regression examining associations between OE dimensions and *effects* PME; *n* = 2,282

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	.01 (-.04 - .02)	.01 (-.04 - .02)	.00 (-.03 - .03)	.00 (-.03 - .03)
Sex				
Male	REF	REF	REF	REF
Female	.21** (.05 - .30)	.20** (.04 - .30)	.19** (.03 - .33)	.19** (.05 - .33)
Trans/Other	.16 (-.27 - .56)	.09 (-.31 - .50)	.03 (-.41 - .47)	.01 (-.43 - .46)
Race				
White	REF	REF	REF	REF
Black	.53*** (.44 - .81)	.29** (.30 - .66)	.39*** (.19 - .59)	.37*** (.17 - .57)
Asian	.27 (-.09 - .41)	.03 (-.24 - .26)	.05 (-.21 - .32)	.05 (-.22 - .31)
Mixed Race/Other	-.04 (-.19 - .22)	-.11 (-.23 - .17)	-.12 (-.34 - .10)	-.12 (-.34 - .09)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.13 (-.03 - .34)	.05 (-.07 - .29)	.09 (-.10 - .28)	.09 (-.10 - .29)
SES				
Education	.19*** (.06 - .21)	.16*** (.04 - .20)	.14** (.06 - .23)	.14** (.05 - .22)
Family HHI	.05** (-.00 - .06)	.06** (.00 - .06)	.05** (.02 - .08)	.05** (.02 - .08)
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	-.28** (-.31 - -.00)	-.19* (-.35 - -.03)	-.19* (-.36 - -.03)
Smokeless (Ever)	-	.02 (-.14 - .24)	.05 (-.15 - .26)	.04 (-.17 - .25)
Vape (Ever)	-	-.89*** (-.67 - -.38)	-.62*** (-.79 - -.45)	-.61***(-.78 - -.44)
Cigar (Ever)	-	-.15 (-.33 - .01)	-.14 (-.32 - .04)	-.13 (-.31 - .06)
Hookah (Ever)	-	-.04 (-.19 - .12)	.01 (-.15 - .18)	.01 (-.16 - .17)
Other Tobacco (Ever)	-	.08 (-.21 - .30)	.07 (-.21 - .34)	.07 (-.20 - .35)
Block 3: Ego Experience OE				
OE Personal Experience Scale	-	-	-.19*** (-.23 - -.15)	-.19*** (-.24 - -.15)
Block 4: Ego Social Att. OE				
OE Social Attraction Scale	-	-	-	.01 (-.04 - .06)
Model R^2	.03	.13	.16	.15
ΔR^2	-	.10***	.03***	-.00
Model F	7.58***	22.18***	27.10***	24.67***

Note: *p<.05, **p<.01, ***p<.001. Models 5 and 6 continued on next table (Table 18b)

Table 18b: Block-wise linear regression examining associations between OE dimensions and *effects* PME; *n* = 2,282

	Model 5	Model 6
	β (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos		
Age	-.01 (-.01 - .02)	.00 (-.02 - .03)
Sex		
Male	REF	REF
Female	.18** (.05 - .31)	.08 (-.04 - .20)
Trans/Other	.00 (-.41 - .42)	.04 (-.35 - .43)
Race		
White	REF	REF
Black	.41*** (.23 - .60)	.46*** (.28 - .64)
Asian	.01 (-.24 - .26)	.03 (-.20 - .27)
Mixed Race/Other	-.11 (-.31 - .09)	-.12 (-.31 - .07)
Hispanic/Latinx (No)	REF	REF
Hispanic/Latinx (Yes)	.15 (-.03 - .33)	.15 (-.02 - .32)
SES		
Education	.11** (.03 - .19)	.08* (.01 - .15)
Family HHI	.05** (.02 - .08)	.03* (.00 - .06)
Block 2: Ego Tob. Use		
Cigarette (Ever)	-.15 (-.30 - .01)	-.12 (-.26 - .03)
Smokeless (Ever)	-.04 (-.24 - .15)	-.01 (-.19 - .17)
Vape (Ever)	-.18* (-.34 - -.01)	-.15 (-.31 - .00)
Cigar (Ever)	-.08 (-.25 - .09)	-.08 (-.24 - .09)
Hookah (Ever)	.07 (-.08 - .23)	.03 (-.12 - .17)
Other Tobacco (Ever)	.05 (-.21 - .31)	.11 (-.13 - .36)
Block 3: Ego Experience OE		
OE Personal Experience Scale	-.09*** (-.12 - -.02)	-.17*** (-.21 - -.13)
Block 4: Ego Social Att. OE		
OE Social Attraction Scale	-.07** (-.12 - -.02)	-.00 (-.05 - .04)
Block 5: Ego Social Avers. OE		
OE Social Aversion Scale	.36*** (.32 - .40)	.16*** (.12 - .21)
Block 6: Ego Health Conc. OE		
OE Health Concerns Scale	-	.36*** (.32 - .41)
Model R^2	.26	.35
ΔR^2	.11***	.08***
Model F	45.23***	62.89***

Note: *p<.05, **p<.01, ***p<.001. Models 1-4 on previous page (Table 18a)

H11: *More positive outcome expectancies will be associated with lower changes in intentions to quit, changes in susceptibility for, and more negative risk beliefs about using e-cigarettes following exposure to anti-vaping messages.*

The previous findings laid out a compelling case for the significance of baseline beliefs about e-cigarettes coloring respondents' reactions to anti-vaping advertisements. This hypothesis sought to examine whether there were any connections between these baseline beliefs and changes in e-cigarette behaviors targeted by the advertisement conditions respondents viewed. H11 was tested in a similar method to that which was discussed for Hypothesis 5. A total of four hierarchical models were employed to answer this hypothesis (*OE Dimensions* – **Δ** Intentions, *OE Dimensions*– **Δ** Susceptibility, *OE Dimensions*– post-exposure Addiction Risk Beliefs [ARB], and *OE Dimensions* - post-exposure Health Risk Beliefs [HRB]). The first step for each model included demographics as controls, followed by previous tobacco use in the second step, personal experiential OE in the third step, social attraction OE in the fourth, social aversion OE in the fifth, and health concerns OE in the sixth (see Tables 19a – 19b).

Results from the first two portions of this hypothesis were mixed following examination of the regression results. As previously stated, pre-post changes in respondent quit intentions and susceptibility were quite small. Modeling these changes in regressions examining how baseline attitudes may have been associated with these changes, then, yielded two weakly associated models, of which only one achieved significance. The final regression model equation examining associations between baseline OE and changes pre-post changes in quit intentions (see Tables 19a – 19b) was significant ($F(18, 972) = 1.75$, $p < .05$) with an R^2 of .03. Although significant, the final model did not explain a vast majority of the observed variance. Additionally, none of

the OE included in the final model was significantly associated with respondent changes in quit intentions.

Table 19a: Block-wise linear regression examining associations between OE dimensions and pre-post changes in respondent quit intentions; *n* = 991

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	.03 (-.01 - .08)	.02 (-.03 - .07)	.02 (-.03 - .07)	.02 (-.03 - .07)
Sex				
Male	REF	REF	REF	REF
Female	-.00 (-.20 - .20)	-.02 (-.23 - .19)	-.00 (-.21 - .21)	-.01 (-.22 - .21)
Trans/Other	.26 (-.49 – 1.01)	.21 (-.54 - .97)	.23 (-.52 - .99)	.23 (-.52 - .99)
Race				
White	REF	REF	REF	REF
Black	.13 (-.22 - .48)	.16 (-.19 - .51)	.18 (-.17 - .53)	.23 (-.13 - .59)
Asian	-.01 (-.44 - .42)	-.06 (-.50 - .37)	-.07 (-.50 - .36)	-.02 (-.46 - .42)
Mixed Race/Other	.12 (-.21 - .44)	.12 (-.21 - .44)	.14 (-.18 - .46)	.14 (-.18 - .47)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	-.16 (-.46 - .14)	-.17 (-.46 - .13)		
SES			-.18** (-.31 - -.05)	-.18** (-.32 - -.05)
Education	-.17* (-.30 - -.03)	-.17* (-.30 - -.03)	-.01 (-.05 - .03)	-.01 (-.05 - .04)
Family HHI	-.01 (-.05 - .04)	-.01 (-.05 - .04)		
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	.17 (-.06 - .40)	.19 (-.04 - .41)	.18 (-.05 - .41)
Smokeless (Ever)	-	.23 (-.02 - .48)	.23 (-.02 - .48)	.23 (-.02 - .48)
Cigar (Ever)	-	-.30* (-.53 - -.06)	-.29* (-.53 - -.06)	-.29* (-.52 - -.05)
Hookah (Ever)	-	.20 (-.02 - .41)	.21 (-.01 - .43)	.19 (-.03 - .41)
Other Tobacco (Ever)	-	-.09 (-.43 - .26)	-.09 (-.43 - .26)	-.06 (-.41 - .29)
Block 3: Ego Experience OE				
OE Personal Experience Scale	-		-.07 (-.14 - .01)	-.06 (-.13 - .02)
Block 4: Ego Social Att. OE				
OE Social Attraction Scale	-	-	-	-.05 (-.12 - .01)
Block 5: Ego Social Avers. OE				
OE Social Aversion Scale	-	-	-	
Block 6: Ego Health Conc. OE				
OE Health Concerns Scale	-	-	-	-
Model R^2	.01	.02	.02	.03
ΔR^2	-	.01*	.00	.00
Model F	1.08	1.54	1.66	1.66*

Note: *p<.05, **p<.01, ***p<.001. Models 5 and 6 continued on next table (Table 19b)

Table 19b: Block-wise linear regression examining associations between OE dimensions and pre-post changes in respondent quit intentions; *n* = 991

	Model 5	Model 6
	β (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos		
Age	.02 (-.03 - .07)	.02 (-.03 - .07)
Sex		
Male	REF	REF
Female	-.01 (-.23 - .20)	-.02 (-.23 - .20)
Trans/Other	.25 (-.51 – 1.00)	.23 (-.52 - .99)
Race		
White	REF	REF
Black	.23 (-.13 - .58)	.23 (-.13 - .59)
Asian	-.01 (-.45 - .42)	-.01 (-.45 - .42)
Mixed Race/Other	.14 (-.18 - .47)	.16 (-.17 - .48)
Hispanic/Latinx (No)	REF	REF
Hispanic/Latinx (Yes)	-.13 (-.43 - .17)	-.15 (-.46 - .15)
SES		
Education	-.17* (-.31 - -.04)	-.17* (-.30 - -.03)
Family HHI	-.01 (-.05 - .04)	-.01 (-.05 - .04)
Block 2: Ego Tob. Use		
Cigarette (Ever)	.19 (-.04 - .42)	.20 (-.03 - .43)
Smokeless (Ever)	.24 (-.01 - .50)	.25 (-.01 - .50)
Cigar (Ever)	-.29* (-.53 - -.06)	-.31** (-.55 - -.08)
Hookah (Ever)	.18 (-.04 - .40)	.19 (-.03 - .40)
Other Tobacco (Ever)	-.04 (-.39 - .30)	-.05 (-.40 - .30)
Block 3: Ego Experience OE		
OE Personal Experience Scale	-.07 (-.15 - .01)	-.07 (-.15 - .01)
Block 4: Ego Social Att. OE		
OE Social Attraction Scale	-.02 (-.09 - .06)	-.02 (-.10 - .05)
Block 5: Ego Social Avers. OE		
OE Social Aversion Scale	-.07 (-.15 - .00)	-.06 (-.15 - .02)
Block 6: Ego Health Conc. OE		
OE Health Concerns Scale	-	-.02 (-.09 - .05)
Model R^2	.03	.03
ΔR^2	.00	.00
Model F	1.74*	1.75*

Note: *p<.05, **p<.01, ***p<.001. Models 1-4 on previous page (Table 19a)

E-cigarette related outcome expectancies also failed to achieve meaningful significance when included in models assessing changes in respondent susceptibility (see Tables 20a – 20b). This could be in part because the average change for susceptibility post exposure was particularly small (*M* = -.03, *SD* = 1.18). However, unlike models assessing changes in quit intentions, the

final regression model equation assessing changes in susceptibility failed to achieve significance ($F(19, 1271) = 1.31$, $p = .17$).

Table 20a: Block-wise linear regression examining associations between OE dimensions and pre-post changes in respondent susceptibility; *n* = 1,291

	Model 1	Model 2	Model 3	Model 4
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	.02 (-.01 - .05)	.02 (-.02 - .05)	.02 (-.02 - .05)	.01 (-.02 - .04)
Sex				
Male	REF	REF	REF	REF
Female	-.05 (-.18 - .08)	-.02 (-.16 - .11)	-.03 (-.17 - .10)	-.03 (-.17 - .10)
Trans/Other	.19 (-.20 - .59)	.25 (-.15 - .64)	.24 (-.16 - .64)	.25 (-.15 - .66)
Race				
White	REF	REF	REF	REF
Black	-.11 (-.29 - .06)	-.14 (-.31 - .04)	-.11 (-.29 - .07)	-.11 (-.29 - .07)
Asian	.08 (-.17 - .32)	.08 (-.17 - .32)	.09 (-.16 - .34)	.09 (-.16 - .34)
Mixed Race/Other	.06 (-.16 - .27)	.05 (-.16 - .27)	.04 (-.17 - .26)	.04 (-.18 - .25)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.10 (-.08 - .28)	.11 (-.07 - .30)	.13 (-.05 - .32)	.15 (-.03 - .34)
SES				
Education	-.05 (-.13 - .03)	-.06 (-.13 - .02)	-.06 (-.13 - .02)	-.06 (-.13 - .02)
Family HHI	-.01 (-.04 - .02)	-.01 (-.04 - .02)	-.01 (-.04 - .02)	-.01 (-.04 - .02)
Block 2: Ego Tob. Use				
Cigarette (Ever)	-	-.09 (-.26 - .08)	-.07 (-.24 - .10)	-.07 (-.25 - .10)
Smokeless (Ever)	-	-.12 (-.39 - .15)	-.11 (-.38 - .16)	-.11 (-.38 - .16)
Vape (Ever)	-	-.12 (-.29 - .04)	-.09 (-.26 - .08)	-.07 (-.24 - .10)
Cigar (Ever)	-	.30** (.09 - .51)	.31** (.10 - .52)	.31** (.10 - .52)
Hookah (Ever)	-	-.06 (-.25 - .12)	-.05 (-.24 - .13)	-.04 (-.23 - .14)
Other Tobacco (Ever)	-	-.05 (-.38 - .28)	-.05 (-.38 - .27)	-.06 (-.38 - .27)
Block 3: Ego Experience OE				
OE Personal Experience Scale	-		-.04* (-.08 - -.00)	-.05* (-.09 - -.00)
Block 4: Ego Social Att. OE				
OE Social Attraction Scale	-	-	-	.00 (-.05 - .06)
Block 5: Ego Social Avers. OE				
OE Social Aversion Scale	-	-	-	-
Block 6: Ego Health Conc. OE				
OE Health Concerns Scale	-	-	-	-
Model R^2	.01	.02	.02	.02
ΔR^2	-	.01	.00*	.00
Model F	1.04	1.33	1.54	1.46

Note: *p<.05, **p<.01, ***p<.001. Models 5 and 6 continued on next table (Table 20b)

Table 20b: Block-wise linear regression examining associations between OE dimensions and pre-post changes in respondent susceptibility; *n* = 1,291

	Model 5	Model 6
	β (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos		
Age	.01 (-.02 - .04)	.01 (-.02 - .04)
Sex		
Male	REF	REF
Female	-.03 (-.17 - .11)	-.03 (-.17 - .11)
Trans/Other	.25 (-.16 - .65)	.25 (-.16 - .65)
Race		
White	REF	REF
Black	-.11 (-.30 - .07)	-.11 (-.30 - .07)
Asian	.09 (-.16 - .34)	.09 (-.16 - .34)
Mixed Race/Other	.03 (-.19 - .25)	.03 (-.19 - .25)
Hispanic/Latinx (No)	REF	REF
Hispanic/Latinx (Yes)	.16 (-.03 - .35)	.16 (-.03 - .35)
SES		
Education	-.06 (-.14 - .02)	-.06 (-.14 - .02)
Family HHI	-.01 (-.04 - .03)	-.01 (-.04 - .03)
Block 2: Ego Tob. Use		
Cigarette (Ever)	-.07 (-.24 - .10)	-.07 (-.25 - .10)
Smokeless (Ever)	-.12 (-.39 - .16)	-.12 (-.39 - .16)
Vape (Ever)	-.08 (-.26 - .09)	-.08 (-.26 - .09)
Cigar (Ever)	.30** (.09 - .52)	.30** (.09 - .52)
Hookah (Ever)	-.05 (-.24 - .14)	-.05 (-.24 - .14)
Other Tobacco (Ever)	-.02 (-.35 - .31)	-.02 (-.35 - .31)
Block 3: Ego Experience OE		
OE Personal Experience Scale	-.05* (-.09 - -.00)	-.05 (-.09 - .00)
Block 4: Ego Social Att. OE		
OE Social Attraction Scale	.00 (-.05 - .06)	.00 (-.05 - .06)
Block 5: Ego Social Avers. OE		
OE Social Aversion Scale	-.01 (-.05 - .03)	-.01 (-.06 - .04)
Block 6: Ego Health Conc. OE		
OE Health Concerns Scale	-	-.00 (-.54 - .84)
Model R^2	.02	.02
ΔR^2	.00	.00
Model F	1.38	1.31

Note: *p<.05, **p<.01, ***p<.001. Models 1-4 on previous page (Table 20a)

These results, combined with the models assessing changes in quit intentions suggest that, at least in a pre-post design, baseline outcome expectancies were not meaningfully associated with changes in either quit intentions or susceptibility for respondents following exposure to anti-vaping messages.

The final portion of this hypothesis predicted a negative relationship between outcome expectancies and post-exposure risk beliefs, suggesting that most positive baseline OE would be associated with lower post-exposure vaping addiction or health risk beliefs. As pre-exposure risk beliefs data were not collected, testing changes in these risk perceptions was not possible. However, by assessing the associations between baseline beliefs and post-exposure risk beliefs, important data about how salient outcomes respondents associate with e-cigarette use may influence promotion of positive public health beliefs about health and addiction risks associated with e-cigarette use following exposure to anti-vaping messages. In short, these data provide a look at how the baseline beliefs a person holds about e-cigarettes may influence key addiction or health risk takeaways from anti-vaping messages a viewer is likely to believe.

Results for this portion of the hypothesis were derived from two-model block-wise regressions (see Table 21). In the first model for both ARB and HRB, demographics and previous tobacco use were included. The second model included all previously examined OE dimensions. In the final models use of vape products was strongly negatively associated with both ARB (ß = -.49, $p < .001$) and HRB (ß = -.33, $p < .001$). The final regression model equation assessing associations between OE dimensions and ARB was significant ($F(19, 2{,}262) = 23.12$, $p < .001$) with an R^2 of .16. As would be expected, higher social aversion (ß = .21, $p < .001$) and health concerns OE (ß = .17, $p < .001$) were positively associated with greater post-exposure ARB. Conversely, higher personal experience OE was negatively associated with ARB (ß = -.07, $p < .05$). Interestingly, greater social attraction OE was also positively associated with higher ARB (ß = .09, $p < .01$), suggesting that respondents could potentially believe that using vaping products is likely to produce favorable social scenarios despite the risk of addiction.

Table 21: Linear regression examining associations between OE dimensions and post-exposure Addiction Risk Beliefs PME; *n* = 2,282

	Model 1		Model 2	
	ARB	HRB	ARB	HRB
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Demos				
Age	-.04* (-.08 - -.00)	-.02 (-.05 - .01)	-.05* (-.08 - -.01)	-.02 (-.04 - .01)
Sex				
Male	REF	REF	REF	REF
Female	.24** (.08 - .40)	.43*** (.29 - .57)	.23** (.08 - .39)	.29*** (.16 - .41)
Trans/Other	.00 (-.51 - .51)	.10 (-.35 - .55)	.04 (-.45 - .53)	.07 (-.31 - .46)
Race				
White	REF	REF	REF	REF
Black	.12 (-.11 - .35)	.04 (-.16 - .24)	.12 (-.10 - .34)	.23** (.06 - .41)
Asian	.10 (-.21 - .41)	-.09 (-.36 - .19)	.04 (-.26 - .34)	-.06 (-.29 - .18)
Mixed Race/Other	-.06 (-.31 - .19)	.07 (-.15 - .30)	-.04 (-.28 - .20)	.07 (-.12 - .26)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	-.09 (-.32 - .13)	-.08 (-.28 - .12)	-.09 (-.31 - .12)	.04 (-.13 - .21)
SES				
Education	.07 (-.03 - .16)	.10* (.02 - .19)	.01 (-.08 - .10)	.01 (-.06 - .09)
Family HHI	.02 (-.01 - .06)	.03 (-.01 - .06)	.01 (-.03 - .04)	.00 (-.02 - .03)
Block 2: Ego Tob. Use				
Cigarette (Ever)	.06 (-.13 - .25)	-.00 (-.17 - .16)	.13 (-.05 - .32)	.16* (.02 - .31)
Smokeless (Ever)	.31* (.07 - .55)	-.21 (-.42 - .01)	.19 (-.04 - .42)	-.23* (-.41 - -.04)
Vape (Ever)	-.98*** (-1.16 - -.79)	-1.12*** (-1.29 - -.96)	-.49*** (-.69 - -.29)	-.33*** (-.49 - -.18)
Cigar (Ever)	-.26* (-.47 - -.05)	-.04 (-.22 - .15)	-.17 (-.37 - .03)	.05 (-.10 - .20)
Hookah (Ever)	.01 (-.18 - .20)	.03 (-.14 - .20)	.08 (-.11 - .26)	.05 (-.10 - .20)
Other Tobacco (Ever)	-.40* (-.72 - -.08)	-.14 (-.42 - .14)	-.36* (-.67 - -.05)	-.09 (-.34 - .15)
Block 3: Ego Experience OE				
OE Personal Experience Scale	-	-	-.07* (-.12 - -.02)	-.13*** (-.17 - -.08)
Block 4: Ego Social Att. OE				
OE Social Attraction Scale	-	-	.09** (.03 - .15)	-.09*** (-.13 - -.05)
Block 5: Ego Social Avers. OE				
OE Social Aversion Scale	-	-	.21*** (.15 - .26)	.19*** (.15 - .23)
Block 6: Ego Health Conc. OE				
OE Health Concerns Scale	-	-	.17*** (.11 - .22)	.38*** (.34 - .42)
Model R^2	.08	*.13*	.16	*.37*
ΔR^2	-	-	.08***	*.25****
Model F	13.17***	*22.65****	23.12***	*71.21*

Note: *p<.05, **p<.01, ***p<.001. ARB = Addiction Risk Beliefs, HRB = Health Risk Beliefs. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of OE; second model includes OE.

Unlike the positive association between social attraction OE and ARB, beliefs about the attractiveness of vaping were negatively associated with Health Risk Beliefs (HRB) (ß = -.09, *p*

< .001), as were personal experience OE (ß = -.13, $p < .001$). Both social aversion (ß = .19, $p < .001$) and health concerns OE (ß = .38, $p < .001$) were positively associated with higher HRB. The final regression model equation for HRB was also significant ($F(19, 2{,}262) = 71.21$, $p < .001$) with an R^2 of .37. The greater explanatory power of the final HRB model, combined with the more pronounced beta coefficients of OE variables within the HRB model suggests that baseline vaping OE may be more important in determining the health risk beliefs an individual is likely to hold following exposure to a brief anti-vaping message than in determining the addiction risk beliefs.

The results from the outcome expectancy hypotheses posed by this study indicate significant associations between e-cigarette baseline beliefs, vaping susceptibility and vaping frequency as well as both *perceptions* and *effects* measures of PME. In a similar manner to how this study struggled to find significant associations between PME measures and minute changes in post-exposure susceptibility or quit intentions, regression models incorporating OE variables to explain these changes struggled to achieve significance. The following section will examine how the baseline attitudes about e-cigarettes examined here as well as the reactions to anti-vaping advertisements respondents were shown may be associated with both the people and attitudes within respondents' networks as well as the interconnectedness of those networks.

Ego Network Descriptives

Respondents in this study reported on over total 15,300 alters within their respective networks. Table 21 reports the demographics and tobacco use statistics for the full networks, health discussion networks (HDN) and social interaction networks (SIN). The majority of alters reported across full networks were egos' friends (61%), who also made up the majority of alters within social interaction (71%) and a plurality of health discussion (45%) networks. There were

a greater percentage of family members (39%) and spouses/partners (9%) within HDN than either SIN or the full network. Nearly one-third of SIN alters reportedly used e-cigarettes, while just over one in four HDN alters vaped ($\chi^2(13{,}960, N = 1{,}339) = 48.21, p < .001$) (see Table 21).

Table 21: Demographic and tobacco characteristics of all captured alters (*N* = 15,393), health discussion alters (*n* = 5,612) and social interactions alters (*n* = 8,349)

	Full Network N (%) or *M* (SD)	Health Discussion Alters N (%) or *M* (SD)	Social Interactions Alters N (%) or *M* (SD)
Age	27.59 (7.83)	30.94 (9.89)	24.40 (6.89)
Sex			
Male	8,067 (52.4)	2,360 (42.5)	4,320 (51.7)
Female	7,050 (45.8)	3,111 (46.6)	3,888 (46.6)
Trans	276 (1.8)	141 (1.7)	141 (1.7)
Race/Ethnicity			
White	10,594 (69.6)	3,966 (73.1)	5,815 (70.2)
Black	2,001 (13.2)	605 (11.1)	1,070 (12.9)
Asian/Pacific Islander	1,013 (6.7)	360 (6.6)	540 (6.5)
Mixed race or Other	1,605 (10.6)	509 (9.3)	861 (10.4)
Hispanic			
Yes	2,066 (14.4)	719 (13.7)	1,148 (13.9)
No	12,282 (85.6)	4,893 (87.2)	7,201 (86.1)
Relation to Ego			
Family Member	4,595 (30.0)	2,194 (39.1)	1,762 (21.1)
Friend	9,391 (61.0)	2509 (44.7)	5,943 (71.2)
Spouse/Partner	906 (5.9)	527 (9.4)	683 (8.2)
Tobacco Use			
E-cigarettes	4,283 (31.4)	1,425 (25.7)	2,723 (32.6)
Cigarettes	3,139 (20.4)	869 (15.7)	1367 (16.4)
Cigars/cigarillos	1,429 (9.3)	416 (7.5)	721 (8.6)
Multi-use	2,175 (14.1)	648 (11.7)	1,151 (13.8)

Independent *t*-tests and chi-square analyses revealed a number of distinct differences between egos' HDN and SIN alters (see Table 22). Health discussion network alters provided more forms of support to egos (M = 2.99, SD = 1.10), than SIN alters (M = 2.42, SD = 1.04) $t(3,177) = 14.91$, $p < .001$. Unsurprisingly, HDN alters were also on average just over 6 years older than their SIN counterparts $t(3,176) = -21.94$, $p < .001$, tended to communicate slightly more frequently with egos $t(3,169) = 5.03$, $p < .001$, and were more likely to be of the same race as ego than SIN alters ($\chi^2(13,961, N = 1,359) = 48.21$, $p < .001$). Social interaction alters were more densely connected with other alters within the network than alters in egos' health discussion networks $t(3,163) = -36.24$, $p < .001$.

Table 22: Means, standard deviations and chi-square or t-test comparisons between health discussion networks (HDN) and social interaction networks (SIN)

	HDN (*n*=5,612)	**SIN** (*n*=8,349)
Variables	*M* (SD) or % (SD)	*M* (SD) or % (SD)
E-cig Users[1]	24.96 (30.35)***	32.28 (33.65)***
Support Functions	2.99 (1.10)***	2.42 (1.04)***
Closeness	8.51 (1.46)***	7.82 (1.64)***
Communication Frequency	5.69 (1.70)***	5.38 (1.75)***
Alter Age	30.94 (9.89)***	24.40 (6.90)***
Sex Homophily	59.84 (28.03)***	66.44 (27.35)***
Race Homophily	78.18 (32.40)***	73.95 (32.66)***
Degree	7.70 (3.96)***	4.88 (1.65)***
Density	.33 (.31)***	.72 (.29)***

Note: [1] Difference indicates significantly higher proportion of e-cig users among HDN of e-cig using egos compared to HDN of non-users, SIN of e-cig users, or SIN of non-users. *p<.05, **p<.01, ***p<.001.

As would be expected, there were a number of indicators demonstrating differences between vapers' network composition and non-vapers' networks (see Table 23). Nearly half of the alters described by vapers within their networks were also vapers, a far greater percentage than non-vapers who listed fewer than one in five vapers among their alters ($\chi^2(95, N = 1{,}359) = 588.98$, $p < .001$). Although the average HDN and SIN had fewer than one multi-tobacco product user in the network, there was still a greater presence of multi-users among vapers' alters ($M = .92$, $SD = 1.31$) than non-vapers' ($M = .38$, $SD = .86$) $t(1{,}818) = -10.41$, $p < .001$. Non-vapers also believed that the alters within their network would react less favorably to them using e-cigarettes ($M = 4.24$, $SD = 1.85$) than alters in vapers' networks ($M = 2.54$, $SD = 1.53$) $t(2{,}252) = 23.30$, $p < .001$.

Table 23: Means, standard deviations and chi-square or *t*-test comparisons between e-cig users' and non-users' social networks.

	Users (*n*=850)	**Non-Users** (*n* = 1,017)
Variables	*M* (SD) or % (SD)	*M* (SD) or % (SD)
E-cig Users[1]	46.68 (27.94)***	17.76 (24.37)***
Multiple tob. product users	.92 (1.31)***	.38 (.86)***
Network injunct. Norm	4.24 (1.85)***	2.54 (1.53)***

Note: [1] Difference indicates significantly higher proportion of e-cig users among HDN of e-cig using egos compared to HDN of non-users, SIN of e-cig users, or SIN of non-users. *p<.05, **p<.01, ***p<.001.

In order to understand potential connections between relevant e-cigarette use behaviors and their respective social environment, this study examined correlations between network variables and e-cigarette behaviors see Table 12. Greater presence of e-cigarette users among alters in an ego's social interactions network was moderately positively correlated with current e-cigarette use $r(1{,}820) = .51$, $p < .001$ and weakly positively correlated with vaping frequency

among users $r(842) = .22$, $p < .001$. Injunctive norms, or the beliefs as to the extent respondents believed individuals within their social interactions network would be upset with their e-cigarette use was negatively correlated with both current e-cigarette use $r(1,820) = -.49$, $p < .001$ and vaping frequency among current users $r(842) = -.26$, $p < .001$. Greater presence of e-cigarette users within respondents' SIN networks was also negatively correlated with SIN e-cigarette injunctive norms $r(1,820) = -.49$, $p < .001$, as was greater presence of multi-tobacco product users $r(1,811) = -.27$, $p < .001$. Interestingly, individuals who reported stronger ties between themselves and their SIN alters were more likely to use e-cigarettes. Current use was weakly positively associated with both SIN support functions $r(1,820) = .12$, $p < .001$ and ego-alter closeness $r(1,819) = .12$, $p < .001$. Vapers whose SIN alters offered more forms of support were also more likely to vape more frequently $r(842) = .10$, $p < .01$.

Table 24: Bivariate correlations between outcome expectancies, personal network variables, and respondent current e-cigarette use

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Current Vaper	-	-	.47***	.23***	-.42***	-.20***	.08**	.07*	-.07**	.01	.05	-.47***	.46***	.21***
2	Past 30-Day Vape	-	-	.19***	-.09**	-.25***	-.06	.13**	.02	-.03	.04	.04	-.20***	.22***	.05
3	Personal Exp. OE	.47***	.19***	-	.46***	-.37***	-.09***	.05	.02	-.10***	-.02	-.00	-.39***	.31***	.23***
4	Social Attraction OE	.23***	-.09**	.06	-	.00	-.09***	-.18***	-.11***	-.10***	-.00	-.08**	.16***	.22***	.12***
5	Social Aversion OE	-.42***	-.25***	-.37***	.00	-	.53***	-.07*	-.03	.05	.01	-.03	.50***	-.34***	-.17***
6	Health Concerns OE	-.20***	-.06	-.09***	-.09***	.53***	-	.05	.03	.03	.01	.03	.32***	-.18***	-.12***
7	Support Functions	.12***	.10**	.07**	-.08***	-.06**	.03	-	.45***	.19***	-.07*	.10***	.07*	-.02	.04
8	Closeness	.12***	.02	.06**	-.00	-.02	.04	.43***	-	.04	-.03	.12***	.06*	-.04	.02
9	Age Homophily	-.07**	-.04	-.07**	-.06*	.05*	.02	.11***	.05*	-	-.14***	.12***	.21***	-.23***	-.11***
10	Gender Homophily	.02	.02	-.03	-.02	-.02	-.00	-.08	-.03	-.14***	-	-.00	-.08**	-12***	.08**
11	Race Homophily	.04	.02	-.01	-.08**	-.02	.03	.07**	.09***	.08**	.04	-	.03	-.04	-.06*
12	Net. Tob Injunc Norms	-.49***	-.26***	-.40***	-.14***	.50***	.27***	-.04	.00	.16***	-.05*	-.02	-	-.51***	-.28***
13	Net. % E-cig Use	.51***	.22***	.31***	.23***	-.33***	-.16***	.07**	.05*	-.18***	.06**	.00	-.49***	-	.42***
14	Net. % Multi-Use	.23***	.05	.23***	.12***	-.18***	-.12***	.07**	.04	-.08**	.03	-.02	-.27***	.40***	-

Note: Social interactions network on bottom half; Health discussion network on the top half. *p<.05, **p<.01, ***p<.001.

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The associations demonstrated between e-cigarette use and SIN variables was largely mirrored in analyzing respondents' health discussion networks. The presence of e-cigarette users within respondents' health discussion network was also positively associated with both current e-cigarette use, $r(1,359) = .46$, $p < .001$, and increased vaping frequency, $r(644) = .22$, $p < .001$. Greater perceived injunctive norms against vaping was again negatively correlated with both current e-cigarette use $r(1,359) = -.47$, $p < .001$ and use frequency $r(644) = -.20$, $p < .001$. These injunctive norms were also moderately negatively associated with the proportion of e-cigarette users in the HDN $r(1,359) = -.51$, $p < .001$ as well as weakly negatively correlated with the proportion of multiple tobacco product using alters $r(1,354) = -.28$, $p < .001$. Similar to findings from the SIN, more supportive HDN networks were correlated with both likelihood to be a current vaper $r(1,359) = .08$, $p < .001$ and vape frequency $r(644) = .13$, $p < .001$. Egos who were closer to their HDN alters were also marginally more likely to be vapers $r(1,358) = .07$, $p < .001$.

RQ1: How are the *compositional* (e.g., proportion of e-cigarette or tobacco users) and *structural* characteristics (e.g., network size or density) of an ego's health and social support discussion networks associated with ego's outcome expectancies regarding e-cigarette use?

Beyond differences between the discussion networks this study analyzed and bivariate correlations, this study sought to examine how various aspects of an individual's network was associated with their baseline attitudes regarding e-cigarette use. This study implemented eight linear regression models to answer this research question (see Tables 25 - 28). Each of the four outcome expectancy dimensions was presented in two models. The first model included all of the ego-level variables (demographics, previous tobacco use), while the second model included network variables. Please note that the data presented in the two tables represents models in

which some variables have been removed either to decrease the presence of multicollinearity errors determined by a variance inflation factor over 2.5 (see Hayes & Cai, 2007; Perry et al., 2018). Insignificant variables that contributed little to the explanatory power of the model were also removed in a step-wise fashion in order to strengthen the fit of the final model. This analytical method allowed the study to examine the incremental associations that both *structural* and *compositional* dimensions of an ego's network have on different outcome expectancy dimensions.

Associations between social interaction network variables and positive outcome expectancies are presented in Table 25. Greater proportion of e-cigarette users was positively associated with more positive personal experiential vaping expectancies (ß = .40, $p < .01$), while greater SIN injunctive norms against e-cigarette use were negatively associated with personal experiential OE (ß = -.15, $p < .001$), as was greater network density (ß = -.19, $p < .05$). Respondents who had greater gender heterophily within their networks were more likely to report more positive personal experiential OE (ß = -.35, $p < .05$)—the coefficient is negative because the variable of interest assesses gender homogeneity, meaning lower homophily is an indicator of greater gender heterophily. The regression model was significant with an adjusted R^2 of .30, ($F(1, 1{,}792) = 47.21$, $p < .001$). These findings indicate that more gender heterogeneous networks with more e-cigarette users were associated with greater ego beliefs about the personal experiential outcomes associated with e-cigarette use at baseline. However, respondents whose networks were more densely connected and contained alters who held stronger negative norms against e-cigarette use were more likely to hold more negative beliefs about how pleasurable vaping may be.

Table 25: Block-wise linear regression examining associations between social interaction network variables and positive e-cigarette outcome expectancies (*n* = 1,792)

	Model 1		Model 2	
	Personal Exp.	Social Att.	Personal Exp.	Social Att.
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Variables				
Age	-.02 (-.05 - .01)	.01 (-.02 - .04)	-.01 (-.04 - .03)	.00 (-.03 - .03)
-Sex				
Male	REF	REF	REF	REF
Female	-.06 (-.19 - .08)	-.34*** (-.46 - -.21)	.04 (-.11 - .19)	-.29*** (-.43 - -.15)
Trans/Other	-.16 (-.59 - .28)	-.19 (-.61 - .22)	-.20 (-.73 - .34)	-.53* (-1.03 - -.02)
-Race				
White	REF	REF	REF	REF
Black	.36*** (.16 - .55)	.76*** (.57 - .94)	.39** (.16 - .62)	.57*** (.36 - .78)
Asian	.13 (-.14 - .39)	.40** (.15 - .65)	.25 (-.03 - .54)	.49*** (.22 - .76)
Mixed Race/Other	-.03 (-.25 - .18)	-.01 (-.22 - .19)	.09 (-.15 - .32)	.10 (-.12 - .32)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.20* (.01 - .39)	.46*** (.27 - .64)	.17 (-.05 - .38)	.35** (.15 - .55)
- SES				
Education	-.09* (-.17 - -.01)	-.00 (-.08 - .08)	-.12* (-.22 - -.03)	-.00 (-.09 - .09)
Family HHI	-.00 (-.03 - .03)	.02 (-.01 - .05)	-.01 (-.22 - -.03)	.01 (-.02 - .04)
Ego Tob. Use				
Cigarette (Ever)	.54*** (.39 - .69)	.30*** (.15 - .44)	.42*** (.25 - .58)	.21** (.05 - .36)
Vape (Ever)	1.47*** (1.32 – 1.63)	.58*** (.43 - .72)	1.22*** (1.03 – 1.40)	.50*** (.32 - .67)
Hookah (Ever)	.21** (.09 - .41)	-.19* (-.34 - -.04)	.20* (.03 - .37)	-.13 (-.29 - .03)
Block 2:Network Variables				
Compositional variables				
Ego-alter gender homophily	-	-	-.35* (-.63 - -.07)	-.29* (-.55 - -.03)
SIN % Ecig Use	-	-	.40** (.14 - .65)	.84*** (.60 – 1.08)
SIN Injunc. Norm Ecig	-	-	-.15*** (-.20 - -.11)	.01 (-.03 - .05)
Structural variables				
SIN Degree	-	-	-.03 (-.08 - .01)	-.09*** (-.14 - -.05)
SIN Density	-	-	-.19* (-.37 - -.01)	-.52*** (-.68 - -.35)
Model Adj. R^2	.26	*.09*	.30	*.13*
Δ Adj. R^2	-	-	.05	*.04****
Model F	68.15***	*17.93****	47.21***	*16.06****

Note: *p<.05, **p<.01, ***p<.001. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of network variables; second model includes network variables.

Similar associations to the previous regression model were found between respondents' beliefs about the social attractiveness of e-cigarette use and their respective social interaction networks. The proportion of vapers within the network had the highest beta coefficient within the final model (ß = .84, p < .001), indicating a strong association between the number of SIN alters who used e-cigarettes and how attractive respondents believed vaping to be. Greater gender

heterogeneity was again associated with more positive beliefs about social attractiveness (ß = -.29, $p < .05$). Unlike personal experiential outcomes, however, there was no significant association between SIN injunctive norms and social attraction OE (ß = .01, *ns*). From a network structure standpoint, larger social interaction networks (ß = -.09, $p < .001$) and more densely connected networks (ß = -.52, $p < .001$) were both negatively associated with beliefs about how socially attractive e-cigarette use is. The final regression model was significant ($F(1, 1{,}792) = 16.06$, $p < .001$) with an adjusted R^2 of .13. These results show similar results as to the previous model. Individuals with more gender heterogeneous social interaction networks, especially those with greater proportions of e-cigarette users are likely to find e-cigarette use more socially attractive. Beliefs about the social norms of SIN alters does not seem to significantly impact this assessment, while larger and more densely connected networks appear to mitigate the positive beliefs about vaping's social attractiveness.

This study also sought to understand how SIN variables were associated with negative outcome expectancies regarding e-cigarette use. In order to test this, a similar two-model structure was utilized using health concerns and social aversion OEs as dependent variables (see Table 26). Unlike positive beliefs about e-cigarette use, there was no statistical connection between the presence of e-cigarette users within an ego's SIN and the ego's beliefs about the health concerns associated with vaping (ß = -.06, *ns*). Ego's beliefs about SIN alters' negative feelings about vaping were positively associated with more negative expected health outcomes (ß = .15, $p < .001$). More densely connected social interaction networks were also indicative of greater health concerns about vaping (ß = .22, $p < .05$). Overall, despite being statistically significant, the final regression model for health concerns outcome expectancies was the weakest of the outcome expectancy models ($F(1, 1{,}792) = 12.14$, $p < .001$)with an adjusted R^2 of .11.

Table 26: Linear regression examining associations between social interaction network variables and negative e-cigarette outcome expectancies (*n* = 1,787)

	Model 1		Model 2	
	Health Concerns	Social Aversion	Health Concerns	Social Aversion
	ß (95% CIs)	*ß* (95% CIs)	*ß* (95% CIs)	*ß* (95% CIs)
Block 1: Ego Variables				
Age	-.03 (-.06 - .00)	.05** (.02 - .08)	-.02 (-.06 - .01)	.04* (.00 - .07)
-Sex				
Male	REF	REF	REF	REF
Female	.32*** (.19 -.46)	-.07 (-.21 - .07)	.27*** (.12 - .42)	-.17* (-.32 - .02)
Trans/Other	-.03 (-.48 - .41)	-.06 (-.51 - .39)	.66* (.11 – 1.20)	.21 (-.32 - .74)
-Race				
White	REF	REF	REF	REF
Black	-.19 (-.39 - .00)	-.00 (-.21 - .20)	-.17 (-.40 - .06)	-.15 (-.37 - .08)
Asian	-.01 (-.28 - .26)	.13 (-.14 - .40)	-.24 (-.53 - .06)	-.03 (-.32 - .26)
Mixed Race/Other	-.02 (-.24 - .20)	-.06 (-.28 - .17)	.03 (-.22 - .27)	.01 (-.22 - .25)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	-.07 (-.27 - .12)	-.06 (-.26 - .14)	-.04 (-.26 - .18)	-.08 (-.29 - .14)
- SES				
Education	.12** (.03 - .20)	.10* (.02 - .19)	.06 (-.26 - .18)	.09 (-.00 - .19)
Family HHI	.05** (.02 - .08)	.02 (-.01 - .05)	.06** (.02 - .09)	.01 (-.02 - .05)
Ego Tob. Use				
Cigarette (Ever)	-.17* (-.33 - -.01)	-.21* (-.37 - -.05)	-.18* (-.35 - -.01)	-.14 (-.30 - .03)
Vape (Ever)	-.69*** (-.85 - -.53)	-1.49*** (-1.65 - -1.33)	-.55*** (-.74 - -.36)	-1.01*** (-1.20 - -.82)
Hookah (Ever)	.04 (-.12 - .20)	-.28** (-.44 - -.11)	.10 (-.08 - .27)	-.10 (-.27 - .07)
Block 2:Network Variables				
Compositional variables				
Ego-alter gender homophily	-	-	.07 (-.22 - .36)	.09 (-.19 - .37)
SIN % Ecig Use	-	-	-.06 (-.32 - .20)	-.22 (-.47 - .04)
SIN Injunc. Norm Ecig	-	-	.15*** (.10 - .19)	.31*** (.26 - .35)
Structural variables				
SIN Degree	-	-	.01 (-.04 - .05)	-.03 (-.07 - .02)
SIN Density	-	-	.22* (-.01 - .36)	.03 (-.15 - .21)
Model Adj. R^2	.06	- *.22*	.11	*.33*
Δ Adj. R^2	-	-	.05***	*.12****
Model F	14.01 ***	*53.69*	12.14***	*52.98****

*Note: *p*<.05, ***p*<.01, ****p*<.001. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of network variables; second model includes network variables.

Associations between negative social beliefs about e-cigarettes and SIN variables was driven entirely by beliefs of the acceptability of vaping among SIN alters. Greater injunctive norms against e-cigarette use among SIN alters was positively associated with stronger beliefs against the social acceptability of e-cigarette use (ß = .31, $p < .001$). No other *compositional* or *structural* network measures were significant in the final model ($F(1, 1{,}792) = 52.98$ $p < .001$)

with an adjusted R^2 of .33. These results indicate that beliefs about the potential negative outcomes associated with e-cigarettes are driven in part by an individual's mental calculus regarding how acceptable the behavior is to the individuals within their social interaction networks. Additionally, when considering the impact of including network variables within these models, three out of the four outcome expectancy models (excluding personal experience OE) were statistically improved when including network variables, with each model gaining at least a 20% net increase in adjusted R^2 explanatory power over the model including only demographic and previous tobacco usage (e.g., network R^2 of .13 compared to a base R^2 of .09). These results provide evidence for the utility of including *compositional* and *structural* network measures to models seeking to understand how attitudes about e-cigarettes may be formed.

The same analytic approach to assessing how social interaction networks were associated with outcome expectancies was used to examine associations with health discussion networks (see Table 27). A number of the results found in the SIN models were mirrored in analyzing HDN. More positive beliefs about the personal enjoyment derived from e-cigarette use were associated with greater proportions of e-cigarette users in the HDN (ß = .48, $p < .001$). Similar to social interaction network results, greater beliefs about the presence of negative injunctive norms among HDN alters was negatively associated with personal experiential OE (ß = -.13, $p < .001$) as were more densely connected health discussion networks (ß = -.24, $p < .05$). The final regression model was statistically significant ($F(1, 1{,}337) = 38.63$ $p < .001$) with an R^2 of .32, indicating that less densely connected health discussion networks with greater proportions of e-cigarette users were positively associated with more positive ego beliefs about the personal experience of vaping.

Table 27: Linear regression examining associations between health discussion network variables and positive e-cigarette outcome expectancies (*n* = 1,337)

	Model 1		Model 2	
	Personal Exp.	Social Att.	Personal Exp.	Social Att.
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Variables				
Age	-.02 (-.05 - .01)	.01 (-.02 - .04)	-.03 (-.07 - .02)	-.02 (-.06 - .02)
-Sex				
Male	REF	REF	REF	REF
Female	-.06 (-.19 - .08)	-.34*** (-.46 - -.21)	.09 (-.09 - .26)	-.36*** (-.52 - -.20)
Trans/Other	-.16 (-.59 - .28)	-.19 (-.61 - .22)	-.02 (-.58 - .54)	-.58* (-1.11 - -.06)
-Race				
White	REF	REF	REF	REF
Black	.36*** (.16 - .55)	.76*** (.57 - .94)	.43** (.15 - .70)	.62*** (.35 - .88)
Asian	.13 (-.14 - .39)	.40** (.15 - .65)	.19 (-.15 - .52)	.65*** (.34 - .96)
Mixed Race/Other	-.03 (-.25 - .18)	-.01 (-.22 - .19)	.14 (-.13 - .41)	.09 (-.16 - .34)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.20* (.01 - .39)	.46*** (.27 - .64)	.16 (-.09 - .40)	.40** (.17 - .63)
- SES				
Education	-.09* (-.17 - -.01)	-.00 (-.08 - .08)	-.14* (-.25 - -.03)	-.01 (-.11 - .09)
Family HHI	-.00 (-.03 - .03)	.02 (-.01 - .05)	-.02 (-.06 - .02)	.01 (-.02 - .05)
Ego Tob. Use				
Cigarette (Ever)	.54*** (.39 - .69)	.30*** (.15 - .44)	.38*** (.18 - .57)	.26** (.08 - .44)
Vape (Ever)	1.50*** (1.35 – 1.66)	.58*** (.43 - .72)	1.31*** (1.09 – 1.53)	.57*** (.37 - .77)
Hookah (Ever)	.25** (.09 - .41)	-.19* (-.34 - -.04)	.25** (.06 - .45)	-.22* (-.40 - -.04)
Block 2:Network Variables				
Compositional variables				
Ego-alter gender homophily	-	-	-.25 (-.56 - .06)	.04 (-.24 - .33)
HDN % Ecig Use	-	-	.48** (.15 - .80)	.76*** (.46 – 1.06)
HDN Injunc. Norm Ecig	-	-	-.13*** (-.18 - -.08)	.00 (-.04 - .05)
Structural variables				
HDN Degree	-	-	-.01 (-.03 - .02)	-.00 (-.03 - .02)
HDN Density	-	-	-.24* (-.46- -.03)	-.20* (-.40 - -.00)
Model Adj. R^2	.26	*.08*	.32	*.12*
Δ Adj. R^2	-	-	.07	*.05*
Model F	68.15***	*17.93****	38.63***	*11.84****

Note: *p<.05, **p<.01, ***p<.001. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of network variables; second model includes network variables.

When examining the social attractiveness respondents attributed to e-cigarette use, once again the variable in the model with the largest beta coefficient was the proportion of HDN alters who used e-cigarettes (ß = .76, p < .001). This large, positive association was tempered by results indicating that more densely connected HDN were negatively associated with beliefs about the

social attractiveness of e-cigarette use (ß = -.20, $p < .05$). In a similar manner to associations found in SIN models, HDN injunctive norms played no significant role in determining social attractive OEs. The final regression model was significant ($F(1, 1{,}337) = 11.84$ $p < .001$) with an R^2 of .12. These results indicate that network variables assessing both the descriptive and injunctive norms of health discussion alters have utility in understanding the social environments that could help form positive beliefs about e-cigarettes. Additionally, these data provide evidence for the utility of analyzing the structure of these discussion networks as well as their attitudinal and behavioral composition.

Negative outcome expectancies about e-cigarettes were also associated with HDN variables in similar ways as in SIN models (see Table 28). Greater health concerns about using e-cigarettes were positively associated with greater beliefs about HDN alters' negative opinions about vaping (ß = .16, $p < .001$), although no other network variables were significant. The final regression model was significant ($F(1, 1{,}339) = 12.86$ $p < .001$) with an R^2 of .13. Beliefs about negative social outcomes associated with vaping were also highly similar to SIN models. Negative social outcomes were positively associated with both greater injunctive norms against vaping (ß = .28, $p < .001$) as well as more densely connected networks (ß = .22, $p < .05$). The final regression model was also significant ($F(1, 1{,}339) = 45.62$ $p < .001$) with an R^2 of .36.

Table 28: Linear regression examining associations between health discussion network variables and negative e-cigarette outcome expectancies (*n* = 1,339)

	Model 1		Model 2	
	Health Concerns	Social Aversion	Health Concerns	Social Aversion
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Variables				
Age	-.03 (-.06 - .00)	.05** (.02 - .08)	-.01 (-.05 - .03)	.06 (.02 - .10)
-Sex				
Male	REF	REF	REF	REF
Female	.32*** (.19 - .46)	-.07 (-.21 - .07)	.24** (.07 - .41)	-.15 (-.33 - .02)
Trans/Other	-.02 (-.46 - .42)	-.06 (-.51 - .39)	.55* (-.00 – 1.10)	-.06 (-.62 - .50)
-Race				
White	REF	REF	REF	REF
Black	-.19 (-.39 - .00)	-.00 (-.21 - .20)	-.07 (-.34 - .21)	-.13 (-.41 - .15)
Asian	-.01 (-.28 - .26)	.13 (-.14 - .40)	-.07 (-.39 - .26)	.24 (-.10 - .57)
Mixed Race/Other	-.02 (-.24 - .20)	-.06 (-.28 - .17)	-.03 (-.29 - .24)	-.05 (-.32 - .22)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	-.07 (-.27 - .12)	-.06 (-.26 - .14)	-.15 (-.39 - .09)	-.14 (-.39 - .11)
- SES				
Education	.12** (.03 - .20)	.10* (.02 - .19)	.04 (-.07 - .15)	.06 (-.05 - .16)
Family HHI	.05** (.02 - .08)	.02 (-.01 - .05)	.04* (.01 - .08)	.01 (-.03 - .04)
Ego Tob. Use				
Cigarette (Ever)	-.17* (-.33 - -.01)	-.21* (-.37 - -.05)	-.17 (-.35 - .02)	-.12 (-.32 - .07)
Vape (Ever)	-.69*** (-.85 - -.53)	-1.49*** (-1.65 - -1.33)	-.59*** (-.80 - -.37)	-1.24*** (-1.46 - -1.02)
Hookah (Ever)	.04 (-.12 - .20)	-.28** (-.44 - -.11)	.04 (-.15 - .23)	-.15 (-.34 - .04)
Block 2:Network Variables				
Compositional variables				
Ego-alter gender homophily	-	-	.10 (-.21 - .40)	.30 (-.01 - .61)
HDN % Ecig Use	-	-	-.03 (-.35 - .29)	-.25 (-.58 - .07)
HDN Injunc. Norm Ecig			.16*** (.11 - .21)	.28*** (.23 - .33)
Structural variables				
HDN Degree	-	-	.02 (-.00 - .04)	.00 (-.02 - .03)
HDN Density	-	-	.10 (-.11 - .31)	.22* (.00 - .43)
		-		
Model Adj. R^2	.06	*.22*	.13	*.36*
Δ Adj. R^2	-	-	.07*	*.15*
Model F	14.01***	*53.69****	12.86***	*45.62****

Note: *p<.05, **p<.01, ***p<.001. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of network variables; second model includes network variables.

These results provide data demonstrating the importance of including both *compositional* and *structural* measures about health discussion networks when attempting to understand the formation of opinions about e-cigarettes. Across all eight models, either networked injunctive or descriptive norms were significantly associated with all analyzed outcome expectancies. Network density was also significantly associated with six of the eight outcome expectancies.

Although HDN models were largely not statistically significantly improved over base models, the explanatory power of each model was raised by at least a 20% net increase in R^2.

Abstracting across SIN and HDN models, these data seem to suggest that respondents with greater proportions of e-cigarette users in core networks such as the HDN and SIN are more likely to hold more positive beliefs about e-cigarettes. However, the attitudes of individuals within these networks also likely plays a significant role; increased injunctive norms negatively affected ego's outcome expectancies in all OE dimensions with the exception of social attraction. Complicating these results is the role of network density. More densely connected networks were commonly associated with more negative outcome expectancies regarding e-cigarette use, lending evidence to the utility of considering how network structure may constrain positive beliefs about e-cigarettes. For example, greater potential for all members of a core network to learn of an individual's vaping appears to tamper the expected enjoyment or social attractiveness of vaping to some degree. Considering the empirical support for connections between respondents' networks and their baseline beliefs about e-cigarette use, this study sought to examine how networks might also shape the next steps in the attitudes-intentions-behaviors theories of reasoned action model, baseline use susceptibility and quit intentions.

RQ2*:* How are the *compositional* and *structural* characteristics of an ego's health and social interaction discussion networks associated with ego's e-cigarette behavioral intentions?

This study utilized four linear regression models to answer this research question. The first two models assessed the differential association of health discussion and social interaction network *compositional* and *structural* variables with baseline e-cigarette susceptibility for non-users (see Table 29). As was the case with network models included in the previous research question, the variables included in this model were pared down to maximize model fit. Two

models are presented for both HDN and SIN, one before the inclusion of *structural* and *compositional* variables, and then a second model demonstrating the change in explanatory power after inclusion of either HDN or SIN network measures.

Table 29: Linear regression examining associations between personal network variables and baseline susceptibility (*n* = 707)

	Model 1	Model 2 SIN	Model 2 HDN
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Variables			
Age	.02 (-.02 - .06)	-.01 (-.05 - .04)	-.03 (-.07 - .02)
-*Sex*			
Male	REF	REF	REF
Female	-.37*** (-.54 - -.19)	-.37*** (-.56 - -.17)	-.30** (-.50 - -.10)
Trans/Other	-.27 (-.80 - .26)	-.32 (-.95 - .31)	-.10 (-.67 - .46)
-*Race*			
White	REF	REF	REF
Black	.61*** (.37 - .85)	.32* (.06 - .59)	.28 (-.02 - .58)
Asian	-.05 (-.38 - .29)	.02 (-.33 - .37)	.03 (-.33 - .40)
Mixed Race/Other	-.20 (-.49 - .09)	-.20 (-.52 - .12)	-.05 (-.37 - .28)
Hispanic/Latinx (No)	REF	REF	REF
Hispanic/Latinx (Yes)	.28* (.03 - .53)	.09 (-.18 - .36)	.15 (-.13 - .43)
- *SES*			
Education	.05 (-.05 - .16)	.06 (-.05 - .17)	.12* (.01 - .24)
Family HHI	.01 (-.04 - .05)	-.00 (-.05 - .04)	.01 (-.04 - .06)
Ego Tob. Use			
Cigarette (Ever)	.64*** (.42 - .86)	.60*** (.38 - .83)	.61*** (.23 - .71)
Vape (Ever)	.49*** (.28 - .71)	.50*** (.27 - .73)	.47*** (.23 - .71)
Hookah (Ever)	-.11 (-.35 - .13)	.00 (-.25 - .25)	.01 (-.25 - .26)
Block 2:Network Variables			
Compositional variables			
Ego-alter gender homophily	-	-.18 (-.54 - .19)	-.02 (-.39 - .34)
NET. % Ecig Use	-	.77*** (.38 – 1.15)	1.11*** (.64 – 1.57)
NET. Injunc. Norm Ecig		-.04 (-.09 - .02)	-.07** (-.07 - -.02)
Structural variables			
NET. Degree	-	-.10*** (-.16 - -.05)	-.05*** (-.07 - -.02)
NET. Density	-	-.46*** (-.68 - -.24)	-.24 (-.49 - .01)
Model Adj. R^2	.09	.15	.18
Δ Adj. R^2	-	.07	.11
Model F	11.48***	10.64***	10.33***

Note: *p<.05, **p<.01, ***p<.001. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of network variables; second model includes network variables.

Greater presence of social interaction network e-cigarette using alters was the strongest predictor of baseline susceptibility among non-users (ß = .77, p < .001). Egos' baseline susceptibility was more highly associated with this metric than previous ever-usage of e-cigarettes or any other

tobacco product. As was the case in previous analyses, *structural* aspects of an ego's social interaction network were negatively associated with baseline susceptibility. Interestingly, perceptions of injunctive norms associated with e-cigarettes among SIN alters was not significantly associated with baseline susceptibility (ß = -.04, *ns*). Respondents with more densely connected networks were less likely to report high levels of baseline susceptibility (ß = -.46, $p < .001$), as were respondents with more individuals within their social interaction networks (ß = -.10, $p < .001$). The final regression model was significant ($F(1, 707) = 10.46$ $p < .001$) with an adjusted R^2 of .15. Although the model did not achieve a statistically significant increase in explanatory power over the base model, the inclusion of SIN variables did grow the adjusted R^2 of the final model by .07 or a net increase of 66% over the base model.

Similar associations demonstrated in the previous model were also present in the model including HDN measures. Once again, the strongest predictor of baseline e-cigarette usage was greater presence of e-cigarette using alters in the health discussion network (ß = 1.11, $p < .001$). Unlike the SIN model, HDN alters' injunctive norms about e-cigarettes were negatively associated with egos' baseline e-cigarette susceptibility (ß = -.07, $p < .01$). Larger health discussion networks were significantly, but weakly associated with ego susceptibility (ß = -.05, $p < .001$), but the density of connections between HDN alters was not significant. The final regression model was significant ($F(1, 707) = 10.33$ $p < .001$) with an adjusted R^2 of .18. The addition of HDN variables to the base model more than doubled the explanatory power of predicting susceptibility through demographic and previous tobacco use variables alone.

This study also sought to examine how HDN and SIN variables were associated with baseline e-cigarette quit intentions for current users (see Table 30). The same control variables and block sections as were used to analyze baseline susceptibility were used to assess this and

subsequent research questions. Compared to the models examining baseline susceptibility, models predicting baseline quit intentions were far less robust. A consistent predictor of high baseline quit intentions was respondent education for both SIN (ß = .26, $p < .001$) and health discussion networks (ß = .28, $p < .001$). The presence of more negative injunctive norms regarding e-cigarette use were positively associated with greater baseline quit intentions (ß = .19, $p < .001$). A very similar effect was found for HDN alters (ß = .18, $p < .001$). Greater density among social interaction network alters was the strongest positive predictor of higher quit intentions (ß = .42, $p < .01$), although HDN density was not significantly associated with baseline quit intentions. Interestingly, greater gender heterogeneity among HDN alters was highly associated with greater quit intentions (ß = .55, $p < .05$). The final regression model for social interaction networks was significant ($F(1, 836) = 3.83$ $p < .001$) with an adjusted R^2 of .05. This marked a significant improvement over the base model ($p < .001$). The final HDN model was also significant ($F(1, 642) = 3.47$ $p < .001$) with an adjusted R^2 of .06. The HDN model was also a significant improvement over the base model ($p < .001$).

These results indicate consistent findings for the utility of using egocentric network variables in assessing baseline respondent susceptibility and baseline quit intentions. Greater presence of e-cigarette using alters among the people respondents see often for social gatherings as well as the people with whom respondents discuss their health was the strongest predictor of higher baseline susceptibility of using e-cigarettes in the near future. This network presence was mitigated across both core networks somewhat by network structure. Larger networks were associated with lower baseline susceptibility, as was denser network connections among egos' SIN alters. The addition of either core network to base models improved the explanatory power of the final model by over 65 percent.

Table 30: Linear regression examining associations between personal network variables and quit intentions (SIN *n* = 836; HDN *n* = 642)

	Model 1	Model 2 SIN	Model 2 HDN
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Variables			
Age	.00 (-.05 - .05)	.00 (-.05 - .06)	.01 (-.05 - .08)
-Sex			
Male	REF	REF	REF
Female	.01 (-.19 - .22)	.02 (-.20 - .24)	-.19 (-.46 - .07)
Trans/Other	-.74 (-1.51 - .02)	-.16 (-1.11 - .79)	-.56 (-1.72 - .59)
-Race			
White	REF	REF	REF
Black	.23 (-.13 - .59)	-.02 (-.44 - -.39)	.38 (-.13 - .89)
Asian	-.11 (-.55 - .33)	-.33 (-.81 - .14)	-.08 (-.63 - .48)
Mixed Race/Other	-.09 (-.41 - .24)	-.16 (-.51 - .19)	.19 (-.21 - .60)
Hispanic/Latinx (No)	REF	REF	REF
Hispanic/Latinx (Yes)	.39* (.08 - .69)	.28 (-.04 - .61)	.24 (-.15 - .63)
- SES			
Education	.22** (.08 - .35)	.26*** (.11 - .41)	.28** (.10 - .47)
Family HHI	.05* (.01 - .10)	.04 (-.01 - .09)	.04 (-.02 - .09)
Ego Tob. Use			
Cigarette (Ever)	-.22 (-.50 - .54)	-.19 (-.43 - .05)	-.21 (-.49 - .08)
Hookah (Ever)	-.13 (-.34 - .08)	-.14 (-.37 - .09)	-.15 (-.41 - .12)
Block 2:Network Variables			
Compositional variables			
Ego-alter gender homophily	-	.35 (-.07 - .76)	.55* (.08 – 1.02)
NET. % Ecig Use	-	-.07 (-.43 - .29)	-.11 (-.56 - .34)
NET. Injunc. Norm Ecig		.19*** (.11 - .27)	.18*** (.09 - .26)
Structural variables			
NET. Degree	-	-.02 (-.09 - .05)	.01 (-.03 - .05)
NET. Density	-	.42** (.13 - .71)	.01 (-.03 - .05)
Model Adj. R^2	*.03*	*.05*	*.06*
Δ Adj. R^2	-	*.04****	*.05***
Model F	3.32***	3.83***	3.47 ***

Note: *p<.05, **p<.01, ***p<.001. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of network variables; second model includes network variables.

Although susceptibility was more associated with the presence of e-cigarette users in these core networks, alters' injunctive norms about e-cigarette use were more associated with baseline quit intentions. More densely connected SIN alters were associated with higher baseline quit intentions as was greater presence of members of the opposite sex in health discussion networks. These results indicate the importance of gathering both *structural* and *compositional* information about alters within at least two dimensions of core networks to better understand

how greater exposure to e-cigarette use may influence young adults' decisions to become e-cigarette users. Data collected from egocentric network methods also demonstrated significant increases over base models in explaining how a current users' beliefs about the social acceptability of the behavior among members of his or her social interaction or health discussion networks can influence that user's intentions to quit using e-cigarettes. Having demonstrated connections between individuals' personal networks and their respective attitudes towards using e-cigarettes and their vaping intentions, the final step of the theories of reasoned action model will now be examined, vaping behaviors.

RQ3*:* How are the *compositional* and *structural* characteristics of an ego's health and social interaction discussion networks associated with ego's e-cigarette use?

In order to answer this research question, this study utilized two ordinal logistic regression models. The two models assessed the differential association of health and social interaction discussion network *compositional* and *structural* variables with ego's e-cigarette use (Tables 31 and 32). The dependent variable for this analysis was the same constructed categorical e-cigarette frequency variable used to assess associations between OE and vaping frequency. The measure included all non-users as a "0," all infrequent users as a "1"(M = 2.80 days vaped/month), all moderate users as a "2" (M = 16.58 days vaped/month) and all heavy users as a "3" (M = 30.00 days vaped/month).

Results from analyzing associations between social interaction network variables and e-cigarette use frequency suggest that, unsurprisingly previous use of other tobacco products was highly associated with greater frequency of vaping (See Table 31). Individuals who had ever used cigarettes (OR = 3.02, $p < .001$) or hookah (OR = 1.69, $p < .001$) were more likely to be more frequent vapers. Greater presence of e-cigarette users in the social interaction network was

the strongest predictor of e-cigarette use frequency in the model (OR = 7.77, $p < .001$). Similar to previous analyses, more negative views of e-cigarette use among SIN alters was predictive of being a more infrequent vaper (OR = .68, $p < .001$). Finally, larger social interaction networks were a small, but significant predictor of greater vaping frequency (OR = 1.07, $p < .05$).

Table 31: Ordinal logistic regression examining associations between social interaction network variables and vape frequency (*n* = 1,801)

Ordered Probit Estimates: *Log Likelihood* = -1,680.84 *LR* χ^2 (16) = 949.38***, *Pseudo* R^2 = .22

	Odds Ratio	Standard Error	*Z*	*[95% Conf. Interval]*
Ego Demos				
Age	.86***	.02	-5.82	(.81 - .90)
Sex				
Male	REF	REF	REF	REF
Female	1.47***	.16	3.59	(1.19 – 1.81)
Trans/Other	.48	.21	-1.71	(.21 – 1.11)
Race				
White	REF	REF	REF	REF
Black	.72	.13	-1.87	(.50 – 1.02)
Asian	.93	.20	-.34	(.60 – 1.42)
Mixed Race/Other	1.09	.19	.52	(.78 – 1.53)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.69*	.11	-2.32	(.51 - .94)
SES				
Education	.95	.07	-.69	(.83 – 1.09)
Family HHI	1.00	.02	.2	(.96 – 1.05)
Ego Tob. Use				
Cigarette (Ever)	3.02***	.34	9.85	(2.43 – 3.77)
Hookah (Ever)	1.69***	.19	4.61	(1.35 – 2.11)
SIN Vars				
Compositional variables				
Ego-alter gender homophily	.72	.15	-1.62	(.48 – 1.07)
SIN % Ecig Use	7.77***	1.34	11.89	(5.54 – 10.89)
SIN Injunc Norm Ecig	.68***	.02	-11.74	(.63 - .72)
Structural variables				
SIN Degree	1.07*	.03	2.10	(1.00 – 1.14)
SIN Density	.90	.12	-.79	(.70 – 1.17)
.cut 1	-2.90	.63	(Ancillary parameters)	
.cut 2	-2.04	.63		
.cut 3	-.75	.62		

Note: *p<.05, **p<.01, ***p<.001.

Unlike SIN alters, more members of an individual's HDN who were of the opposite gender from that individual was a strong negative predictor of vaping frequency (OR = .38, $p < .001$). While previous tobacco use was once again significant (see Table 32), greater proportions of the HDN who were vapers was once again the most significant predictor of greater vaping frequency (OR = 6.85, $p < .001$), while greater norms against e-cigarette use among HDN alters was negatively associated with vaping frequency (OR = .71, $p < .001$). Neither the size or density of health discussion networks were significantly associated with vaping frequency.

These results indicate consistent evidence of examining the *composition* of both health discussion and social interaction networks when attempting to predict how frequently an individual may vape or use e-cigarettes. Across both networks, greater presence of vapers was a strong predictor that an individual would transition towards being a daily vaper. Conversely, respondents whose alters in either their SIN or HDN were more critical of e-cigarette use were less likely to vape as often. Curiously, the presence of alters of the opposite gender of an ego in their HDN was one of the strongest negative predictors of frequent e-cigarette use. Finally, these data present tentative evidence for a potential weak association between the size of an individual's social interaction network and their vaping frequency.

Thus far, this study has presented results indicating that the *structure* and *composition* of an individual's personal network is influential in determining the individual's attitudes about using e-cigarettes, intentions to use or quit using e-cigarettes, and the frequency with which they vape. The final section of this chapter will present results from analyses examining whether, beyond these influences, the components of respondents' respective networks had a direct influence on their near-immediate perceptions of anti-vaping advertisements.

Table 32: Ordinal logistic regression examining associations between health discussion network variables and vape frequency (*n* = 1,349)

Ordered Probit Estimates: *Log Likelihood* = -1,287.59 *LR* χ^2 (16) = 690.49***, *Pseudo* R^2 = .21				
	Odds Ratio	Standard Error	*Z*	*[95% Conf. Interval]*
Ego Demos				
Age	.82***	.02	-6.65	(.77 - .87)
Sex				
Male	REF	REF	REF	REF
Female	1.50**	.18	3.27	(1.18 – 1.91)
Trans/Other	.26**	.13	-2.80	(.10 - .67)
Race				
White	REF	REF	REF	REF
Black	.62	.13	-1.87	(.50 – 1.02)
Asian	.71	.18	-1.37	(.44 – 1.16)
Mixed Race/Other	1.09	.22	.42	(.74 – 1.61)
Hispanic/Latinx (No)	REF	REF	REF	REF
Hispanic/Latinx (Yes)	.61**	.11	-2.64	(.42 - .88)
SES				
Education	.89	.07	-1.46	(.76 – 1.04)
Family HHI	1.03	.03	1.18	(.98 – 1.09)
Ego Tob. Use				
Cigarette (Ever)	3.24***	.42	9.04	(2.51 – 4.18)
Hookah (Ever)	1.86***	.24	4.79	(1.44 – 2.40)
SIN Vars				
Compositional variables				
Ego-alter gender homophily	.38***	.09	-4.32	(.24 - .59)
HDN % Ecig Use	6.85***	1.50	8.77	(4.46 – 10.53)
HDN Injunc Norm Ecig	.71***	.03	-9.59	(.66 - .76)
Structural variables				
SIN Degree	1.01	.02	.68	(.98 – 1.05)
SIN Density	.83	.13	-1.22	(.61 – 1.12)
.cut 1	-5.07	.71	(Ancillary parameters)	
.cut 2	-4.21	.71		
.cut 3	-2.99	.70		

Note: *p<.05, **p<.01, ***p<.001.

RQ4: How do the *compositional* and *structural* characteristics of an ego's health and social support discussion networks relate to ego's perceived effectiveness of anti-vaping advertisements?

This study assessed the relationship between an individual's SIN and HDN network and PME scores through six linear regression models. Two models included either *perceptions* or

effects measures of PME as the dependent variable and control variables such as demographics or previous tobacco usage (see Tables 33 and 34). Social interaction network or HDN variables were then added to these base models to create four additional linear regression models (SIN – *effects*, SIN – *perceptions*, HDN – *effects*, HDN - *perceptions*).

Results from models predicting *effects* PME measures provide data for the importance of collecting both *structural* and *compositional* network-level data when assessing potential receptiveness to anti-vaping messages (see Table 33). Respondents with more e-cigarette users in their social interaction networks were more likely to have a negative opinion about the likely effects of anti-vaping messages (ß = -.28, $p < .05$). Beyond the presence of e-cigarette users, greater SIN injunctive norms against e-cigarette use among was positively associated with PME *effects* measures (ß = .20, $p < .001$). Respondents who had more densely connected SIN alters were also more likely to favorably appraise the likely effects of anti-vaping messages (ß = .20, $p < .001$). The final SIN – *effects* regression model was significant ($F(1, 1{,}801) = 27.03$ $p < .001$) with an adjusted R^2 of .20. The inclusion of SIN variables significantly improved the base model's explanatory power, raising the adjusted R^2 by a net 66% ($p < .001$).

Unlike the final model assessing SIN alters, the proportion of HDN alters who used e-cigarettes was not significantly associated with respondent's *effects* PME scores (ß = -.24, *ns*). Alters' beliefs about the acceptability of using e-cigarettes was significant, however, and positively associated with respondents' *effects* PME scores (ß = .23, $p < .001$). HDN density was not significantly associated with *effects* PME, but there was a very small, positive association between the size of a respondents' health discussion network and their appraisal of anti-vaping message's likely effects (ß = .02, $p < .05$). The final regression model was significant ($F(1, 1{,}349) = 24.64$ $p < .001$), with an adjusted R^2 of .23. The final HDN model was also a significant

improvement over the base model ($p < .001$) and nearly doubled the adjusted R^2 of the base model.

Table 33: Linear regression examining associations between personal network variables and *effects* PME (SIN *n* = 1,801; HDN *n* = 1,349)

	Model 1	Model 2 SIN	Model 2 HDN
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Variables			
Age	-.01 (-.04 - .02)	.01 (-.03 - .05)	.03 (-.01 - .07)
-Sex			
Male	REF	REF	REF
Female	.22** (.08 - .35)	.19* (.04 - .34)	.18* (.01 - .35)
Trans/Other	.12 (-.32 - .56)	.22 (-.32 - .77)	-.00 (-.57 - .56)
-Race			
White	REF	REF	REF
Black	.28** (.09 - .48)	.33** (.10 - .56)	.47** (.18 - .75)
Asian	.05 (-.23 - .32)	-.11 (-.41 - .18)	-.07 (-.34 - .21)
Mixed Race/Other	-.10 (-.23 - .32)	-.07 (-.31 - .17)	-.07 (-.37 - .30)
Hispanic/Latinx (No)	REF	REF	REF
Hispanic/Latinx (Yes)	.06 (-.14 - .26)	.06 (-.16 - .28)	.00 (-.25 - .25)
- SES			
Education	.16*** (.08 - .24)	.14** (.05 - .24)	.05 (-.06 - .16)
Family HHI	.05** (.02 - .09)	.06** (.02 - .09)	.06** (.02 - .10)
Ego Tob. Use			
Cigarette (Ever)	-.31*** (-.47 – -.16)	-.25** (-.42 - -.08)	-.30** (-.49 - -.10)
Vape (Ever)	-.91*** (-1.07 - -.75)	-.63*** (-.82 - -.44)	-.62*** (-.84 - -.40)
Hookah (Ever)	-.07 (-.23 - .09)	.02 (-.15 - .20)	-.09 (-.29 - .10)
Block 2:Network Variables			
Compositional variables			
Ego-alter gender homophily	-	.18 (-.11 - .46)	.06 (-.25 - .38)
NET. % Ecig Use	-	-.28* (-.54 - -.02)	-.24 (-.57 - .09)
NET. Injunc. Norm Ecig	-	.20*** (.16 - .24)	.23*** (.18 - .28)
Structural variables			
NET. Degree	-	.02 (-.03 - .06)	.02* (.00 - .05)
NET. Density	-	.21* (.03 - .40)	.10 (-.11 - .32)
Model Adj. R^2	.12	.20	*.23*
ΔR^2	-	.08***	*.12****
Model F	27.49***	27.03	24.64***

Note: *p<.05, **p<.01, ***p<.001. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of network variables; second model includes network variables.

Many of the associations that were captured between the two networks and *effects* PME measures were mirrored in models examining *perceptions* PME measures, although the final models were not as robustly associated (see Table 34). Greater perceptions of negative SIN

injunctive norms were once again associated with higher *perceptions* PME scores (ß = .18, $p < .001$) as was more densely connected SIN alters (ß = .17, $p < .05$). The final regression model was both significant ($F(1, 1{,}801) = 16.40$ $p < .001$), with an adjusted R^2 of .13 and a significant improvement over the base model predicting *perceptions* PME scores ($p < .001$). The HDN model predicting *perceptions* PME scores was also influenced perceptions of negative norms among HDN alters (ß = .18, $p < .001$). However, unlike the SIN model, no structural measures were significant in the final HDN – *perceptions* model. The final model was significant ($F(1, 1{,}349) = 16.34$ $p < .001$), with an adjusted R^2 of .16. The final model was a significant improvement over the base model ($p < .001$) and more than doubled the explanatory power of the base model ($R^2 = .07$).

These results provide evidence for the need to include both *compositional* and *structural* network measures in predicting post-exposure effectiveness measures for anti-vaping campaigns. Individuals with more e-cigarette users in their social interactions networks were less likely to indicate the anti-vaping messages had any message effects post-exposure. Specific attention should be paid to the role of injunctive norms among alters of both social interaction and health discussion networks. Greater perceived norms against e-cigarette use were consistently associated with higher PME ratings across both *effects* and *perceptions* scales. This study also provides evidence for the importance of *structural* measures of core networks, especially the density of social interaction networks in determining post-exposure *perceptions* and *effects* message effectiveness measures. Finally, models including both networked descriptive and injunctive norms along with network structural measures significantly improved all regression models and increased the explanatory power of these models by at least 66% net over models including only demographic and past tobacco use variables.

Table 34: Linear regression examining associations between personal network variables and *perceptions* PME (SIN *n* = 1,801; HDN *n* = 1,349)

	Model 1	Model 2 SIN	Model 2 HDN
	β (95% CIs)	*β* (95% CIs)	*β* (95% CIs)
Block 1: Ego Variables			
Age	-.01 (-.04 - .02)	-.02 (-.05 - .01)	-.01 (-.05 - .03)
-Sex			
Male	REF	REF	REF
Female	.18** (.06 - .31)	.16* (.02 - .29)	.12 (-.03 - .28)
Trans/Other	.12 (-.28 - .53)	.17 (-.33 - .66)	.10 (-.03 - .28)
-Race			
White	REF	REF	REF
Black	.48*** (.29 - .66)	.47*** (.26 - .68)	.67*** (.41 - .92)
Asian	.03 (-.22 - .28)	-.09 (-.36 - .18)	.03 (-.27 - .33)
Mixed Race/Other	-.02 (-.23 - .18)	-.06 (-.29 - .16)	.01 (-.24 - .26)
Hispanic/Latinx (No)	REF	REF	REF
Hispanic/Latinx (Yes)	.11 (-.06 - .29)	.07 (-.13 - .27)	.09 (-.14 - .31)
- SES			
Education	.12** (.04 - .20)	.10* (.01 - .19)	.05 (-.04 - .15)
Family HHI	.03* (.00 - .06)	.03 (-.01 - .06)	.04* (.00 - .07)
Ego Tob. Use			
Cigarette (Ever)	-.18* (-.33 - -.04)	-.11 (-.26 - .05)	-.18* (-.36 - -.01)
Vape (Ever)	-.54*** (-.69 - -.40)	-.33*** (-.50 - -.15)	-.32** (-.52 - -.12)
Hookah (Ever)	-.06 (-.21 - .08)	.02 (-.14 - .17)	-.06 (-.24 - .12)
Block 2:Network Variables			
Compositional variables			
Ego-alter gender homophily	-	.06 (-.33 - .15)	.23 (-.05 - .52)
NET. % Ecig Use	-	-.10 (-.33 - .14)	-.21 (-.51 - .09)
NET. Injunc. Norm Ecig	-	.18*** (-.03 - .05)	.18*** (.14 - .23)
Structural variables			
NET. Degree	-	.01 (-.03 - .05)	.02 (-.00 - .04)
NET. Density	-	.17* (.00 - .34)	.18 (-.02 - .38)
Model Adj. R^2	.07	.13	*.16*
ΔR^2	-	.06***	*.10****
Model F	14.99***	16.40***	*16.34****

Note: *p<.05, **p<.01, ***p<.001. For parsimony, only two models for each DV are displayed. First model includes all variables before inclusion of network variables; second model includes network variables.

The purpose of this chapter was to present the empirical data collected in this study. These analyses present compelling evidence about the utility of *effects* PME measures in selecting anti-vaping messages, even in a conservative pre-post exposure experiment featuring only two 30-second advertisements. These data also demonstrate the strong associations between baseline beliefs about e-cigarette use and susceptibility, quit intentions, and vaping frequency.

Outcome expectancies about e-cigarettes were also shown to inform reactions to anti-vaping advertisements such that, overall, individuals with more positive beliefs about e-cigarette use were less optimistic about the potential effectiveness of anti-vaping advertisements. Finally, these data demonstrated strong, significant associations between personal network *structural* and *compositional* variables and baseline attitudes, e-cigarette intentions, and e-cigarette use frequency. The data in this chapter concluded by finding evidence for direct associations between the composition and interconnectedness of a young adult's personal networks and his or her near-immediate reactions to anti-vaping advertisements. The following chapter will serve to contextualize these findings within the greater literature and offer recommendations for how these data may help in future message development and evaluation efforts.

CHAPTER 5: DISCUSSION

The previous chapter presented quantitative data collected and analyzed to answer this study's various hypotheses and research questions. The purpose of this chapter is to contextualize and describe the implications of the findings reported in the previous chapter within the confines of the study's aims as well as the theoretical and/or methodological literature that has informed this study. This chapter will finally seek to provide context to the empirical and theoretical contributions of this study. The rest of the chapter will be structured as follows:

1. Summation of the study's overall goals and major research themes
2. Discussion of major findings and theoretical implications for
    - Message testing, and use of perceived message effectiveness [PME]
    - The relationships between e-cigarette outcome expectancies [OE] and e-cigarette usage, perceived norms, and assessments of anti-vaping advertisements
    - How individual's personal networks impact their e-cigarette usage, OE about e-cigarette use, and assessments of anti-vaping advertisements

5.1 Study summary

Before diving into detailed descriptions of the major findings of this study, I believe it is important to briefly restate the major aims and overall purpose of this dissertation. The driving problem behind this dissertation is to fill in gaps in the research on how national anti-vaping campaigns are likely to be received by young adults. As discussed in the literature review of this dissertation, young adults (18-25) are the most likely users of e-cigarettes or other vaping devices of any adult cohort (Mirbolouk et al., 2018). Unfortunately, compared to large-scale

campaigns aimed at deterring youth (< 18) from using e-cigarettes, there has been a significant lack of national anti-vaping ad campaigns targeting this demographic. The lack of a cohesive public health messaging strategy about the potential dangers of vaping has largely ceded depictions of the behavior to either marketing campaigns from vaping companies (Kornfield, Huang, Vera, & Emery, 2015) or through informal social networks (Allem, Dharmapuri, Unger, & Cruz, 2018; Chu et al., 2015). Indeed, there is a need for a national anti-vaping campaigns for targeted at young adults; however, formative research is most pressing.

National health campaigns are inherently expensive and time-consuming endeavors. Therefore, extensive research is needed to ensure that the audience segmentation, message tailoring, and evaluation metrics used to determine these campaigns' ultimate effectiveness are rigorous. This study is built upon a number of research traditions that have helped inform the scope of current effectiveness measures (e.g., Shavitt, 1989; Shimp, 1981). Most uniquely, this study drew from network researchers who have long contended that the networks in which we are enmeshed can have a causal impact on our attitudes and behaviors (Erickson, 1988). This can occur through social influence processes such as repeated exposure to vaping behaviors or attitudes among the members of a person's social environment (Huang, Soto, Fujimoto, & Valente, 2014). These social environmental factors have long been considered important in the adoption and maintenance of attitudes, behavioral intentions, and ultimately behaviors (Ajzen, 1991; Bandura, 1989, 2001; Fishbein & Ajzen, 2011). Therefore, this study sought to better understand how the *structure* and *composition* of young adults' networks can influence respondents' salient attitudes about e-cigarette use, their baseline behaviors and their reactions to anti-vaping advertisements in order to aid in future message development and evaluation efforts.

Salient attitudes about the likely outcomes associated with e-cigarettes have been shown repeatedly to predict current e-cigarette use among young adults (Barker et al., 2019). From a persuasive messaging evaluation standpoint, a foundational theoretical assumption is that individuals seek to maintain their current attitudes about a product or behavior (e.g., Shimp, 1981). Individuals who are presented with messages that contradict existing attitudes or behaviors are likely to react negatively to those messages. For example, one of the most often found results for anti-tobacco message testing is that people who use tobacco products perceive anti-smoking advertisements less favorably than non-users (e.g., Davis & Duke, 2018). This study aimed to extend this research by examining how key dimensions of existing attitudes related to outcomes associated with e-cigarette use are related to an individual's assessments of anti-vaping advertisements. These data are vital in determining ways in which messages may be developed to inoculate or counter-argue against salient attitudes strongly associated young adults' e-cigarette usage or susceptibility.

Existing theories have shaped the underlying assumptions of this study that the members of a person's social network likely influence their e-cigarette behaviors and attitudes and that those attitudes play a key role above and beyond a person's use of e-cigarettes in determining how persuasive they may find an anti-vaping advertisement. This study also sought to explore the potential that the people surrounding young adults may have a direct impact on their reception of anti-vaping messages. In other words, apart from informing e-cigarette use attitudes about the behavior, do the people with whom we interact have a direct influence on our perceptions of an advertisement, even if they are not with us when we see it? Beyond informing theoretical understanding about the role of the social environment in message reception, these data provide important insights into how the effectiveness of a brief anti-vaping message may be

initially influenced by the types of people in our surroundings. In short, these data provide a way to model potential audience members through the *composition* and *structure* of their networks in addition to their baseline quit intentions/susceptibility/e-cigarette usage.

Finally, this study sought to provide additional data about how exactly campaign evaluation researchers should structure their message effectiveness instrumentation. A growing debate has been waged within the communication literatures about the utility of determining whether an ad will be effective by asking individuals whether or not a message is likely to be resonate with audience members. Within the anti-tobacco literatures there is ample evidence that PME scores are associated with quit intentions or quit attempts (Brennan, Durkin, Wakefield, & Kashima, 2013; Davis et al., 2017; Noar, Barker, Bell, & Yzer, 2018). However, there is an emerging debate as to whether it is more beneficial to ask about the likely *effects* an anti-vaping message may have on an individual or to ask the individual about his or her *perceptions* of that message (Rohde, Noar, Prentice-Dunn, Kresovich, & Hall, 2020). As was discussed previously, this study utilized two widely implemented scales (Baig et al., 2018; Davis et al., 2013) that represent examples of two ways of measuring PME.

This study ultimately provides more empirical evidence for this debate by providing additional data about the comparative utility of *effects* and *perceptions* measures in predicting risk beliefs, changes in quit intentions, and changes in susceptibility after viewing an anti-vaping advertisement. Although these effects have been demonstrated in a number of anti-tobacco contexts (see Noar, Barker, et al., 2018), there are still fundamental questions pertaining to how well PME scales developed to test anti-smoking campaigns are suited to examining anti-vaping message effectiveness. As these measures are ultimately the basis of a key method of determining a message's likely effectiveness before launch, the following section will begin by

examining the relative diagnostic capabilities of two potential measurement models that could guide near-future anti-vaping campaign evaluation.

5.2 Perceived message effectiveness findings

PME dimensions

One of the most basic needs when fielding a national messaging campaign is to determine before launch whether or not the campaign's message is likely to resonate with its intended audience. Within the world of anti-tobacco literatures, one of the major ways of testing messages' effectiveness before launch is by surveying large groups of either tobacco users or non-users, showing them the intended message, and asking whether or not the messages are likely to be effective through perceived message effectiveness measures [PME]. This has been standard practice for anti-tobacco messages for three decades, but the measurements used have lacked consistency across studies (Noar, Bell, Kelley, Barker, & Yzer, 2018). Many recent studies either choose to ask respondents about their *perceptions* of an advertisement (e.g., "Did this message grab your attention?" see Davis et al., 2018) or the likely *effects* of a message (e.g., "This message discourages me from wanting to use e-cigarettes" see Rohde et al., 2020). There have been comparatively few studies that have employed models utilizing both dimensions (Brennan et al., 2013 is a noteworthy exception). As recent research into the comparative predictive validity of *effects* and *perceptions* dimensions has called for rigorous testing to determine whether they act independently or can have additive diagnostic capabilities in message testing (see Baig et al., 2019, p. 8), this study sought to determine not only if *effects* or *perceptions* are more finely tuned to detect differences between ad conditions or predict changes in outcomes, but also to determine whether models incorporating both were a significant improvement over either.

This dissertation, then, set out to examine a fundamental question about message testing. First and foremost, does it matter whether researchers ask individuals about their *perceptions* of an anti-vaping message or if they ask about the message's likely *effects*? This study presented over 2,000 young adults with either two graphic, high-sensation FDA *Real Cost* anti-vaping advertisements or two low-sensation, expert testimonial anti-vaping messages and asked them nine PME questions drawn from previously used *effects* and *perceptions* scales.

The results indicated that the nine items broke down into two clear-cut dimensions of PME, indicating that the six questions about message *perceptions* were likely assessing a different aspect of a respondent's message appraisal than the three message *effects* questions. These scales were highly intercorrelated, a finding that echoes previous research examining *effects* and *perceptions* dimensions (Baig et al., 2018). Logically, one would expect two scales assessing a message's likely effectiveness to be somewhat related. However, the extent to which these scales were intercorrelated provides cause for concern in interpreting the results from this dissertation. Early research into PME especially by Dillard and Ye (2008) and Noar and colleagues (2010) posited that PME might be best classified as a unidimensional construct. As this study utilized two previously validated scales for PME, a confirmatory factor analysis structure was used to confirm the presence of two distinct PME factors. This process did not allow for the potential unidimensional results that might have been achieved had an exploratory factor analysis method been employed. Therefore, the good model fit achieved in the results presented above should be approached with caution and understood as derived from theoretical inquiry rather than an exploratory examination of the factor structure. Despite the intercorrelation, the acceptable model fit and scalar reliability of the two PME dimensions allowed the study to proceed to its next stated goal, determining whether one of these PME

dimensions is better suited to predict positive changes in vaping intentions or attitudes following exposure to anti-vaping messages.

In order to determine whether *effects* or *perceptions* items would be better to include in anti-vaping message testing, this study first had to determine whether or not the respective scales were able to capture differences between the two ad conditions. Each of the respondents in this study was randomized to view only one set of advertisements and then all answered the same PME questions. Consistently higher scores for one ad condition were thus considered indicative that those messages were widely considered to be more "effective." Through a series of *t*-tests broken down by ad condition as well as vaping status (current vapers vs. non-users), this study found that FDA ads were widely considered to be more effective than the control ads. Among the entire sample as well as among non-users, the FDA ads were deemed more effective in both the *effects* and *perceptions* PME dimensions. This means that both dimensional scales indicated significant differences when the entire respondent sample was assessed, as well as when only the non-users were considered. However, when only current users were examined, only the PME *effects* scale was able to indicate a significant difference between the FDA ads and the control condition.

These findings were able to provide a baseline understanding of the function of the two PME dimensions in choosing a message. One of the key criticisms about the use of PME has been its predictive capabilities. In short, whether asking people about the likely effectiveness of a message truly *means* anything when selecting which message a campaign should fund and distribute (see O'Keefe, 2018). In response to this criticism, Cappella (2018) argued that PME is a valid measure of effectiveness for message selection, especially in circumstances in which there is a measurable difference in quality between the messages being considered. In other

words, PME scores are most likely to be effective at predicting which messages are more likely to lead to positive outcomes if there is a significant gap in perceived quality between the messages being considered. The ads under consideration within this study provide an opportunity to study PME's diagnostic capabilities when this condition is satisfied. Across the entire sample as well as broken down by use status, the FDA ad condition was consistently, significantly found to be more effective than the control ads. Having established a sizable difference between the two ad conditions based on the PME scales used, this study was able to move forward to examine whether these scores are predictive of positive changes in vaping intentions and beliefs after ad exposure.

The aforementioned *t*-tests employed in this study provided a glimpse into whether one dimension of PME is more suited to anti-vaping message testing. *Effects* measures in this study were the only PME measures that captured a significant difference between the FDA and control conditions among current e-cigarette users. Current users had almost identical *perceptions* of the ads, but the FDA ads were judged as more likely to have positive *effects* on an individual's beliefs and vaping behaviors than the control advertisements. This finding extends the literature as to the diagnostic capabilities of different PME dimensions. Rohde and colleagues (2020) tested the same messages in this study among 557 young adults, finding that both dimensions of PME indicated significant differences between the two ad conditions. This study found the same result when considering the entire sample (users and non-users), but extends the authors' findings by providing large-scale data suggesting that *effects* measures are likely a more finely tuned instrument to incorporate when attempting to select messages among current vapers since only *effects* measures found significant differences between the two conditions among current users.

Thus far, findings from the PME data suggest that *effects* measures, as Baig and colleagues (2018) argued, are potentially capable of more minute differentiation between anti-vaping messages. These findings are presented with the caveat that, although differences were demonstrated in a number of empirical tests, the underlying scales were highly correlated, a phenomenon that has been demonstrated in previous research (Baig et al., 2018). Across users and non-users, *effects* measures were capable of finding significant differences such that *Real Cost* ads were favored over Control ads. In other words, if message testing were to rely solely on either *perceptions* or *effects* measures to identify the "stronger" message, researchers would be well-served to select *effects* measures based on the findings from this study. The following section will examine whether the means differences diagnosed by these PME measures were connected to changes in relevant vaping outcomes post-exposure.

PME and predicting vaping behavior or attitudinal change

Beyond assessing whether PME can determine differences in perceptions about a message, this study sought to examine whether these scores were predictive of positive changes in three major outcomes: quit intentions among users, susceptibility among non-users, and risk beliefs about e-cigarettes. Rohde and colleagues (2020) found that PME *effects* measures, but not *perceptions* measures were associated with post-exposure risk beliefs about vaping as well as vape intentions. This study employed a conservative pre-post experimental methodology to assess similar outcomes. The key difference between this study's method and that employed in the Rohde study was that, in this study respondents were asked about their respective susceptibility or quit intentions both before and after viewing the advertisements. This decision was reached in order to attempt to preempt a key criticism levied by O'Keefe (2019); PME research has largely relied thus far upon correlational evidence to support its diagnostic

capabilities. Essentially, O'Keefe (2019) argues that asking individuals to rate a message and then asking them at follow-up whether or not they have attempted to quit using a tobacco product or if they intend to quit using a tobacco product is not a valid method in determining whether the advertisement with the higher PME score is truly causing a change in those behaviors or intentions. Rather, he argues that what PME may actually be doing is acting as an audience segmentation measure by diagnosing which types of individuals are more likely to be immediately receptive to a message rather than predicting a change caused *by* viewing a message. By assessing quit intentions and susceptibility both before respondents viewed a message as well as after, this study sought to capture whether PME scores were capable of predicting any immediate changes in susceptibility or quit intentions.

Results from block-wise linear regressions predicting changes in susceptibility indicated that there were no significant regression models predicting changes to susceptibility. In other words, when considering an individual's demographics, previous tobacco use, and both *perceptions* and *effects* PME scores, no model achieved significance in predicting any changes to susceptibility. This result, although disappointing is hardly surprising. Rohde and colleagues (2020) found no difference in use intentions among their young adult sample testing the same messages. The pre-post method employed by this study ultimately yielded a dependent variable (change in susceptibility) that was almost non-existent (M = -.03, SD = 1.18, n = 1,342). Logically, this finding makes sense. Respondents viewed two 30-second advertisements and were asked both immediately before and immediately after whether about their susceptibility to using e-cigarettes. Health campaigns generally rely on repeated exposure to messages to achieve a meaningful effect on health beliefs or behaviors, making this test of susceptibility change very conservative and stacked in favor of the null hypothesis.

A similar method was used to determine whether higher PME scores were predictive of changes in quit intentions among current users. Just like non-users, current users saw two advertisements and answered quit intentions questions both before and after viewing the ads. Among the 1,001 current users, there was a cumulative negative impact of viewing the messages (M = -.19, SD = 1.57, n = 1,003), meaning overall viewers were more likely to report being less likely to quit using e-cigarettes post-exposure. This may be due in part to the relatively high levels of negative reactance vapers had to the advertisements, a result that is in line with what attitude toward the ad theory (A_{ad}) (Mitchell & Olson, 1981; Shimp, 1981) and functional attitude theory (Hullett & Boster, 2001) would predict. Essentially, current vapers hold more positive beliefs about vaping (to be discussed more in-depth in the outcome expectancies section) and when presented with a counter argument, are more likely to react negatively to the message. Evidence for this interpretation comes from the significantly lower PME scores for current users than non-users across both *perceptions* and *effects* measures as well as the higher negative reactance among vapers for both ad conditions.

Despite the cumulative negative impact on quit intentions post-exposure, this study found two significant models predicting changes in quit intentions. When *effects* measures, but not *perceptions* measures were included in the regression, *effects* measures were a significant, positive predictor of changes in quit intentions. This means that, despite the overall negative effect of the ads and the conservative nature of the test, higher *effects* PME scores were predictive of positive change in quit intentions immediately post-exposure among current vapers. When *perceptions* items were added to the model, neither PME dimension was significant and the overall model did not gain any explanatory power. These results, from a conservative pre-post exposure test of two 30-second anti-vaping advertisements provide evidence that higher

effects PME scores may be predictive of small, but immediate changes in current vaping young adults' quit intentions. This interpretation should be considered with caution, however, as the overall explanatory power of the model (R^2 = .03) is incredibly small and the *effects* items were only positively significantly associated when *perceptions* items were left out of the model. Having considered these notable limitations, though, this study was able to capture significant positive prediction of quit intentions through *effects* PME measures.

The final outcomes investigated in this study were risk beliefs about e-cigarettes. These beliefs were assessed only post-exposure, meaning that the data for these risk beliefs were correlational and would not address O'Keefe's (2019) criticisms. Recent research has demonstrated that PME scores are associated with higher young adult risk beliefs about vaping following exposure to FDA ads (see Rohde et al., 2020). This study extends those findings by examining two separate dimensions of e-cigarette related risks: health risk beliefs [HRB] and addiction risk beliefs [ARB]. Block-wise linear regression models tested associations between *effects* and *perceptions* PME scores with these two dimensions of vaping risk beliefs. Both PME dimensions were positively associated with both post-exposure HRB and ARB. Digging into the numbers underlying these findings, though, reveals some interesting data about how *effects* and *perceptions* PME measures may be associated with risk beliefs. When testing associations between PME scores and addiction risk beliefs, the final model which included both *effects* and *perceptions* was significant and had significantly improved explanatory power (R^2 = .22) over the model with only *effects* measures (R^2 = .20). This result indicates that, when attempting to model what an individual respondent's post-exposure beliefs about risks of addiction associated with e-cigarettes, it is beneficial to include both measures that ask about the respondent's perceptions of the advertisement as well as the likely effects of viewing that advertisement.

This finding is not necessarily repeated when considering associations between PME scores and health risk beliefs [HRB]. Once again, both *effects* and *perceptions* items were significantly associated with HRB in the final model. The final model for HRB demonstrated greater predictive power (R^2 = .45) than the ARB model (R^2 = .22). However, when examining the relative explanatory power of the final two models in the HRB block-wise regression, the utility of including *perceptions* measures is not as strongly supported. The final model including both *effects* and *perceptions* items has significantly stronger explanatory power than the model with only *effects* items, but the cumulative gain for the R^2 is only .01. Additionally, the final model's *F* score is reduced compared to the *F* score of the model only including *effects* scores. These numbers indicate that the inclusion of *perceptions* scores to the model may not necessarily improve the overall explanatory power of a model that already includes *effects* scores. This result is reminiscent of similar findings from Brennan and colleagues (2013) who found that personalized perceived effectiveness measures (called *effects* measures here) were far more closely associated with desired tobacco outcomes than ad-directed perceived effectiveness measures (called *perceptions* measures in this study).

These results indicate that PME scores are associated with individuals' risk beliefs about e-cigarettes. However, they do not answer O'Keefe's question as to whether the advertisements people viewed, and their subsequent measured perceptions of those advertisements, are indicative of a change in risk beliefs caused by viewing the ads. What can be gleaned from these data is that individuals with higher beliefs about the likely health or addiction risks associated with e-cigarette use are likely to rate both their *perceptions* of a message as well as the likely *effects* of an anti-vaping message more highly. Beyond this association, these data provide a mixed picture of whether to include *effects* PME measures, *perceptions* measures, or both. This

study's data provides support for including both dimensions when the goal is to test messages aimed at educating young adults about the potential addiction risks of vaping. When the goal is to test messages aimed at promoting risk beliefs, the answer is less clear. In this study, the addition of *perceptions* measures marginally improved some aspects of the model, but diminished other aspects.

This study also provides an interesting test of the cumulative effects of single-exposure messages on important outcomes like quit intentions or e-cigarette susceptibility. Despite a large sample size, the pre-post exposure methodology employed by this study failed to find consistent, significant changes to either of these outcomes regardless of message shown. This finding should provide useful data for determining the upper limits of what should be considered effective when testing persuasive health messages. One potential interpretation for this lack of change could be that respondents' pre-exposure scores were still highly salient in their minds when they repeated the measures post-exposure. This could have had a dampening effect on the amount of pre-post change recorded. Delays in collecting post-exposure reactions such as those seen in Davis and colleagues (2013; 2017) could have helped control for this potential effect, but were outside the scope of the current study.

An additional and more pessimistic interpretation of this lack of pre-post movement is that single exposure to messages is simply unlikely to create a measurable significant effect. Young adults in this study either frequently used e-cigarettes or were overwhelmingly likely to have encountered their usage within their respective social networks. Therefore, it could be overly optimistic to believe that exposure to two 30-second ads would functionally alter baseline quit intentions or susceptibility for this audience. If this is the case, then longitudinal data from a panel repeatedly exposed to anti-vaping messages would be useful to determine if the very small

changes demonstrated in the pre-post method employed by this study are likely to accumulate over the course of a campaign or if they are simply statistical noise.

In summation, the data from this study indicate that *effects* PME measures should be included in studies attempting to select anti-vaping messages that are most likely to be effective for young adults. These measures were more finely tuned to eliciting differences in messages for current users, and were the only dimension capable of predicting small but significant changes in quit intentions after a single exposure to two anti-vaping advertisements. This study also provides evidence that *effects* measures were highly predictive of post-exposure health and addiction risk beliefs, but cannot assess whether these beliefs were altered by the advertisements shown. Although there were no significant predictions among either dimension for changes in non-user susceptibility, further research in a longitudinal analysis of a campaign may provide further data for whether PME measures can predict changes in susceptibility after repeated viewing in a non-experimental setting. In the following two sections of this chapter, this study will discuss and contextualize how baseline outcome expectancies about e-cigarettes and the social environment in which respondents are enmeshed can provide valuable insights about additional factors that may influence immediate receptivity of anti-vaping messages.

5.3 Outcome expectancy findings

Outcome expectancies [OE] about e-cigarettes can generally be understood as the fundamental answers to the question: "Well, what did you *think* was going to happen?" Crafting anti-vaping messages requires a detailed understanding of the potential positive and negative outcomes associated with the behavior as understood by the intended audience. The previous section of this chapter detailed how measurement instruments that are finely tuned to the purpose of an anti-vaping message were shown to provide greater diagnostic capabilities than

instrumentation investigating an audience member's *perceptions* of the advertisement's attributes (e.g., how much the ad captured the respondent's attention). That is, PME items asking about the potential *effects* an advertisement would have on the individual were more closely connected to a number of outcomes of interest after ad exposure. This section will offer a continuation of that basic argument for increased correspondence in message testing. Namely, that in order to better understand the effectiveness of a messaging intervention such as an advertisement against e-cigarette use, it is vital to include baseline attitudinal measurements that correspond closely to the specific purpose of the advertisement and the specific beliefs that advertisement seeks to change or fortify.

This study chose to utilize outcome expectancies as its baseline attitudinal measurement for two key reasons. First, OE have long been utilized in substance use literatures to examine the myriad of competing outcomes that could come together to influence health-risk behaviors (Jones, Corbin, & Fromme, 2001). Kirsch (1997) explains that OE can be broken up into either *stimulus* OE, or an outcome that is an indirect effect of a behavior like using e-cigarettes, or a *response* OE that is directly related to the behavior in question. Both categories of OE have been examined in the context of e-cigarette OE. Barker and colleagues (2019) included *stimulus* OE, through socially beneficial outcomes related to e-cigarettes (e.g., that using e-cigarettes will make it easier to fit in with friends). This outcome is not a direct result of e-cigarette use such that the act of inhaling e-cigarette vapor does not directly lead to better social standing, but rather may allow an individual to engage in shared behaviors with other group members, thus increasing social standing. The same study also included personal experiential outcomes, which can be understood as *response* OE. These items examined the potential for e-cigarette use to relieve stress, provide good tastes, or other direct, immediate results of using a behavior in order

to understand which OE dimensions most closely associated with young adult and adolescent e-cigarette usage.

Outcome expectancy measurement's ability to include multiple and potentially conflicting or seemingly illogical dimensions of e-cigarette attitudes provides the theoretical basis for the second major reason this study chose to include OE as a baseline attitudinal measure. Namely, that previous research that compared modeling alcohol dependency through outcome expectancy dimensions against utilizing traditional theories of reasoned action attitudinal measures found OE measurements provided greater explanatory power in explaining alcohol use (Kuther, 2002). In other words, the use of OE measurements targeting specific outcomes related to drinking (e.g., feeling relaxed) outperformed generalize outcome measurements (feeling pleasant/unpleasant) when predicting alcohol use (Kuther, 2002, p. 40). The inclusion of OE to measure specific *stimulus* (social) or *response* (personal experiential) outcomes has been widely utilized in the literatures to understand the attitudes driving individuals to use e-cigarettes (Gibson et al., 2018). This study ultimately sought to extend this research by examining how the OE that lead young adults to use e-cigarettes can be employed to better understand their immediate reactions to anti-vaping advertisements that present negative outcomes associated with e-cigarette use.

Outcome expectancies and baseline outcomes

This study incorporated outcome expectancies in three major ways. First, a series of outcome expectancies were factor analyzed and grouped into distinct dimensions. These dimensions were then examined for their associations with baseline e-cigarette behaviors (e-cigarette usage or susceptibility). Second, OE dimensions were incorporated in analyses examining associations between the individual's beliefs about the outcomes of using e-cigarettes

and their reception of anti-vaping advertisements (PME) as well as subsequent changes in susceptibility or quit intentions. Finally, the dimensions were utilized to examine which OE dimensions were most closely associated with norms regarding e-cigarette use—which will be examined in the network section of this chapter.

Using measures from previous research (e.g., Pokhrel et al., 2018), this study ultimately included four OE dimensions in its final analyses. These dimensions included two positive (social attraction-*stimulus*; personal experience-*response*) and two negative (social aversion-*stimulus*; health concerns-*response*) dimensions. These dimensions were then compared between users and non-users and also included in regression analyses to determine the extent to which each was associated with e-cigarette use as well as baseline susceptibility or quit intentions. As would be expected, individuals who were current vapers had significantly higher positive OE for both social attractiveness and personal experience of using e-cigarettes than did non-users. Vapers were also significantly less worried about the potential health effects or negative social impact of vaping than were non-users. These results largely conform to previous research about e-cigarette outcome expectancies, in which vapers consistently hold more positive beliefs overall about the behavior than non-users (see Barker et al., 2019 for example).

Beyond examining the differences between vapers and non-vapers, this study sought to understand how these dimensions of OE combined to influence susceptibility and overall e-cigarette usage. Outcome expectancies that are closely associated with the risk that a non-user may begin using e-cigarettes in the near future are important to understand in determining how messages aimed at e-cigarette prevention may be received. Similarly, OE that are closely associated with more frequent e-cigarette use may be counter-argued in effective advertisements seeking to limit vaping or encourage quit attempts. Thus, the next section will describe the

associations this study found between baseline OE and baseline susceptibility. Following this discussion, associations between baseline OE and use frequency will be discussed before examinations between OE and PME dimensions and, finally, discussion of OE dimensions and respective changes in susceptibility and quit intentions following exposure to anti-vaping messages.

Outcome expectancies and baseline susceptibility

In order to understand which OE dimensions were most closely associated with a respondent's susceptibility to use e-cigarettes in the near future, this study constructed a block-wise linear regression that controlled for the respondent's demographics and previous tobacco use before including each dimension in a separate block to examine how their respective inclusion changed the model's explanatory power. Among OE dimensions examined in this study, only social aversion was not significant in the final model. The strongest OE predictor for greater baseline susceptibility was social attraction. Beliefs about the social benefits of using e-cigarettes were more strongly associated with vaping susceptibility (β = .46) than previous e-cigarette use (β = .26) and were the strongest predictor of any covariate except previous use of smokeless tobacco (β = .79). These results indicate that perceptions that e-cigarettes will enhance social standing among an individual's peers are a prime motivator for non-users to consider using the products, echoing previous findings about the significance of social enhancement as a positive motivator for vaping susceptibility (see Pokhrel et al., 2014). However, the findings from this study of over 1,200 young adult non-vapers suggest a stronger association between perceptions of social benefits related to e-cigarette use and young adult vaping susceptibility than Pokhrel and colleagues (2014) had previously found.

Greater positive beliefs about the personal experience of using e-cigarettes were also associated with susceptibility, but to a lesser extent (β = .16) than social attraction outcomes. This finding also has basis in previous research examining young adult susceptibility (see Pokhrel et al., 2014; 2018). The more an individual believed he or she was likely to receive immediate positive sensory outcomes from an e-cigarette, the more likely they were to be willing to try the products in the near future. Combined, these positive OE provided evidence that both positive *stimulus* (social attraction) and *response* (personal experience) OE are significantly associated with increased risks that young adults who do not currently use e-cigarettes will use the products in the near future.

As previously mentioned, socially aversive outcomes were not significantly associated with e-cigarette susceptibility among our sample. However, greater concerns about the health risks associated with e-cigarettes were negatively associated with e-cigarette susceptibility (β = -.14). These results provide an interesting look at the motivating beliefs behind what beliefs might be more influential in determining a young adult's e-cigarette susceptibility to e-cigarette use. On average, non-users expressed stronger beliefs about socially aversive outcomes of e-cigarette use (M = 4.39, SD = 1.84) than the socially attractive outcomes (M = 2.35, SD = 1.53). However, individuals who were more inclined to believe vaping was socially acceptable compared to the average non-user were far more likely to indicate their willingness to try e-cigarettes than were individuals who were less reticent about the socially consequential outcomes associated with e-cigarette use. In fact, social aversion OE had next to no influence on the final model, in which increased beliefs about the negative health consequences of e-cigarettes were the only OE dimension to have a negative association with e-cigarette susceptibility.

Outcome expectancies and e-cigarette use frequency

As with young adult e-cigarette susceptibility, young adult e-cigarette use has been examined through outcome expectancies in a number of studies in recent years (see Gibson et al., 2018). Results from these studies often suggest that having greater positive expectancies and fewer negative expectancies are significantly associated with e-cigarette use among young adults (Barker et al., 2019; Pokhrel et al., 2016; Pokhrel, Lam, Pagano, Kawamoto, & Herzog, 2018). However, historically e-cigarette use has often been categorized as a dichotomous variable in studies assessing the role of outcome expectancy dimensions in determining usage. In other words, young adults who use e-cigarettes in the final analyses are either users or non-users. This study sought to extend this literature by creating an ordinal scale for e-cigarette use to determine the extent to which relevant outcome expectancy dimensions not only determined *whether* respondents used e-cigarettes, but also *how often* they used them.

Respondents in this analysis were coded on an ordinal scale from "0" (non-user) to "4" (heavy users). Non-users were individuals who had not used e-cigarettes within the last 30 days, while heavy users were daily users ($M > 29$ of last 30 days). Results from this analysis suggested that personal experiential outcomes were the strongest predictor among tested OE dimensions in determining vape frequency (OR = 1.47). In other words, individuals who held more positive beliefs about the personal experience of e-cigarette use were about one-and-a-half times more likely to move into a higher use status than individuals with less positive beliefs. Similar to the analysis assessing susceptibility, greater beliefs about the social attractiveness of e-cigarette use were also associated with greater use status (OR = 1.23). These results largely conform with dichotomous analyses of e-cigarette use in previous studies (see Barker et al., 2019 for example), but extend those findings to demonstrate that most positive beliefs about the personal experiential or socially attractive outcomes associated with e-cigarettes not only influence the

decision to use e-cigarettes, but are also associated with greater use frequency among adults who already use e-cigarettes. In other words, these positive beliefs about e-cigarettes not only get an individual's "foot in the door" to the behavior, but also underpin the maintenance and growth of e-cigarette use among current users.

Although positive OE dimensions associated with increased baseline susceptibility functioned in much the same way in associations between baseline e-cigarette use, there were distinct differences found in the manner in which negative OE dimensions functioned. Greater health concerns about e-cigarette use were negatively associated with baseline susceptibility for non-users, while perceptions of about socially aversive outcomes added essentially nothing to the final susceptibility model. When examining use frequency, however, these findings were largely reversed. Among all respondents, greater beliefs about the social ramifications of using e-cigarettes were negatively associated with e-cigarette use frequency (OR = .65), while beliefs about the potential health concerns of using e-cigarettes were not significantly associated with how often respondents used e-cigarettes (OR = .96). These findings suggest that, while the beliefs about the health effects of using e-cigarettes are likely important in determining whether or not a young adult will use e-cigarettes or is likely to try them in the near future, individuals who currently use e-cigarettes are more likely to moderate their usage based on social contexts rather than specific concerns about their health.

Outcome expectancies and PME

Having considered the OE dimensions that influence baseline susceptibility and e-cigarette use frequency, this study sought to understand the extent to which these baseline beliefs about e-cigarette use impact the ways in which young adults perceive anti-vaping advertisements. As was discussed in the literature review, baseline attitudes about a product or

behavior have long been theorized as important in determining an audience's reception to a persuasive message. Previous research utilizing PME as a dependent variable has often attempted to model PME scores through previous quit attempts (Davis et al., 2017), quit intentions at baseline (Wakefield et al., 2011) or frequency of tobacco use (Davis, Nonnemaker, Duke, & Farrelly, 2013). Davis and colleagues (2013) employed outcome expectations about quitting cigarettes (e.g., the amount that quitting cigarettes may improve health in 20 years), but there is a gap in the research about the manner in which baseline OE related to the social, health, or personal experiential outcomes associated with a tobacco product may influence initial reaction to anti-tobacco/anti-vaping advertisements. By including these OE dimensions in this analysis, this study extends the literature by describing how *stimulus* and *response* OE dimensions audience members hold at baseline impact reception to anti-vaping messages.

This study assessed this topic by incorporating two separate models. One model examined how baseline OE dimensions' associated with *perceptions* PME, while the other assessed dimensions' associated with *effects* PME. This choice was made in order to determine whether the OE dimensions that corresponded with either e-cigarette susceptibility or e-cigarette use frequency were more closely associated with one dimension of PME over the other. As one of the main points of this study is to determine whether increased correspondence between the attitudes assessed and the post-exposure message testing measurements lead to stronger diagnostic models, it was important to compare model fit between relevant OE and potential dimensions for measuring PME.

Both *perceptions* and *effects* PME dimensions were entered as dependent variables in two block-wise linear regressions that controlled for respondent demographics and previous tobacco use. Each OE dimension was entered in a separate block to examine incremental changes in how

its inclusion helped explain the detected variance in PME scores. The final model for both *perceptions* and *effects* PME dimensions provided an interesting extension of current PME literatures. The final model predicting *perceptions* PME suggests that previous usage of tobacco products is largely unrelated to *perceptions* of an anti-vaping message. Respondent usage of cigarettes, smokeless tobacco, vapes, or other types of tobacco products had no measurable impact on reactions to anti-vaping messages. Likewise, the only demographic variable that was a significant predictor of *perceptions* PME was that black respondents were more likely to have more positive *perceptions* of anti-vaping messages than white respondents (β = .56).

Respondents' personal experience OE about e-cigarette use was negatively associated with *perceptions* PME (β = -.08). Interestingly, although social attraction OE had been positively associated with both respondent vape susceptibility as well as vape frequency, there was no significant association between the social attractiveness an individual afforded vaping and their respective *perceptions* PME of anti-vaping messages. Negative OE were more highly associated with *perceptions* PME, such that greater beliefs about the negative social impact of vaping (β = .13) as well as greater health concerns about vaping (β = .24) were more strongly associated with *perceptions* PME scores than either positive outcome expectancy. The same pattern and directionality of significant outcome expectancy dimensions was found in regression models predicting *effects* PME scores. In the final model, personal experiential OE (β = -.17) was the only negative OE dimension that was significantly associated with *effects* scores, while both social aversion (β = .16) and health concerns (β = .36) were more strongly associated with *effects* PME.

These findings provide two important takeaways that extend the literature about how baseline outcome expectancies about e-cigarettes influence reception to anti-vaping messages.

First, the outcome expectancy dimensions that are most influential in either increasing a young adult's susceptibility to use e-cigarettes or their e-cigarette use frequency do not exactly correspond to their reception to anti-vaping messages, but are important to modeling those reactions. Non-users' perceptions of the social attractiveness of e-cigarette use was most strongly associated with their respective susceptibility to use e-cigarettes. Similarly, social attraction OE were significantly associated with vape frequency across the entire sample. However, this dimension was not associated with either *perceptions* or *effects* PME. This finding indicates that the beliefs about increased social standing are likely more important in starting or maintaining a habit than in determining a reaction to a message against that habit.

This finding may be in large part due to the specific focus of the messages used in this study. Both the *Real Cost* and control advertisements focus on specific dangers of addiction and health risks associated with e-cigarette usage. Expectations about the health risks associated with e-cigarettes were shown to be important in determining baseline susceptibility to e-cigarette use, but not necessarily in determining the frequency with which an individual vapes. However, across both PME dimensions, health concerns OE were the largest behavioral or attitudinal predictor. This indicates that correspondence between the outcome of interest within the vaping messages (health and addiction risks) and baseline attitudinal instrumentation is likely more important to modeling advertisement reception than the inclusion of more salient motivators to use e-cigarettes. In other words, this study posits that the discrepancy is a result of the specific focus of the advertisements—health or addiction risks—making health concerns OE more associated with reactions to those messages than the attitudes that were more closely associated with susceptibility or frequency of vaping.

The second key takeaway from this section is that the explanatory power of the model which included OE and examined respondents' *effects* PME was demonstrably superior to the model examining *perceptions* PME. *Effects* PME was described earlier in the chapter as being a more finely tuned instrument for predicting changes in quit intentions or examining differences in reception to anti-vaping messages among current e-cigarette users. These findings help provide some context as to why this may be the case. Although both *perceptions* and *effects* models were significant, the beta coefficients for all significant OE dimensions demonstrated stronger associations with *effects* PME scores than *perceptions* scores. Additionally, the overall R^2 of the *effects model* (.35) was one-and-a-half times higher than R^2 for the perceptions model (.20). These data provide support for the use of *effects* PME measures by demonstrating the increased role that relevant outcome expectancies associated with e-cigarette susceptibility and use frequency play in predicting *effects* scores over *perceptions* scores.

The theoretical basis upon which PME has been built supposes that greater baseline attitudes for or against a product or behavior are likely to impact the overall reaction an individual has towards that message (e.g., Shimp, 1981). This study detailed a number of attitudinal dimensions (OE) that were relevant in predicting the vaping behaviors that the anti-vaping messages sought to curb. As a message testing instrument, *effects* PME measures were more strongly impacted by relevant respondent attitudes about e-cigarettes. Yzer and colleagues (2015) call for increased correspondence between PME measures and the underlying intention of the persuasive message they are used to evaluate. Results from this study indicate that *effects* measures of PME demonstrate greater correspondence with relevant attitudes than *perceptions* measures.

Outcome expectancies and changes in susceptibility or quit intentions

Having considered how OE is associated with e-cigarette behaviors as well as to the reactions to the messages against vaping respondents viewed, this study also sought to examine how OE dimensions were associated with any changes in e-cigarette intentions or susceptibility that arose post-exposure. This study probed relationships between baseline OE and changes in susceptibility or quit intentions by using the respective outcomes in a block-wise linear regression including the same covariates and model building techniques previously described to test associations between OE and PME above. These tests ultimately were plagued by the same pre-post exposure limitations described in the PME section. Namely, there was so little variance in the scores for changes in susceptibility that no attitudinal or behavioral variable included in the final model was significant (with the curious exception of cigar usage). The same issues befell tests attempting to examine associations between OE dimensions and changes in quit intentions. The final model predicting quit intentions was significant, but again no OE dimensions were significant in the final model.

Ultimately, despite the failure of this study to find any associations between OE dimensions and pre-post changes in either susceptibility or quit intentions, the findings elsewhere from examining OE provide a potential explanation for the failure of these tests to reject the null hypothesis. As was already discussed above, the pre-post nature of this experiment was conservative and arguably unlikely to find any significant changes after respondents only viewed two 30-second advertisements. Considering the associations between PME and OE discussed above, however, some interesting alternative hypotheses can be considered. Perceived message effectiveness, regardless of *effects* or *perceptions* dimension, was most strongly associated with beliefs about the health impacts of vaping. Health concerns OE were also inconsequential in determining vape frequency and the least impactful significant OE dimension associated with

baseline susceptibility. These data provide tangential evidence that the core message promoted by both the control advertisement and the *Real Cost* ads used in this study may not be immediately impactful for young adults.

In other words, the lack of correspondence between the OE most associated with e-cigarette susceptibility and use frequency were not specifically targeted by the advertisements. PME scores ultimately showed significant differences between the control and *Real Cost* conditions, but the actual message effectiveness (at least as tested in this method) may have been hampered by a message strategy that did not target the most salient OE dimensions among the sample. This interpretation is undergirded by another indirect source of evidence. Namely, the strong associations between OE dimensions examined in this study and post-exposure addiction risk beliefs (ARB) and health risk beliefs (HRB). Results from PME analyses indicated strong model support for associations between both *effects* and *perceptions* PME and ARB and HRB. When examining OE in relation to ARB and HRB, health concerns is once again one of the most significant predictors for both. Health concerns OE was the strongest variable in the model predicting post-exposure health risk beliefs and second only to social aversion and ever-use of vaping for predicting post-exposure addiction risk beliefs. In short, the core message of the advertisements used in this study—that e-cigarette use leads to adverse health effects and addiction—correspond to relevant risk beliefs about e-cigarettes, but potentially not the most important outcome expectancies that underlie e-cigarette susceptibility or use among the young adults in this study.

In summation, the data from this study provide insights into how outcome expectancies may be used to develop or test the likely effectiveness of anti-vaping messages. Outcome expectancy dimensions provide important data about the types of beliefs that are most likely to

lead to increased young adult e-cigarette susceptibility or use frequency before exposure to anti-vaping advertisements. These data can be used to craft targeted cessation or avoidance messages by targeting relevant attitudes that lead to negative vaping behavioral choices. Outcome expectancies also provide additional data points when examining perceived message effectiveness measures. In this study, *effects* measures were shown to more strongly correspond with relevant outcome expectancy dimensions than did *perceptions* measures. These data can help guide future researchers in choosing measurement strategies that most closely correspond to the attitudes that inform vaping behaviors. Finally, examining the OE dimensions most closely associated with PME provided some context as to why the messages utilized in this study may have underperformed. This study's assertion that a potential explanation for the lack of positive change in susceptibility or quit intentions is a lack of correspondence between the dimensions of e-cigarette use targeted by the ads and the most significant OE dimensions associated with baseline susceptibility or use frequency. The next section of this chapter will examine how social environmental factors surrounding the respondents in this study may be used to better understand the formation and prominence of OE about e-cigarette use as well as the individual respondents' reactions to anti-vaping advertisements.

5.4 Network findings

The previous sections of this chapter demonstrate that asking individuals to explain whether or not anti-vaping messages they have just seen are likely to have direct impacts on key outcomes related to vaping is a useful strategy to guide message selection for national anti-vaping campaigns. Furthermore, the answers respondents give to questions asking about the likely effects of an anti-vaping message are informed by a number of factors including their baseline beliefs about the likely outcomes associated with using e-cigarettes. Thus far, the

findings in the study have largely conformed to what theories of reasoned action (Ajzen, 1991; Fishbein & Ajzen, 2011) or social learning theories (Bandura, 2009) might predict would influence message reception. Namely, that the previous experiences of respondents (including their previous tobacco use) are integral to forming baseline attitudes about the behavior in question (vaping). Once presented with a message about vaping, these baseline attitudes and previous experiences produce a spectrum of potential reactions based on how the messages either align or are discordant with the baseline beliefs of the respondent.

The findings from this section seek to provide an examination into how the people in this study's social environment may have impacted their baseline attitudes about vaping, vaping behaviors, and ultimately their respective reactions to the advertisements they were shown that were captured through PME instrumentation. In other words, this section seeks to test Erickson (1988) and other network researchers' claims that social networks have direct impacts on attitude formation and maintenance. The underlying rationale for including egocentric network data—respondents' perceptions of the attitudes, behaviors, and interconnections within their respective networks—is to provide data that could aid in future audience segmentation and campaign evaluation for large-scale advertising campaigns. If, as theories of reasoned action and social learning theories contest, the social environment of an individual is an integral variable to consider when modeling attitudes, intentions, or behaviors, collecting detailed data about that social environment should help understand not only vaping behaviors and attitudes, but also help explain respondents' reactions to advertisements about vaping.

The data for this section were captured by a series of name generators answered by the respondents prior to exposure to the advertisements. Respondents were asked to provide the demographic, tobacco use, communication frequency, social support, and perceived closeness of

people with whom they either interacted with socially or with whom they discussed their health as well as to indicate which alters knew one another. These data ultimately provided measures of four key dimensions of a personal network described by Perry and colleagues (2018): network *structure* (e.g., interconnectedness), *function* (e.g., support functions), *strength* (e.g., interpersonal closeness), and *content* (e.g., proportion of e-cig users). These dimensions were operationalized in order to control for criticisms raised in the literature about the flow network paradigm championed by a number of communication scholars (see Shumate et al., 2013), which hypothesize that the *structural* components of a network as the causal mechanism of individual outcomes. Likewise, collection of these four dimensions of personal networks allowed this study to extend previous public health research into network impacts on tobacco use or beliefs by including *structural* measures to the previously studied *compositional* network dimensions (e.g., *content*) published in public health literatures (see Huang et al., 2014). In short, the instrumentation utilized in this study combined contributions to the literature about network impacts on attitudes and behaviors that have examined either network structure or composition. This instrumentation was then used to not only examine existing attitudes and behaviors, but also model individual reactions to anti-vaping messages. The rest of this section will describe the differences between the networks analyzed in this study before discussing associations between individuals' networks and their baseline e-cigarette behaviors and outcome expectancies, and finally discussing findings examining direct associations between personal network variables and post-exposure PME scores.

Describing core health discussion and social interaction networks

One of the key themes of this study is a central argument that increased correspondence between instrumentation selection and outcomes of interest should lead to better explanatory

power in models predicting behaviors or attitudes. This was demonstrated in the increased explanatory power of PME *effects* measures over *perceptions* measures. Additionally, the relatively small impact of the advertisements selected for this study was hypothesized as a lack of correspondence between outcome dimensions discussed in the ads shown to respondents and the outcome expectancy dimensions that were more closely associated with e-cigarette behaviors among respondents. As previous research has indicated that both health (Pokhrel et al., 2015) and social (Barker et al., 2019) outcomes play an integral part in determining e-cigarette use in young adults, this study chose to ask individuals about who they might interact with socially (social interaction networks [SIN]) as well as the individuals with whom they might talk to about their health (health discussion networks [HDN]). This decision was made to attempt to create the closest correspondence between the attitudes that have been shown to influence e-cigarette use and the networks that might be responsible for influencing those attitudes. Specifically, this study sought to delve into the types of individuals and the attitudes that respondents were likely to encounter frequently as repeated exposure to a behavior in a social environment is recognized in theories of reasoned action and social learning theories as a key factor in attitude maintenance and formation (Ajzen, 1991; Bandura, 2001)

Respondents to this study named over 15,300 alters across their SIN and HDN. Comparisons between the two networks revealed some interesting findings. Unsurprisingly, young adults' social interaction networks (SIN alters) were younger, more diverse, more likely to use tobacco products, and were less likely to be related to the respondent than those with whom they discussed their health (HDN alters). Furthermore, respondents reported communicating with their HDN alters more frequently and felt closer to alters with whom they discussed their health. However, the alters from the health discussion network were also less likely to know one another

than those in their social interaction network. This structural difference between the two networks is worth pointing out because it has implications for how the network may influence attitudes or behaviors regarding e-cigarettes. More densely connected networks are likely to be more supportive (although the less dense HDN were more supportive in this study), but may be more restrictive (Perry et al., 2018). Networks in which every alter knows each other likely exert some kind of normative pressure on attitudes or behaviors like e-cigarettes as there is a high likelihood that, should one person in the network know that a young adult is vaping, others in the network would also find out in short order.

The results from this study suggest that young adults' social interaction networks as captured in this sample were more densely connected than their health discussion networks. This is an interesting, but ultimately logical finding. Social interaction network alters for young adults would be expected to be more densely connected as young adults would likely want to interact with individuals whom were also friends or at least acquaintances. It should be noted that the density for these networks may be artificially inflated as the question eliciting network density simply asked which of the alters knew one another, rather than asking for more intimate connections (e.g., "would these people talk if you were not present"). An additional caveat needs to be made in the structure of the networks captured here. Respondents were given questions eliciting social interaction networks first, followed by health discussion networks. The smaller size of health discussion networks, then, can be interpreted in two ways. Young adults may legitimately not have had as many individuals within their networks with whom they discussed their health as individuals with whom they interacted socially. Additionally, respondent fatigue could have played a role in suppressing the number of alters listed in the second name generator.

Namely, respondents may not have wished to add many additional names to the HDN section and instead simply left out alters from this name generator.

Despite the significant differences in closeness and communication frequency between the SIN and HDN alters, the average scores for these variables were near the top of their respective scales, meaning respondents were overall close and communicated frequently with the majority of alters they included in the name generators. This close contact and strong relationships indicate that this study largely captured respondents' "core" networks or highly salient relationships (Hammer, 1983). Because this study captured respondents' core networks, it limits discussion about the effects of weak ties within the analyses proposed. Strong networks and frequent communication among respondents and alters does, however, allow for the study to examine the types of relationships that theories of reasoned action or social learning would hypothesize might have an outsized effect on attitude/behavior formation or maintenance.

Initial cross-comparative analyses between the collective vaping injunctive norms of the SIN and HDN networks and respondents' perceptions of collective injunctive norms of their close friends or family members indicate that the discussion networks included in this study may be qualitatively different than respondents' larger networks. Respondents answered questions not only about how each of their alters in their respective networks might react to them vaping, but also traditional single-item injunctive norm items asking how they believed their "close friends" or "family" would react. Respondents indicated that the people in either their HDN or SIN would likely be more approving of their e-cigarette use than their close friends or family overall might be. Hammer's (1983) conceptualization of a core network of highly salient alters provides a theoretical justification for this data point. Namely, that respondents believe the highly salient

core alters named in this study are more likely to approve of their e-cigarette behaviors than would their peripheral friends or family members not listed.

Outside of the differences demonstrated here between social interaction and health discussion networks, there were marked differences between the networks of e-cigarette users and non-users. Fewer than one-in-five alters in a non-user's network used e-cigarettes. Among current e-cigarette users, nearly half of the alters named in either their HDN or SIN were also e-cigarette users. Current users were also more likely to have multiple tobacco product users in their networks, with each respondent having about one multi-product user in their networks. Fewer than half of non-users named a multi-product user in any of their networks. Finally, e-cigarette users were unsurprisingly more likely to indicate that their network members were more likely to be approving of their e-cigarette use than non-users' alters would be.

This section has described the two core networks that this study examined. These data were collected to test whether the types of people, behaviors, and attitudes contained within these networks had any appreciable influence on the attitudes-intentions-behavior theories of reasoned action model commonly used in modeling health campaign evaluations. The following sections will contextualize the associations found between respondents' HDN and SIN networks and their baseline attitudes towards e-cigarette use, their intentions to use or quit using e-cigarettes, their vaping behaviors, and their ultimate reactions to anti-vaping advertisements.

Networks and baseline outcome expectancies

The above section provides evidence that this study was able to capture data about core networks within the respondents' social environments. These core networks were qualitatively different; social interaction networks were younger, more diverse, and more densely connected;

health discussion networks were older, more strongly tied to the respondent, comprised of more family members, and less likely to know one another. There were also key top-level differences in both the networked injunctive (perceptions of e-cigarette use) and descriptive (number of e-cigarette users) vaping norms between young adult e-cigarette users and non-users. This section will discuss findings of analyses examining the associations between *structural* and *compositional* aspects of SIN and HDN with baseline assumptions respondents had about the outcomes associated with using e-cigarettes.

Personal networks and positive e-cigarette OE

This study sought to understand the extent to which respondents' personal networks were associated with their baseline beliefs about e-cigarettes. In order to examine this, eight block-wise linear regressions were run with each of the four outcome expectancy dimensions as a dependent variable for both SIN and HDN models (see Tables 25 - 28 in the Results chapter). Independent variables were entered in two blocks, the first block included respondent demographic and previous tobacco use, while the second block included network *compositional* (e.g., proportion of network that used e-cigarettes) and *structural* variables (e.g., network density). This study found that respondents who had greater beliefs about the social attractive outcomes associated with e-cigarettes were more likely to both be susceptible to future use and use e-cigarettes more frequently. Running eight models allowed this study to examine how a respondent's social interaction network or health discussion network was associated with each one of the four OE dimensions examined in this study.

Models assessing SIN and HDN associations with social attractiveness OE found compelling evidence for the importance of considering both the *structure* and *composition* of a young adult's personal networks in understanding the formation or maintenance of these beliefs.

From a compositional standpoint, regression models indicate that a higher proportion of e-cigarette users within a respondent's social interaction network was the strongest indicator for more positive social attractiveness outcome expectancies (β = .84). Interestingly, individuals with more gender diverse SIN were less likely to hold positive social attractive OE, possibly due to the fact that female respondents consistently reported lower social attraction OE than male respondents.

The structure of an individual's SIN also played an important role in understanding the amount to which he or she believed using e-cigarettes would make them socially attractive. Larger social interaction networks were negatively associated with social attraction OE, but weakly. Density was a stronger factor, however, as greater interconnectivity between the members of a person's social interaction network was strongly associated with more pessimistic beliefs about the social attractiveness of vaping (β = -.52). These findings are similar to those displayed in HDN models predicting social attraction OE. Once again, the proportion of e-cigarette users in a respondent's HDN was the strongest predictor for more positive social attraction OE (β = .76), and greater alter interconnectedness (density) was negatively associated with social attraction OE.

These findings add to an extensive literature suggesting that the presence of tobacco using alters within an individual's social environment is associated with greater likelihood or frequency of use (Huang, Unger, et al., 2014; Simons-Morton & Farhat, 2010; Stojanovic-Tasic, Grgurevic, Trajkovic, & Pekmezovic, 2016). This study's data underscore the importance of the proportion of e-cigarette users within core networks as a determining factor in influencing the types of attitudes most closely linked to increased susceptibility and also strongly associated with more frequent use in this study. These data also extend the literature by offering an empirical

caveat largely missing from the previous literatures. Denser networks, or networks in which more alters knew one another were associated with more pessimistic beliefs about the social attractiveness of e-cigarette use. In other words, being around more vapers likely increases the amount to which a young adult believes vaping is socially attractive, but if those networks also include non-users and are densely connected, their beliefs would likely be tempered.

Alongside social attractiveness OE, the baseline beliefs a young adult held about the way using e-cigarettes was likely to make them feel was an important factor in modeling baseline susceptibility for non-users and frequency of use for current users. Unlike social attraction, which was an example of a *stimulus* OE, or an indirect outcome associated with vaping, personal experience is an example of a *response* OE, or an outcome that is directly generated through the behavior in question. As a result, the most prominent variable in determining personal experiential OE for both SIN and HDN models was previous vape status. In other words, the beliefs about taste, stress release, or other personal experience OE were most closely tied with whether or not the respondent had ever used e-cigarettes. Outside of direct prior experience with vaping, however, network *compositional* variables in both the SIN and HDN were most closely associated with personal experience OE in this study's data. The proportion of e-cigarette users in the SIN (β = .40) and HDN (β = .48) were once again significantly associated with respondents' OE and greater density in both networks was negatively associated with personal experiential OE. Greater gender diversity in SIN was also negatively associated with personal experience OE (β = -.35), but this effect was not seen in the HDN model.

Unlike models testing associations between network variables and social attraction OE, both social interaction and health discussion network injunctive norms were negatively associated with personal experience OE. This finding presents an interesting look into an

example of the differential impact of networks in attitudinal dimensions. As Erickson (1988) and other researchers have hypothesized, this study found key associations between network variables and both positive outcome expectancy dimensions tested. However, the composition of these networks functioned differently for expectancies related to social attraction versus those related to personal experience. Young adults' baseline attitudes about how much they were likely to enjoy using e-cigarettes was negatively impacted by greater perceived injunctive norms against e-cigarette use in both their SIN and HDN. Paradoxically, their beliefs about how socially attractive e-cigarette use would make them appear was not influenced in any way by their perceived injunctive norms of their SIN or HDN. These analyses present preliminary data suggesting that not only do the *structure* and *composition* of different young adults' personal networks influence the extent to which they believe positive outcomes will arise from using e-cigarettes, these networks influence separate positive OE dimensions in disparate ways. Greater proportion of e-cigarette users in all networks was associated with all positive e-cigarette OE, while greater density was negatively associated with all positive OE. However, respondents' perceptions of the extent to which e-cigarette use was approved of by members of their HDN or SIN only significantly influenced their beliefs about how much they would enjoy the sensations associated with e-cigarettes, not the amount to which they believed e-cigarette use would make them socially attractive.

Personal networks and negative outcome expectancies

When testing associations between OE dimensions and baseline e-cigarette behaviors, beliefs about socially disadvantageous outcomes were not associated with an individual's baseline susceptibility of using e-cigarettes. They were highly important, however, in determining the frequency with which young adults vaped. When positive social outcomes were

tested against network variables, the networked descriptive norms—the number of e-cigarette users in the respondents' SIN or HDN networks—were key factors in understanding how attractive respondents thought vaping might be to others. Interestingly, when negative social outcomes were included as the dependent variable, networked descriptive norms were nowhere near significant. In other words, the number of people who vaped in respondents' HDN or SIN had no impact on their beliefs about how vaping might negatively impact their social standing.

Greater beliefs that using e-cigarettes would be viewed disapprovingly by people that young adults interacted socially or spoke with about their health were closely linked with young adults' beliefs about the socially negative outcomes associated with e-cigarettes. Although the number of people who vaped in respondents' HDN or SIN did not seem to matter, respondents' perceptions of what those alters *thought* about vaping was highly significant. Outside of whether or not individuals had ever vaped, SIN ($\beta = .31$) and HDN ($\beta = .28$) were the strongest predictors of social aversion OE in their respective models. In the health discussion network model, the positive association between HDN injunctive norms was joined by a positive association between HDN density and social aversion OE. The opinions HDN alters had about e-cigarettes mattered to our respondents' perceptions of the social acceptability of vaping, but so did the interconnectedness of HDN alters.

Concerns about the likely health impacts of using e-cigarettes were demonstrated to be more useful in determining whether an individual was a vaper or non-vaper rather than examining the extent to which an individual vaped. This might indicate that individuals' perceptions of health risks associated with vaping act as more of a threshold than a spectrum across users. People who are sufficiently concerned with health impacts may just not vape rather than reduce their vaping out of health concerns. Analysis of the social-environmental context

surrounding these beliefs revealed patterns largely in conjunction with socially aversive outcomes. Young adults' health concerns were once again not connected to the number of e-cigarette users in either respondents' HDN or SIN. Rather, like beliefs about the negative social outcomes associated with vaping, respondents were much more influenced by their perceptions of the acceptability of vaping among their network alters. Health concerns were significantly associated with social interaction network density as well as SIN injunctive norms, but not HDN density. This is a reversal of the pattern demonstrated in socially aversive outcomes, where the density of health discussion network alters was important, but not those with whom respondents saw for informal social occasions.

Interpreting networks and outcome expectancies

This study sought to understand how vaping-related attitudes might be influenced by the *composition* and *structure* of the respondent's personal networks. Network researchers like Erickson (1988) have suggested that personal networks exert a causal influence on the adoption and maintenance of attitudes. As this was a cross-sectional study, the question of causality cannot necessarily be grappled with by the analyses performed and interpreted here. However, this study did find significant associations between the habits and beliefs of the people within the respondents' networks and respondents' beliefs about vaping outcomes.

The choice to include health discussion and social interaction networks was guided by previous research demonstrating that beliefs about the socially advantageous or disadvantageous outcomes associated with e-cigarette use, along with potential health repercussions, impact the likelihood that young adults will vape (Barker et al., 2019; Pokhrel et al., 2015). Capturing more extensive data about the *structural* and *compositional* aspects of a young adult's personal network allowed this study to build upon previous research examining how subjective norms

related to e-cigarette use impacted young adult's tendency to use the products. Namely, this study sought to move beyond single-item measures of injunctive or descriptive norms that have been widely used in the literature (see Kong et al., 2014; Pepper et al., 2017). Instead of asking about close friends or family's use or beliefs about e-cigarettes, this study was able to encourage users to divulge the demographic and tobacco use behaviors and attitudes of members of their core networks and construct networked descriptive and injunctive norms from those alters with whom respondents conversed with often and were overall quite close.

This study ultimately found strong support for the overall theoretical assertion that attitudes related to e-cigarettes are closely associated with elements of an individual's social network. The data collected in this study contribute to two ongoing research traditions relevant to health communication. First, the use of discussion networks and structural components adds to current public health research examining the interrelation of social environments and key attitudes about e-cigarettes. As discussed previously, researchers such as Huang and colleagues (2014) or Stojanovic-Tasic et al. (2016) have used various types of social environmental measures including personal networks to determine the extent to which exposure to tobacco-using network alters impacts the likelihood that people will use tobacco products. This study helps extend those findings by examining not only direct effects of network tobacco usage on e-cigarette use (discussed more fully in the next section), but also the impact that tobacco use in these networks impacts key attitudes about vaping that were shown to be associated with susceptibility or increased vaping frequency.

Second, this study extends public health research into network impacts on tobacco usage among young adults by adopting structural measures that have proliferated in communication literatures in no small part due to the influence of the network flow paradigm of information

exchange (Shumate et al., 2013). Briefly, the network flow theoretical model suggests that the ultimate driving force behind individual behaviors and attitudes can be found in how those individuals are situated within complex social networks. This model is built off of the work done by Burt (2004) and other structural network researchers. This study does not wholly adopt the causal claims made by network flow theorists, but sought to incorporate *structural* measures alongside the *compositional* variables that have previously been used in tobacco literatures. This choice allowed the study to demonstrate how the structure of a person's network can have categorically opposite effects of its compositional elements. In other words, one of the key contributions that can be taken from this study is that the detrimental impact of greater proportions of alters who use addictive products on individuals' beliefs about those products can be offset to some extent by increased interconnectedness among network alters.

Finally, this study contributes to a nascent literature examining the role networks play on forming relevant attitudes about e-cigarettes (Pokhrel, Fagan, et al., 2018). Pokhrel and colleagues (2018) have published the first structural equation model demonstrating network associations between an ego's personal network, relevant outcome expectancies about e-cigarettes, and ultimately young adult usage. This study furthers the examination started by these researchers by demonstrating how negatively valanced—outcomes whether health or social—tended to be more closely associated with respondents' perceptions of the collective injunctive norms contained within both their HDN or SIN. Positively valanced outcomes, however, were more strongly tied to exposure to the behavior among a greater proportion of their personal networks.

Additionally, this study furthers the methodological rigor associated with collecting egocentric data for explaining e-cigarette phenomena that has previously been used to examine

tie activation following exposure to anti-tobacco messages (Ramanadhan, Nagler, McCloud, Kohler, & Viswanath, 2017) or attitudes about e-cigarettes (Pokhrel, Fagan, et al., 2018) by demonstrating the impact of a network's structure on attitudes. In this study, denser networks tended to increase negative outcome expectancies and temper positive expectancies. This consistent, significant main effect within a number of attitudinal models provides preliminary support for a functional specificity understanding of e-cigarette attitudes (see Perry & Pescosolido, 2010). Namely, alters who were enmeshed in networks in which they were more able to control the flow of information through the network structure were more likely to have more positive e-cigarette outcome expectancies. The ability to use with certain members of a network and keep that action separate from other members of the network appears to be an important factor in predicting baseline e-cigarette outcome expectancies and, as will be discussed in the next sections, e-cigarette usage. These findings lend credence to the continued examination of network cohesion measures when examining network effects on tobacco-related attitudes. As this study is built around a theories of reasoned action attitudes-intentions-behaviors model, the following section will briefly discuss direct network associations with baseline e-cigarette susceptibility and vaping frequency before discussing findings related to how aspects of the study's respondents' personal networks were directly associated with their perceptions of the likely effectiveness of the anti-vaping messages to which they were exposed.

Personal networks and baseline tobacco behaviors

The major crux of the network component of this study was to assess the relationships between *structural* and *compositional* aspects of a young adult's personal networks and his or her baseline attitudes about using e-cigarettes as well as his or her reactions to anti-vaping advertisements. This research aimed to provide more detailed data about the ways in which an

individual's social environment informed their baseline beliefs about an addictive substance that has not been the subject of large-scale national health campaigns aimed at their collective age cohort. It also aimed to help model how these networks and baseline beliefs taken together could better inform the literature's understanding about the potential for networks to have a direct impact on immediate perceptions of anti-vaping messages.

However, it is important to spend a brief amount of time discussing a subsection of this data that provides additional theoretical insights and a methodological contribution to future network approaches to understanding vaping susceptibility and use frequency. Respondents to this survey who were not e-cigarette users provided baseline data about their susceptibility to use e-cigarettes in the near future. Current users also provided data about the number of days in the last month they believe they had vaped. Over 700 non-users and nearly 650 current users provided information about both their networks and their baseline vaping behaviors, creating an opportunity to examine both for associations between the *structural* and *compositional* components of their respective SIN and HDN and those behaviors.

Personal networks and baseline susceptibility

Data from analyses assessing the role of networks in understanding young adult susceptibility provides interesting evidence about how the presence of vaping within networks may directly influence decision making. Mason and colleagues (2017) published a longitudinal study examining introduction of adolescents to addictive behaviors such as alcohol and tobacco. One of the key variables they found that determined tobacco uptake after two years was the presence of tobacco using alters within the networks, particularly those who used the products in the presence of respondents. Small and Sukhu (2016) provide a theoretical context for this, suggesting that individuals may rely on members of their network for information about certain

topics even if they may not normally rely on those members for advice in general. In other words, these network studies seem to coincide with the major suppositions of social learning theories, particularly that exposure to vaping in a network should lead to decreased barriers to initiating vaping among those without a deep repository of knowledge about the subject themselves.

Results from this study seem to align with this theoretical interpretation. Among non-users, the most important variable predicting higher baseline susceptibility was increased presence of vapers in either the SIN (β = .77) or health discussion networks (β = 1.11). The importance of networked descriptive norms of vaping aligns with the patterns among non-users seen in the positive outcome expectancies described above in this chapter. Namely, that descriptive norms were more predictive than networked injunctive norms. There was a small negative association between HDN injunctive norms regarding e-cigarettes and baseline susceptibility, but it was far overshadowed by the positive impact of HDN descriptive norms. Interestingly, there was a significant negative association between the size of both the SIN and HDN networks and baseline susceptibility which coincided with a significant negative association between the density of the respondents' SIN and their baseline susceptibility. These results again paint a complicated picture of the role of social networks in determining baseline susceptibility. In short, those who we would anticipate being the most susceptible to vaping in the near future would be young adult males with relatively small, comparably disconnected social interaction or health discussion networks that contain people who vape. These data suggest that susceptible individuals likely do model their expectations about vaping after those within their inner circle, so long as their networks are not constrained by either a large number of alters or high amounts of interconnectedness between the alters. These findings interject the role of

behavioral restraint discussed by Perry and colleagues (2018) into our interpretation of networked influence processes by suggesting that, once again, *compositional* and *structural* components of the respondents' networks seem to operate differentially to both set expectations about vaping as well as influence decisional balance towards vaping in the near future.

Personal networks and vaping frequency

Although baseline susceptibility among non-users was largely not influenced by the collected injunctive norms of either their SIN or HDN alters, the same cannot be said for vaping frequency. Rather, the amount to which an individual vaped in this study was influenced in highly significant, often contradictory ways by the properties of his or her social interaction or health discussion networks. Like the results from the susceptibility analysis, the largest effect for predicting whether someone would vape more frequently throughout the month was the presence of e-cigarette users in his or her SIN (OR = 7.77) or HDN (OR = 6.85). This coincides with longstanding understanding of tobacco use as a social activity (Ennett & Bauman, 1993; Ennett et al., 2008; Lindstrom & Giordano, 2016). Respondents who had individuals in their core networks who shared their behavior were far more likely to vape more frequently than those whose networks did not share their addiction. Increased negative perceptions about vaping among HDN or SIN alters also reduced the likelihood that a current user would vape more frequently.

In previous analyses of vaping attitudes, female respondents were more pessimistic about the overall beneficial outcomes associated with vaping. However, when examining behavioral patterns associated with vaping, female respondents were more likely to be susceptible to vaping in the near future (OR = 1.47) and more likely to be frequent vapers than males among current users (OR = 1.50). Despite this reversal, there was still a significant negative association between

HDN gender homophily and vaping frequency among our current users (OR = .38). This finding is rather difficult to parse. It is possible that female respondents in this study were more open about trying vaping in the near future despite not being as convinced about the beneficial outcomes associated with it. Once they had begun vaping, they also seem to be more likely to vape with greater frequency than males. However, gender diversity within these networks still had a significant dampening effect on the frequency with which respondents would vape, suggesting that the behavior may thrive especially in highly homophilous groups.

Findings from this section largely confirm broad findings throughout the tobacco literatures. Increased presence of vapers not only leads to more positive beliefs about vaping, but also greater susceptibility for future use and greater frequency of use once the habit has been established. Perceptions of negative opinions within SIN and HDN networks have an opposing effect on both susceptibility and use frequency. These data largely support the conceptualization of a theories of reasoned action framework in understanding individuals' decisional balance towards baseline e-cigarette use. Social network alters who use or have favorable opinions of e-cigarettes appear to either influence non-users towards more positive beliefs about vaping or strengthen the already held beliefs and behaviors of current vapers. Importantly, these data provide additional evidence for the importance of conceptualizing not just the *composition* of alters within young adults' core networks when modeling baseline decisional balance towards using e-cigarettes, but also investigating the role interconnectedness of these networks plays in shaping susceptibility and vape frequency. This section has thus far examined how social networks can influence baseline beliefs and behaviors about vaping among young adults. The following section will interpret data examining whether these networks exert a direct influence on the immediate post-exposure perceptions viewers had regarding anti-vaping advertisements.

Personal networks and PME

Previous sections in this chapter have described a number of factors that influenced respondents' responses to the anti-vaping advertisements to which they were exposed in this study. Individuals who were current vapers were more pessimistic than non-vapers. People who believed that they would be more likely to enjoy the sensations involved with using e-cigarettes or were less concerned about their potential health outcomes also did not perceive the messages as particularly effective. Those who believed vaping would make them appear socially disadvantageous were more optimistic about the effectiveness of the messages. Thus, the baseline attitudes individuals had before the viewing, as well as their experiences as either vapers or non-vapers were important factors in their interpretations of the advertisements.

This chapter has also established clear connections between the personal networks in which individuals were enmeshed and their baseline e-cigarette beliefs. Respondents in networks with more vapers tended to believe that they would enjoy the sensation of vaping more and that vaping would make them appear to be more socially attractive. Respondents with alters whom they perceived to be more critical of e-cigarette use were more likely to express greater fears about the potential health risks associated with vaping or to indicate that vaping was likely to make them appear less socially desirable. Additional data showed that, in some cases, greater interconnectedness in an individual's network would either reduce their positive beliefs about e-cigarettes or promote more negative beliefs about likely vaping outcomes. These data were considered alongside additional data demonstrating the importance of network *composition* and *structure* on baseline vaping susceptibility and frequency of use.

Thus far, this study has established that a number of common variables are associated with both an individual's perceptions of an anti-vaping message they have viewed and their

respective personal networks. This section will examine a lingering question that should contribute important insights into both message testing and social influence literatures. Namely, are there specific, detectable effects of an individual's personal network on their interpretations of a persuasive message, regardless of whether or not those alters are present when a person views that message?

This question has been answered obliquely in message testing studies before. Dillard and Ye (2008) examined referents in conjunction with PME, finding that persuasive health messages that caused individuals to think of more people whom they knew were viewed more favorably than messages that did not cause individuals to think of anybody. The authors of that study included an open, elective measure in which people could indicate the groups of people in his/her network that an advertisement made them think of before answering PME questions. Although the literature on PME would grow most extensively into the diagnostic capabilities or measurement necessities of measuring audience perceptions of a message, Dillard and Ye's foundational paper demonstrating referent salience as an important predictor of message effectiveness followed a similar methodological logic to the current study. This study utilized the same network variables included in outcome expectancy and e-cigarette behavior analyses above as independent variables in four block-wise linear regressions using either the *effects* and *perceptions* PME measures as dependent variables. Results from this analysis indicate evidence for the importance of both *compositional* and *structural* network measures to be included in message effectiveness modeling.

Effects PME measures were impacted differently when considering the impacts of social interaction or health discussion network alters. More e-cigarette users in the individual's SIN was negatively associated with *effects* PME, but the proportion of HDN members who vaped had

no significant impact on *effects* scores. In other words, respondents' *effects* measures scores were closely tied to the number of people in their core social interaction networks who vaped, but not impacted at all by the number of people with whom they spoke to about their health who vaped. Both SIN and HDN alters' injunctive norms against e-cigarettes played a significant role in determining *effects* scores. People who believed their SIN or HDN alters would be angrier knowing the respondent vaped gave more optimistic *effects* scores.

There were differential structural impacts between the two networks as well. Greater interconnectedness among SIN alters was positively associated with *effects* scores, while there was a small, but positive association between larger health discussion networks and higher *effects* scores. These *structural* findings from the SIN demonstrate a likely restraining influence from interconnectivity among alters. Specifically, it is likely that individuals who would prefer to not have the fact that they vape spread throughout a densely connected social interaction network were more likely to find the advertisements they viewed as effective. The HDN finding was smaller in effect and more difficult to parse. It is possible that individuals who discuss their health with more people may have greater underlying health problems, or that more people discussing health to someone may make them more wary of potential negative outcomes of vaping and therefore more receptive to anti-vaping advertisements.

The findings from regressions assessing *perceptions* scores were largely similar to those assessing *effects* scores. As previously noted, neither the proportion of HDN or SIN alters who used e-cigarettes was important in predicting *perceptions* scores. However, respondents' perceptions of both HDN and SIN injunctive norms regarding e-cigarettes was positively associated with *perceptions* scores. In other words, both *perceptions* and *effects* scores were increased if the respondent thought that the people in either network would be angry with them

for using e-cigarettes. Social interaction network density was once again significant in predicting *perceptions* PME, while there were no structural network variables in either the HDN or SIN models that significantly predicted *perceptions* scores.

In short, this study was able to demonstrate direct network effects on an individual's immediate perceptions of the likely effectiveness of anti-vaping messages. People who regularly interacted socially with more vapers were less likely to think these advertisements would discourage others from using e-cigarettes, make people more concerned about the health effects of vaping, or make vaping seem unpleasant. However, people who more strongly believed that either the people they hang out with socially or those they discuss their health with disapprove of vaping were more likely to say these advertisements would have those effects on viewers. People who had more densely interconnected social interaction networks also believed the ads would be more effective at achieving those impacts on viewers. These results extend previous network research into the social influence of risk perceptions (e.g., Kohler et al., 2007) by demonstrating how networks can exert influence not just on beliefs about a behavior, but also near-immediate reactions to messages regarding that behavior.

Even when discussing individual's *perceptions* of the advertisement, there were network effects present. People whose networks were believed to be more disapproving of vaping were more likely to agree that the ads they saw were "powerful," "informative," "meaningful," or "convincing." Once again, greater density between the people with whom a respondent interacted with socially also led to more positive *perceptions* of the advertisement. These results demonstrate the utility of including network measures of descriptive of injunctive norms when assessing personal reactions to advertisements. They also present the first data of which I'm aware demonstrating direct associations between the behaviors and attitudes of a person's

discussion networks and that person's near-immediate reactions to a persuasive message. These results could help guide message development by recognizing the outsized impact members of core networks who do not approve of vaping might hold over individual vaping beliefs or behaviors. Direct network impacts on vaping beliefs and behaviors could also be used to segment audiences for digital campaign messages or text-based interventions based on the structure and content of a respondent's networks (the next chapter will more fully discuss network implementation possibilities).

Health discussion and social interaction network compositional and structural measures were significantly associated with both *perceptions* and *effects* measures of PME. However, it is also important to recognize how the inclusion of these variables produced changes in models' collective explanatory power. The base model using only demographic and previous tobacco usage to predict *effects* PME was significantly improved by the inclusion of either HDN or SIN network variables such that the inclusion of HDN variables doubled the R^2 of the base model. When predicting *perceptions* scores, both SIN and HDN were again significant improvements when added to the base model. The addition of social interaction network variables almost doubled the predictive power of the base model, while adding HDN variables more than doubled that power. It should be noted that models predicting *effects* PME measures demonstrated greater predictive validity than those predicting *perceptions* scores. *Effects* scores were also impacted by network variables in ways that more closely aligned with how SIN and HDN network variables impacted baseline susceptibility, vaping frequency, and a number of associated outcome expectancies.

These improvements above models containing only demographics and personal tobacco history provide data supporting the inclusion of personal network variables into models seeking

to understand respondents' reactions to advertisements. The explanatory power of all models was significantly improved when including *structural* and *compositional* personal network variables. Furthermore, the associations between *effects* PME and personal network variables mirrored the network variable's impacts on attitudes relevant to e-cigarette use and vaping behaviors. In other words, there were consistent network associations at each step of the theories of reasoned action attitude-intentions-behavior model. Presence of vapers, beliefs about what network alters thought of vaping, and the connections between those alters influenced attitudes about vaping, baseline e-cigarette behaviors, as well as reactions to anti-vaping advertisements in consistent ways.

Interpreting personal network results

This study set out to examine whether examining the types of people a young adult talks with about their health or goes out with socially could impact three key markers that have long been used to evaluate persuasive messages: attitudes, intentions, and behaviors. Furthermore, this study sought to extend the message evaluation literature by searching for direct connections between that young adult's network alters and their near-immediate reactions to anti-vaping messages. These aims were guided by theories of reasoned action (Ajzen, 1991), social learning theories (Bandura, 2009) and network theories of attitude formation (Erickson, 1988). Among young adults, vaping is a behavior that is often informed through social interactions with non-experts (Hall, Pepper, Morgan, & Brewer, 2016). Recent scholarship has demonstrated associations between a young adult's personal networks, their beliefs about e-cigarettes, and e-cigarette use (Pokhrel, Fagan, et al., 2018). Other researchers have utilized networks to understand how different types of networks might be activated after exposure to anti-tobacco content (Ramanadhan et al., 2017). However, this study is the first to demonstrate consistent

associations between components of a person's network and their respective baseline vaping attitudes, intentions, behaviors, and their reactions to anti-vaping messages.

This study utilizes network data to provide vital context to the literature's understanding of how each step in a theories of reasoned action framework may be impacted by the *composition* and *structure* of a person's network. As Erickson (1988) theorized and Pokhrel and colleagues (2018) initially demonstrated, this study found significant associations between a person's network and his/her baseline beliefs about e-cigarettes. Greater proportions of vapers in a person's core networks led to more positive initial beliefs about e-cigarette use. Increased hostility towards vaping in these core networks also led to more negative attitudes about vaping. This finding is important because it provides a deeper understanding of the informal vaping informational sources Hall and colleagues (2016) discussed. Young adults who are most likely to start vaping are not necessarily those who are already using other products or have used other tobacco products, but rather are those who believe they will be more socially attractive if they were to use e-cigarettes. This study situates that attitude as heavily influenced by the number of vapers in their social circles. The findings from this study then demonstrate that the proportion of e-cigarette users in an individual's social interaction network—the principal factor for determining social attractive attitudes about e-cigarettes—directly impacts how effective that individual believed the anti-vaping ads they were shown would be at keeping somebody from using e-cigarettes.

Reactions to advertisements have long been theorized as influenced by existing attitudes about a product or behavior (Shimp, 1981). This theoretical tradition helped shape the use of perceived effectiveness measures, including the two measures utilized in this study. Dillard and Ye (2008) provided the first data explaining how referents, or those people an individual thought

of when viewing an ad, were tied to PME. The authors argued that the more people someone thought of during an advertisement, the more likely they were to view the ad favorably. The data collected in this study supports the overall theorizing behind Dillard and Ye's (2008) findings, that there is a connection between the people who might be salient to an individual when viewing an ad and their perceptions of this advertisement.

However, in the case of anti-vaping advertisements, this study comes to a different conclusion. When examining highly salient, core networks, more positive appraisals of the advertisements was driven not by the number of people who shared the behavior shown on screen, but on the correspondence between the attitudes held in the network and those championed by the message. In other words, the number of people who vaped in a person's network did not correspond with more positive PME scores. In fact, the opposite was found for social interaction network alters. Higher PME scores were more driven by greater similarities between the attitudes a person believed their network alters had about vaping and those expressed in the advertisements. People who believed their health discussion or social interaction alters would be more critical of vaping were more likely to believe the message was effective. Thus, this study found that individual's attitudes, intentions to use or quit e-cigarettes, vaping frequency, and ultimately their reactions to anti-vaping advertisements were directly associated with aspects of their core personal networks.

5.5 Summary of findings

This study largely adopted theories of reasoned action attitudes-intentions-behaviors models as a roadmap for starting at the reactions a young adult has to an anti-vaping advertisement and working backwards. Results from a variety of analyses demonstrate that *effects* measures should at the very least be used in conjunction with *perceptions* measures to

select anti-vaping advertisements as they were more finely tuned diagnostic measures for identifying differences in ad preferences for current vapers and were the only measures to contribute to a model predicting post-exposure changes in quit intentions. This study's examination of baseline attitudes about e-cigarettes pointed to key associations between the personal experiential and social outcomes young adults held and their baseline susceptibility, quit intentions, and vaping frequency. These attitudinal dimensions also influenced respondents' reactions to the advertisements they saw. Including OE measures in models predicting PME scores demonstrated a lack of congruence between the social and personal experiential dimensions most closely associated with baseline behaviors and intentions and the health dimensions most closely associated with PME scores.

Finally, this study incorporated detailed examinations of core health discussion and social interaction networks to better understand how the social environment in which respondents were enmeshed influenced their attitudes, intentions, behaviors, and reactions to advertisements. The study found significant associations with network structure and composition at each step of the attitudes-intentions-behaviors model. People with more vapers in their networks and those with individuals in their networks who were less likely to react negatively to a respondent vaping were more likely to hold positive beliefs about vaping, be more susceptible, less likely to want to quit, use e-cigarettes more often, and react unfavorably to anti-vaping advertisements. These effects were mitigated in some instances by greater interconnectedness between alters, particularly those in social interaction networks, meaning that restraining factors of dense networks could work to lessen the impact of repeated exposure to a vaping alter in shaping key baseline vaping attitudes and behaviors and potentially making individuals more receptive to anti-vaping messages.

This chapter has served to contextualize the findings within the current literatures and explain the theoretical and empirical contributions this dissertation has made. The final chapter will serve to provide a road map for how a similar methodology and theoretical basis could be used to generate and initially test future messages about vaping for young adults.

CHAPTER 6: CONCLUSION

The purpose of the previous chapter was to contextualize the major findings of this study within relevant academic literatures. It was mainly discussed with examining the potential empirical and theoretical contributions that could be taken from this data. This chapter will describe how the methods implemented in this study might be used as the basis of future health campaign message development and evaluation. This recommendation will not discuss, but also does not wish to discount the importance of, qualitative research methods such as focus groups, interviews, or participant observation. Rather, this final chapter will focus on how the above methods and insights could be used in conjunction with qualitative methods to develop and initially test an anti-vaping message for young adults. The framework for this section will be an insight pulled from the data, followed by a brief discussion of how this might be enfolded into the message development/testing process. These discussions will be followed by a brief conclusion.

Insight: Personal networks highly associate with personal experience and social attraction attitudes

Data from this study suggests young adult respondents were mindful of how vaping might affect them from personal experiential and social attractiveness standpoints. People who believed they would like the taste or the feelings associated with e-cigarettes as well as those who believed they would be more likely to fit in with others if they vaped were more likely to be susceptible to starting vaping in the near future or use vaping products more frequently. These attitudes were driven by the presence of vapers in their networks, but offset somewhat by how

densely those networks were connected. If we dig into the network data behind social attraction and personal experience, we see that there is a negative association between gender homophily and social attraction/personal experiential attitudes among our respondents. Our respondents do not seem to care what the people in their networks think about e-cigarettes when deciding how socially attractive vaping is, but if they perceive more pushback from their alters, they are more likely to question how much they would like vaping, how unhealthy they think it is, or how likely they may be ostracized for vaping.

Importantly, we know from our data that increasing the amount of pushback our respondents believe their core network members would give towards vaping is associated with lower susceptibility, increased quit intentions, and less frequent vaping among users. The strongest, most consistent effects for these outcomes are seen in our social interaction network measures. Taken together, these data suggest that our casting should focus on recruiting a gender diverse, young adult group in an informal social setting as the backdrop for our message. This setting and cast should correspond most directly with the network variables that are shown in this data to impact a wide variety of outcomes for both users and non-users.

Insight: Messages tested focused on less salient attitudinal dimensions

The messages we tested in this round focused on the health impacts of using e-cigarettes. Both the FDA and our control messages discussed addiction and potential negative health outcomes of using e-cigarettes. Although increased health concerns was shown in the data to restrict entry into using e-cigarettes, there were no associations between this attitudinal dimension and vaping frequency or quit intentions. In short, the attitudinal dimension that was the focus of the ads we showed these young adults was not the one that most directly impacts their decision to use e-cigarettes, to restrict their usage, or to want to quit vaping. Our data shows

that these outcomes are more closely associated with their beliefs about the feelings associated with using e-cigarettes and the social outcomes surrounding e-cigarette use.

Rather than being concerned about using e-cigarettes because of their health, there seems to be a more complex story being told here. Our respondents are more likely to use or to use more frequently if they have more vaping friends in their networks, but are overall less likely to exhibit these behaviors if their networks are more densely connected. If we interpret this combined with the data showing greater pushback against vaping in these networks leads to more beneficial outcomes, we can derive additional insights about potential creative directions for message development. Non-users seem to want to try to use e-cigarettes only around those alters who may share that behavior, but not if there is a risk that members of their networks who are anti-vaping find out. This interpretation comes from data suggesting that negative perceived norms and network density restrict e-cigarette susceptibility while negative perceived norms also restrict e-cigarette use. In other words, more connected networks may be more likely to spread the information that someone is using e-cigarettes. The risk that this information might lower the social standings of someone is a direction that might be salient for many young adults considering using e-cigarettes. Therefore, this data suggest that loss of social standing or missing out on the opportunity for a romantic partnering due to e-cigarette use could be a salient plot device in a short anti-vaping message targeting young adults.

Insight: Messages changed basically nothing, but measurement seems reliable

The messages we tested did not significantly move the mark on respondent susceptibility and barely moved respondent quit intentions. That is the bad news. The better news is that our message evaluation metrics [PME] seem to be reliable in capturing the potential for change if the ads perform better. Although there was hardly any change in pre-post quit intentions, our *effects*

scale was able to delineate significant differences in perceived quality between the FDA ads and the control ads for both non-users and users. These differences may have been driven by differences in production—higher sensation value messages are often rated more highly by respondents—but the data in this study suggest the lack of impact is likely driven by the core message from both the control advertisement and the FDA ads focused on health concerns, an attitudinal dimension that had limited utility in predicting the outcomes we need to focus on in this sample.

Although this round of message testing did not achieve the goals we hoped to achieve, we must be aware of some pretty severe restrictions that could have limited our observations. First, this was a pre-post test of two 30-second advertisements. It should be expected that simply watching two advertisements might not move the intentional or behavioral needle for young adults. Rather, the data from this study provides some hopeful observations. Namely, our measurement device seems adequately sensitive for detecting measurable differences between advertisement conditions.

However, we believe that moving beyond a past-the-post score metric for PME might improve overall campaign performance. As we have shown, although the FDA ads were significantly more well-liked than the control ads, neither showed much movement at follow-up. If we were to simply run with the higher scoring ads, we would have statistical support, but might not achieve any greater outcome in our campaign evaluations than if we had runt he control ads. We believe we should consider two additional checks on these messages before dissemination to increase the rigor of our message testing research.

First, advertisements should be scored on PME and checked against attitudinal dimensions that are most closely associated with the behavioral outcomes on which the

advertisements focus. If this step were taken before release of these advertisements, the data would have noted that, although the FDA ads scored more highly on the PME scales, those PME scores were driven by attitudinal dimensions that were not strongly related to a number of the e-cigarette outcomes we hope to alter. Rather, messages should have to score well on baseline *perceptions* and *effects* PME, but those scores should be most closely associated with the attitudinal dimensions that most closely correspond to decreasing vape frequency or susceptibility.

Second, personal network data should be collected at the onset of each message testing survey. Our data found key associations between the attitudes, behaviors, and reactions to ads we tested and the structure and composition of the respondents' networks. We know from previous research that people get a lot of information about e-cigarettes from informal sources and that the people around us can inform our expectations about addictive behaviors. We know from our data that individuals in highly gender diverse social networks with a large number of vapers are most likely to try e-cigarettes in the near future. We also know that the presence of vapers as well as their interconnections with other members of these networks directly influenced both key attitudinal dimensions as well as reactions to the advertisements we showed our respondents.

Collecting network data allowed us to subset the most susceptible members of our audience. Moving forward, we will be able to examine how the next round of messages influences both the young adult audience as a whole, as well as subset audience members based on their network variables to determine whether the messages are salient with those who are at most risk of developing a vaping habit. We can also use this data longitudinally in testing campaign effectiveness after release, by examining whether different compositional or structural components of a network impact long-term effectiveness of messages or message spread

throughout networks. Standards of campaign evaluation could then be followed at scale to determine lasting impact of single exposure (follow-up for the test group) as well as large-scale media exposure evaluation or A/B testing based on exposed and not-exposed audience markets.

This alternative approach to message selection has been meant to demonstrate an example of how network, OE, and PME data can work in conjunction to guide audience segmentation as well as evaluation, if informed by theories of reasoned action attitude-intention-behavior models, as well as social network/social learning theories and methods. This study ultimately argues for the inclusion of social network and attitudinal dimension evaluation during message development to guide audience segmentation and to improve the explanatory power of evaluation models after dissemination. The final section of this study will provide a consideration of limitations to this study as well as how this research may be expanded upon in the future.

Study limitations

This study provided the first data examining direct effects between the people in a person's discussion network and their near-immediate reactions to anti-vaping advertisements. Data from this study support inclusion of personal network variables including compositional and structural components to better model the conditions surrounding outcome expectancy formation, vaping behaviors, and post-exposure reactions. However, this study is not without its limitations. First and foremost, this study was an experimental design in which individuals watched two 30-second advertisements and then completed post-exposure PME measures as well as outcomes. It is possible that the lack of effects found in the post-exposure quit intentions and susceptibility could be due to the fact that respondents had answered the same types of questions pre-exposure and were then conditioned to not want to change their responses following

exposure. Post-exposure assessments of addiction risk beliefs and health risk beliefs found larger effects sizes indicating that there might be a priming effect of having conducted quit intentions and susceptibility in a pre-post manner. However, the alternative hypothesis that post-exposure collection of ARB and HRB simply demonstrated existing belief stratifications that were not significantly influenced by viewing either ad condition cannot be discounted.

This study also relied on online panel data generated from professional survey respondents. A pretest of the basic methodology for this study was performed the previous year using college students to respond to name generator and outcome expectancy/usage questions. The time it took those students to complete the survey was nearly 20 minutes per completion. Despite a more in-depth method and instrument that included message testing components, respondents in this study completed the survey more quickly than the college students in the pretest. Great care was taken to identify and remove respondents who satisficed or provided unusable data, but there remains the possibility that respondents purposefully curtailed information in order to finish the survey more quickly. Preliminary evidence for this exists in the previously mentioned difference between the number of HDN and SIN alters, as it appears respondents may have suppressed the number of HDN alters in the second name generator out of a need to reduce the amount of time it took to complete the survey. Although previous research has suggested that online panels can function in a similarly reliable fashion as other methods of collecting respondents (Smith, Roster, Golden, & Albaum, 2016), the repetitive nature of egocentric network instrumentation has not, to my knowledge, been tested between in-person and online panel data collection. The fact remains that professional survey takers who get paid per completion may have been financially incentivized to truncate the data they provided in sections of this study.

Unlike previous studies examining anti-tobacco messaging (see Brennan et al., 2013), this study did not have a "deep bench" of anti-vaping messages with which to test. The FDA messages shown to young adults here were developed and disseminated originally to impact adolescent perceptions of e-cigarettes. Although previous research has demonstrated a number of similarities between adolescent and young adult e-cigarette OE (Barker et al., 2019), there is still a possibility that a lack of correspondence between the intended audience of the messages and the secondary audience tested here yielded some effect on the results captured in this study. This research also relied entirely on self-report for both individual's perceptions of both their own and their network alters' tobacco usage and beliefs. Self-reporting of alters may not be the most accurate form of data collection in an ontological sense, but network researchers have argued that an individual's perceptions of their alters' behaviors or attitudes is a useful metric when modeling individual behavior (see Perry et al., 2018).

Finally, the cross-sectional nature of this study does not allow the research to potentially delve into selection versus influence network effects on attitude maintenance or reinforcement. In other words, unlike Huang and colleagues (2014), this study cannot say with any certainty if the network effects observed here are due to greater proportions of e-cigarette users entering into these networks and influencing respondents' attitudes and behaviors or if respondents who held these attitudes and behaviors selected like-minded alters or alters with similar behaviors as them to be included in these core networks. Huang and colleagues' (2014) assertion that the selection versus influence debate should be more characterized as a "both and" rather than an "either or" effect provides context to the findings exhibited here, but the study can do no more than nod to those findings based on the current design.

Future research

Findings from this study should provide theoretical and empirical justification for including both baseline outcome expectancy and personal network variables into future message testing endeavors. This study found strong associations between the types of people and connections in respondents' networks and their baseline beliefs about e-cigarettes as well as their reactions to anti-vaping advertisements. Further understanding about the role social network alters play in forming and maintaining vaping attitudes and behaviors can help guide message design and evaluation for anti-vaping or other health messaging campaigns. Namely, future digital campaigns can adapt the collection of network alters' e-cigarette or vaping behaviors to target anti-vaping advertisements to individuals with strong ties to alters who share e-cigarette company social media posts or discuss vaping on social media platforms. Anti-vaping messages created for television or digital video dissemination were tested in this study due to a lack of a strong national repository of other anti-vaping media targeting young adults. However, the findings from this study should be adapted for digital or locational (e.g., university) campaigns to test whether the discussion network effects found in this study also apply to digital alter connections or to workplaces or university sociocentric networks.

Longitudinal network evaluations are desperately needed for two key reasons. First, from a network standpoint, longitudinal evidence would provide an opportunity to determine the extent to which dynamics within a person's social network (alters entering or leaving the networks) either restricts or accelerates adoption of health messaging. Second, discussion network data could aid in tracing earned campaign media by modeling the types of networks that are most likely to be conducive to spreading health messages championed by national

campaigns. These data can help segment audiences and guide campaign spending or more direct messaging tactics based on the composition or structure of an audience's network.

Conclusion

This study presented the first attempt to examine direct network influences on perceptions of an anti-vaping message's likely effectiveness. Modeled on theories of reasoned action attitudes-intentions-behaviors model, this study sought to start at the measures of effectiveness used to evaluate anti-vaping campaigns and work backwards to examine what kinds of attitudes influenced these reactions. This study also sought to examine how the *structure* and *composition* of respondents' networks influenced those baseline attitudes, and ask for the first time whether these network components could have a direct impact on respondents' appraisals of anti-vaping messages. Results from this study suggest robust associations between networks, baseline beliefs about e-cigarettes, and reactions to anti-vaping messages. The structure and composition of the study's respondents helped shape not only their attitudes, intentions, and baseline behaviors, but also their near-immediate appraisals of the ads to which they were exposed. This study presents compelling data supporting the inclusion of *effects* measures in assessing anti-vaping message effectiveness, as well as the inclusion of outcome expectancy dimensions and core network characteristics for both message development and message testing.

APPENDIX: SURVEY CODEBOOK

LABEL	TOPIC	QUESTION ASKED OR TEXT STATED	SCALE | MEASURE	SOURCE
01 Introduction | IRB Statement		Consent form will show here.		

SOCIAL INTERACTION NETWORKS				
SI_1_names	Name Generator: Social interaction	(a) Think about the people with whom you spend your free time/leisure time. Over the last 6 months, who are the 5 people you have been with the most often for informal social activities (e.g., lunch, drinks, movies, sports, visits) or who you would call if you just wanted to hang out?	[5 name slots] Please list the 5 people with whom you have been with the most for informal social activities over the last 6 months. In the space below, please write the nicknames of with whom you spend your free time/leisure time.You can write their nicknames or their first names or their initials. If two people have the same first name, please use the first letter of each person's last name to differentiate the two. Please do not enter any person's full last name.	Burt et al., 2012

SI_1_none		If you cannot think of anyone whom you spend free time/leisure time with, please select the option below.	(1) I cannot think of anyone.	
SI_2_names	Name Generator: Social interactions	(b) Who would be most likely to call you if they were going out for the night?	[5 name slots] Please list as many as five names. In the space below, please write the nicknames of people who would be most likely to call you if they were going out for the night. You can write their nicknames or their first names or their initials. If two people have the same first name, please use the first letter of each person's last name to differentiate the two. Please do not enter any person's full last name.	Bidart & Charbonneau (2011)
SI_2_none		If you cannot think of anyone whom would call if you were going out for the night, please select the option below.	(1) I cannot think of anyone.	
SI_3_names	Name Generator: Tobacco users	(c) Now please think of anybody you know who uses any form of tobacco. They do not have to be close friends or family members, just the first few people that come to mind whom you know use some type of tobacco product.	[5 name slots] Please list as many as five names. In the space below, please write the nicknames of people who uses any type of tobacco product. You can write their nicknames or their first names or their initials. If two people have the same first name, please	

			use the first letter of each person's last name to differentiate the two. Please do not enter any person's full last name.	
SI_3_none		If you cannot think of anyone who uses any form of tobacco product, please select the option below.	(1) I cannot think of anyone.	
SI_4	If no discussants are listed:	It appears that you did not enter any names on the previous questions. If you cannot think of anyone who you would spend time with informally OR who uses any form of tobacco product, please indicate below.	Respondent can select: I cannot think of anyone who I spend time with informally OR who uses any form of tobacco product. If selected, respondent skips to the end of the SI block.	
SI_5 Remove duplicates from SI_1, SI_2, SI_3	dupSI	Here are the names of people who you would spend your free time with: [Pipe list of names from SI_1 through SI_3 here.] Below are the people you listed who you would call if you were going to go out or people you know use some form of tobacco product. **Now please drag each name one time into the "Social Interaction Contacts" box so that NO names appear twice in that box.**		

SI_6 Orienting language	Orienting before alter info	Now we'd like to ask you some questions about the nature of your relationships with the people listed below. [Pipe and display names from SI_1 – SI_3 if name field is not empty and were not selected as a duplicate in SI_5.]		
A_SI1 Attribute Data	Gender	What is [this alter's] gender?	[Select one] Male Female Transgender/Gender Fluid	
A_SI2 Attribute Data	Ethnicity	Please share [this alter's] ethnicity?	[Side by Side Question] [Column 1: Race] White/Caucasian (1) African American (2) Asian (3) Native American (4) Pacific Islander (5) Other (6) [Column 2: Latino] Hispanic, Latino, or Spanish (1) Not Hispanic, Latino, or Spanish (0)	

A_SI3 Relational data	Role and Relationship	Please identify the nature of your relationship with the people you listed. [Pipe and display names from SI_1 – SI_3 if name field is not empty and were not selected as a duplicate in SI_5 or SI_6.] [Name of Person 1] is a... (1) [Name of Person 2] is a... (2) [Name of Person 3] is a... (3) [Name of Person 4] is a... (4) [Name of Person 5] is a... (5)	spouse or partner (1) Parent or guardian (2) child (3) sibling (4) other family member (5) friend (6) coworker (7) group member (i.e., social group or association) (8) neighbor (9) health care provider (10) other [open ended] (11)	Ramanadhan et al. (2017) ** allowed for multiple selections in order to capture the multiplexity of the relations.
A_SI4 Comm Frequency data	afreqweek[…15]	During a normal week, how many days of the week do you talk with: [Carry forward displayed statements in A_SI1, and for all remaining D Qs.]	[Insert the following scale for each name listed.] (0) Never (1) About once a month (2)> 1 day (3) 2 days (4) 3 days (5) 4 days (6) 5 days (7) 6 days (8) 7 days/every day (9) Don't Know	Sadri et al. (2018)

A_SI5 Perceived closeness	Perceived closeness	For each person you listed, please rate how close you feel your relationship is to that person.	[Insert the following scale for each name listed here.] 0 Not close … 10 Close	Adapted from Friedkin (1990)
A_SI6 Supportive Role	asupport1[…30] A1[…10]_SI_support	When thinking of the people listed below, what type of support does each person provide you? Please select all options that apply.	[Insert matrix table for the following for each name listed] listens to me (1) tells me they care for me (2) makes practical suggestions (3) helps with things like daily chores and tasks (4) gives/loans me money (5) None of these. (6)	Perry & Pescosolido, 2010
A_SI7	Orienting language	Now we'd like to ask you a series of questions about your perceptions of these individuals' health and smoking behaviors		
A_SI9 Perceived alter health	Perceived alter health	On a scale from 0 to 10, how healthy, based on your own assessment, would you describe ____? A 0 is not healthy at all and 10 is extremely healthy. READ QUESTION FOR PERSON (Noar), AND ASK "HOW ABOUT _____?" FOR (Roditis et al.)-(Noar). REPEAT QUESTION IF NECESSARY.	A 0 is not healthy at all and 10 is extremely healthy.	Kelly, L., Patel, S. A., Narayan, K. V., Prabhakaran, D., & Cunningham, S. A. (2014).

A_SI10 Alter smoking patterns	Alter smoking habits	To the best of your knowledge, does [alter] use any of the following tobacco products?	1. No 2. Cigarettes 3. Smokeless tobacco 4. E-cigarettes or vaping 5. Cigars/Cigarillos 6. Hookah	Adapted from Kelly, L., Patel, S. A., Narayan, K. V., Prabhakaran, D., & Cunningham, S. A. (2014).
A_SI11 Alter tobacco offered (If any tobacco product marked for A_SI6) Relational data	Smoking surrounding	Has [this alter] ever offered to share a tobacco product with or buy a tobacco product for you?	Yes/No	
(If above question answered yes) A_SI12 Relational data	Types used	Please select which products [this alter] has offered to share with you or buy for you.	[multiple entry] Cigarettes Smokeless tobacco E-Cigarettes or Vapes Cigarillos/Cigars Hookah	
A_SI13	Injunctive beliefs	How upset do you believe the following people would be if you used e-cigarettes? [Name of persons from carry forward displayed statements in SI_7.]	[7-Point Likert Scale ranging from Extremely upset-Not at all upset]	Adapted from Gibson et al., 2018
A_SI14 Ego IDs Alters' Relations	knows1[…30]-1[…30] A1[…10]_SI_knows	To the best of your knowledge, please select whether the person listed in the left column knows any of the people listed on the right.	[Insert matrix table for each name listed] [Pipe and display names from SI_1 – SI_3 if name field is not empty and were	Borgatti, Everett, & Johnson, 2013; Scott & Carrington, 2011

		For example, “Person 1” is listed in the first row in the column furthest to the left, if “Person 1” knows only “Person 2”, you would only select "Person 2". But, if “Person 1” knows everyone listed to the right, you would select all the people listed to the right. Repeat this for each person listed on the left.	not selected as a duplicate in SI_5 or SI_6.]	

HEALTH DISCUSSION NETWORKS				
HDN_1 Name generator Discussants	A1[…10]_HDN_discussant	Now we are interested in the people in your life with whom you talk to about any health problems when they come up. Who are the people that you discuss your health with or you can really count on for help when you have physical or emotional problems? Please write their first names in the space below. Please do not enter last names. If two people have the same first name, use the first letter of each person's last name.	Name of person 1 (1) Name of person 2 (2) Name of person 3 (3) Name of person 4 (4) Name of person 5 (5)	Specific terms: Perry & Pescosolido, 2010; PhenX Measure: Social Networks (#211100)

		Please list as many names as necessary.		
HDN_1_none		If you cannot think of anyone whom you discuss your health with, please indicate that below.	(1) I cannot think of anyone.	
HDN_2 Name generator Regulators	A1[…10]_ HDN_regulator	Who are the people, whether or not you have listed them before, who are always talking about <u>your</u> mental or physical health and trying to get you to do things about them? **Please list as many names as necessary and follow the previous instructions for listing only first names and initials, if necessary.**	Name of person 1 (1) Name of person 2 (2) Name of person 3 (3) Name of person 4 (4) Name of person 5 (5)	
HDN_2_none		If you cannot think of anyone who tried to get you to do things about your mental or physical health, please indicate that below.	(1) I cannot think of anyone.	
HDN_3 No names entered	nonameHDN	[If all the names from HDN_1 to HDN_2 are blank, this question appears.] It appears that you did not enter any names on the previous questions. If you cannot think of anyone who you talked to about your health OR who talked to you about their health, please indicate below.	I cannot think of anyone who I talked to about my health OR anyone who talked to me about their health. [If yes, go to TB_1]	
HDN_4 Remove duplicates from HDN_1 through HDN_3		Here are the names of people who you discuss your health with or who discuss their health with you: [Pipe list of names from HDN_1 through HDN_2 here.] **Now please drag each name one time into the "Health Discussion Contacts" box so that NO names appear twice in that box.**	[Display names from HDN_1 through HDN_3 if name field is not empty.]	

HDN_5 Orienting language	Orienting before alter info	Now we'd like to ask you some question about the nature of your relationships with the people listed below. [Pipe and display names from HDN_1 – HDN_3 if name field is not empty and were not selected as a duplicate in HDN_5 or HDN_6.]		
A_HDN1 Attribute Data	Gender	What is [this alter's] gender?	[Select one] Male Female Transgender/Gender Fluid	
A_HDN2 Attribute Data	Ethnicity	Please share [this alter's] ethnicity?	[Side by Side Question] [Column 1: Race] White/Caucasian (1) African American (2) Asian (3) Native American (4) Pacific Islander (5) Other (6) [Column 2: Latino] Hispanic, Latino, or Spanish (1) Not Hispanic, Latino, or Spanish (0)	

A_HDN3 Alters' Relational Role	atie1[…30] A1[…10]_ HDN_tie	Please identify the nature of your relationship with the people you listed, select all that apply. [Pipe and display names from HDN_1 – HDN_3 if name field is not empty and were not selected as a duplicate in HDN_5 or HDN_6.] [Name of Person 1] is a... (1) [Name of Person 2] is a... (2) [Name of Person 3] is a... (3) [Name of Person 4] is a... (4) [Name of Person 5] is a... (5)	spouse or partner (1) Mother (2) Father (3) child (4) sibling (5) other family member (6) friend (7) coworker (8) group member (i.e., social group or association) (9) neighbor (10) health care provider (11) other [open ended] (12)	Ramanadhan et al. (2016) ** allowed for multiple selections in order to capture the multiplexity of the relations.
A_HDN4 Comm Frequency data	afreqweek[…15]	During a normal week, how many days of the week do you talk with: [Carry forward displayed statements in HDN_4, and for all remaining D Qs.]	[Insert the following scale for each name listed.] (0) less than 1 day a week/never (1) 1 day (2) 2 days (3) 3 days (4) 4 days (5) 5 days (6) 6 days (7) 7 days/every day (-0) Don't Know	Sadri et al. (2018)
A_HDN5 Perceived closeness	Perceived closeness	For each person you listed, please rate how close you feel your relationship is to that person.		Adapted from

			[Insert the following scale for each name listed here.] 0 Not close … 10 Close	Friedkin (1990)
A_HDN6	asupport1[…30] A1[…10]_HDN_support	When thinking of the people listed below, what type of support does each person provide you? Please select all options that apply. [Name of persons from carry forward displayed statements in HDN_7.]	[Insert matrix table for the following for each name listed] listens to me (1) tells me they care for me (2) makes practical suggestions (3) helps with things like daily chores and tasks (4) gives/loans me money (5) None of these. (6)	Perry & Pescosolido, 2010
AHDN_7	Orienting language	Now we'd like to ask you a series of questions about your perceptions of these individuals' health and smoking behaviors		
AHDN_8	Perceived alter health	On a scale from 0 to 10, how healthy, based on your own assessment, would you describe ____? A 0 is not healthy at all and 10 is extremely healthy. READ QUESTION FOR PERSON (Noar), AND ASK "HOW ABOUT _____?" FOR (Roditis et al.)-(Noar). REPEAT QUESTION IF NECESSARY.	A 0 is not healthy at all and 10 is extremely healthy.	Kelly, L., Patel, S. A., Narayan, K. V., Prabhakaran, D., & Cunningham, S. A. (2014).

AHDN_9	Alter smoking habits	To the best of your knowledge, does [alter] use any of the following tobacco products?	1. No 2. Cigarettes 3. Smokeless tobacco 4. E-cigarettes or vaping 5. Cigars/Cigarillos 6. Hookah	Adapted from Kelly, L., Patel, S. A., Narayan, K. V., Prabhakaran, D., & Cunningham, S. A. (2014).
AHDN_10 Alter tobacco offered (If any tobacco product marked for AHDN_9)	Tobacco offered	Has [this alter] ever offered to share a tobacco product with or buy a tobacco product for you?	Yes/No	
(If above question answered yes) A_HDN11	Types offered	Please select which products [this alter] has offered to share with you or buy for you.	[multiple entry] Cigarettes Smokeless tobacco E-Cigarettes or Vapes Cigarillos/Cigars Hookah	(If above question answered yes) A_IM73 Relational data
A_HDN12 Injunctive e-cigarette beliefs	Injunctive beliefs	How upset do you believe the following people would be if you used e-cigarettes? [Name of persons from carry forward displayed statements in B30.]	[7-Point Likert Scale ranging from Extremely upset-Not at all upset]	Adapted from Gibson et al., 2018
A_HDN13 Ego IDs Alters' Relations	knows1[…30]-1[…30] A1[…10]_HDN_knows	To the best of your knowledge, please select whether the person listed in the left column knows any of the people listed on the right. For example, "Person 1" is listed in the first row in the column furthest to the left, if "Person 1" knows only	[Insert matrix table for each name listed] [Display names from HDN_3 if name field is not empty.]	Borgatti, Everett, & Johnson, 2013; Scott & Carrington, 2011

		"Person 2", you would only select "Person 2". But, if "Person 1" knows everyone listed to the right, you would select all the people listed to the right. Repeat this for each person listed on the left.		
A_ON1	E-cig conversations outside discussion networks	Think back to the last time you discussed e-cigarettes with anybody. This can be a long discussion or even a brief mentioning of the subject. Was that discussion with anybody you have listed below? [Pipe and display names from SI_1 – SI_3 if name field is not empty and were not selected as a duplicate in SI_5, SI_6, or HDN_5, or HDN_6.] [Pipe and display names from HDN_1 – HDN_3 if name field is not empty and were not selected as a duplicate in HDN_5 or HDN_6.]	Yes/No	Adapted from Small & Sukhu, 2016
(If above question answered "No" A_ON2 Outside network comm frequency	afreqweek[…15]	During a normal week, how many days of the week do you talk with the last person you discussed e-cigarettes with?	(0) Never (1) About once a month (2)> 1 day (3) 2 days (4) 3 days (5) 4 days (6) 5 days (7) 6 days (8) 7 days/every day	Sadri et al. (2018)

			(9) Don't Know	
A_ON3 Perceived closeness	Perceived closeness	Please rate how close you feel your relationship is to the person with whom you last discussed e-cigarettes.	0 Not close … 10 Close	Adapted from Friedkin (1990)
A_ON3	How recent	How recently did you have your last discussion about e-cigarettes?	6-Point Likert Scale [1] Within the last day [2] Within the last week [3] Within the last two weeks [4] Within the last three weeks [5] More than 3 weeks ago [6] I don't know	
A_ON4	How positive e-cigarette conversation	How were e-cigarettes discussed in your last discussion?	7-point Likert scale [0] Not at all positively [7] Extremely positively	

E-CIGARETTE OUTCOME EXPECTATIONS AND USAGE PRE-EXPOSURE

TB_1	Orienting language	For the next few questions, we would like to ask you about tobacco products.		
TB_1	Ever use	Have you ever used any of the following products, even once or twice?	Cigarettes Smokeless tobacco E-Cigarettes or Vapes Cigarillos/Cigars Hookah	
TB_2	Current use	During the past 30 days, please indicate whether you've used any form of tobacco.	I do not use tobacco products. (0) Cigarettes (1) E-cigarettes (2) Traditional cigars (3) Cigarillos, filtered cigars or little cigars (4) Pipe filled with tobacco (5) Hookah (6) Smokeless tobacco (such as snus, moist snuff, dip, spit and chew) (7)	
TB_3 (For all tobacco products indicated)	Frequency of use	In the past 30 days on how many days did you use the following tobacco products?	[Number list 1-30] Cigarettes Smokeless tobacco E-Cigarettes or Vapes Cigarillos/Cigars Hookah	
TB_4	Number of total friends who use e-cigarettes	How many of your close friends do you think use e-cigarettes or other vaping devices?	[7-Point Likert Scale ranging from None-All]	Gibson et al., 2018
TB_5	Number of total family members	How many of your family members do you think use e-cigarettes or other vaping devices?	[7-Point Likert Scale ranging from None-All]	Gibson et al., 2018

	who use e-cigarettes			
TB_6	Injunctive norms: Friends	How upset do you believe your close friends would be if you used e-cigarettes?	[7-Point Likert Scale ranging from Extremely upset-Not at all upset]	Gibson et al., 2018
TB_7	Injunctive norms: Family members	How upset do you believe your family members would be if you used e-cigarettes?	[7-Point Likert Scale ranging from Extremely upset-Not at all upset]	Gibson et al., 2018
TB_8	Perceived Behavioral Control	During the next six months, I can easily quit e-cigs if I want to.	[7-Point Likert Scale ranging from Strongly disagree-Strongly agree]	Phua, 2018
TB_9	Perceived Behavioral Control	How much control do you have over quitting e-cigts in the next six months?	[7-Point Likert Scale ranging from No control-Much control]	Phua, 2018
TB_10	Intentions to use	How likely are you to use an e-cigarette in the next 6 months	[7-Point Likert scale anchored with Extremely likely or Extremely unlikely]	Adapted from Pu & Zhang, 2017
TB_11	Quit intentions (for users)	In the next three months, how likely is it that you will: • Quit using e-cigarettes completely • Reduce the amount you vape in a day • Talk to someone (e.g., friend or family member) about quitting e-cigarettes	[7-Point Likert scale anchored with Extremely likely or Extremely unlikely]	Adapted from Bigsby et al., 2013
OE_1	E-cigarette outcomes	Below are what some people think of when they think about using e-cigarettes. Even if you have not used these devices before, please give your best answer. If I were to use an e-cigarette or other vaping device, I would… 25. Worry about my health 26. Wonder what I was inhaling 27. Damage my lungs 28. Get addicted 29. Not get enough nicotine	[7-Point Likert scale anchored with Definitely wouldn't-Definitely would]	Adapted from Barker et al., 2018; Pokhrel et al., 2018; etc. (see Methods)

		30. End up using other tobacco products too 31. Feel less stressed 32. Feel good physically 33. Like the feeling of inhaling vapor into my mouth 34. Like the feeling of creating vapor clouds 35. Like the flavor of the vapor 36. Like the smell of the vapor 37. Smell bad 38. Have bad breath 39. Be able to create vapor clouds that look cool/appealing 40. Be able to do vape tricks (e.g., blowing vapor clouds or shapes like rings) 41. Look more attractive 42. Feel more sophisticated 43. Fit in better with friends 44. Be able to hide my use from others (e.g., parents) 45. Look awkward 46. Look unpleasant 47. Look like I was smoking cigarettes 48. Look like I was trying to quit smoking		
OE_2	Comparison to other types of tobacco	Electronic cigarettes are less harmful to the user's health than traditional cigarettes	[7-Point Likert scale anchored by Strongly disagree-Strongly agree] (reverse coded)	Hershberger et al., 2017
OE_3	Comparison to other types of tobacco	Electronic cigarettes are less harmful to the health of those in close proximity to the user than traditional cigarettes	[7-Point Likert scale anchored by Strongly disagree-Strongly agree] (reverse coded)	Hershberger et al., 2017

IMMEDIATE POST-EXPOSURE TO EACH E-CIGARETTE ADVERTISEMENT			
H10	Transition to Advertisements	Thank you for filling out this survey to this point. You will now see a series of advertisements. After each ad, you will be asked a few questions about your thoughts regarding that ad.	

		Please click the next >>> button to proceed.		
Reactance_1	Reactance_*Anno y*	This message annoys me	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Hall et al., 2017
Reactance_2	Reactance_*Over blown*	This warnings in this message are overblown	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Hall et al., 2017
Reactance_3	Reactance_*Mani pulate*	This message is trying to manipulate me	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Hall et al., 2017
PME_1	PME_*Discourag ement*	This message discourages me from wanting to use e-cigarettes	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Baig et al., 2018
PME_2	PME_*Concern*	This message makes me concerned about the health effects of vaping.	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Baig et al., 2018
PME_3	PME_*unpleasant ness*	This message makes vaping seem unpleasant to me.	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Baig et al., 2018
PME_4	Davis_*Remembe ring*	This message is worth remembering	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Davis et al., 2013
PME_5	Davis_A*ttention*	This message grabbed my attention	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Davis et al., 2013
PME_6	Davis_*Powerful*	This message is powerful	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Davis et al., 2013
PME_7	Davis_*Informativ e*	This message is informative	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Davis et al., 2013

PME_8	Davis_*Meaningful*	This message is meaningful	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Davis et al., 2013
PME_9	Davis_*Convincing*	This message is convincing	[7-Point Likert scale anchored by Strongly disagree-Strongly agree]	Adapted from: Davis et al., 2013

FOLLOWING LAST ADVERTISEMENT				
H10	Transition to Advertisements	Thank you for providing valuable feedback on these ads. Before moving to the final section, please answer the following questions. Please click the next >>> button to proceed.		
RB_1	Risk beliefs-Matrix	If I vape, I will… 1. Damage my body 2. Harm my brain 3. Become addicted to vaping 4. Be controlled by vaping 5. Be unable to stop vaping when I want to 6. Breathe in dangerous chemicals 7. Inhale poisons 8. Breathe in harmful toxins	[7-Point Likert scale anchored with Extremely likely – Extremely unlikely]	Adapted from Crosby, Delahanty, & Walker, 2018; Rohde et al., (working paper), Brennan et al., 2017
TB2_1	Intentions to use	How likely are you to use an e-cigarette in the next 6 months	[7-Point Likert scale anchored with Definitely Yes or Definitely Not]	Adapted from Pu & Zhang, 2017
TB2_2	Quit intentions (for users)	In the next three months, how likely is it that you will: • Quit using e-cigarettes completely • Reduce the amount you vape in a day	[7-Point Likert scale anchored with Extremely likely or Extremely unlikely]	Adapted from Bigsby et al., 2013

		Talk to someone (e.g., friend or family member) about quitting e-cigarettes		
OE2_1	Comparison to other types of tobacco	Electronic cigarettes are less harmful to the user's health than traditional cigarettes	[7-Point Likert scale anchored by Strongly disagree-Strongly agree] (reverse coded)	Hershberger et al., 2017
OE2_2	Comparison to other types of tobacco	Electronic cigarettes are less harmful to the health of those in close proximity to the user than traditional cigarettes	[7-Point Likert scale anchored by Strongly disagree-Strongly agree] (reverse coded)	Hershberger et al., 2017

DEMOGRAPHICS			
H10	Transition to Demographics	Thank you for filling out this survey to this point. In this final section, we would like to ask you a few details about yourself. Please click the next >>> button to proceed and finish this survey.	
H20	Age	What is your current age?	Please enter numerical age in years from most recent birthday: [text entry]
H30 Attribute Data	Gender	What is [this alter's] gender?	[Select one] Male Female Transgender/Gender Fluid
H40 Attribute Data	Ethnicity	Please share [this alter's] ethnicity?	[Side by Side Question] [Column 1: Race] White/Caucasian (1)

			African American (2) Asian (3) Native American (4) Pacific Islander (5) Other (6) [Column 2: Latino] Hispanic, Latino, or Spanish (1) Not Hispanic, Latino, or Spanish (0)
H50	Education	Please select your level of education by selecting your last year completed:	[Select one] less than HS HS grad 2-year or technical degree 4-year degree [BA or BS] Graduate school
H60	Annual Income	Please select your total annual household income:	[Select one] less than $20K $20K-$40K $40K-$60K $60K-$80K $80K-$100K $100K-$125K $125K-$150K $150K-$200K $200K+

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