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Examining the Association amongst Expected Costs and Benefits, Peer Use, and Self-Reported Use of Electronic Cigarettes in Adolescents

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ABSTRACT

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Understanding why e-cigarettes are becoming increasingly popular with adolescents, despite the potential negative health consequences of these products, is critical to informing prevention and intervention efforts. Prior research has identified peer use as a salient risk factor of adolescent e-cigarette use, but has not expanded on the mechanism of this association. For this study, 569 adolescents were recruited from an adolescent medicine clinic and public schools in rural and suburban areas of the mid-Atlantic United States. Participants completed a study-specific demographic questionnaire, the *Youth Risk Behavior Survey* (YRBS) to assess substance use, and the *Smoking Expectancy Scale for Adolescents* (SESA) to measure perceptions about the consequences of e-cigarette use. Mediation analyses revealed that peer use has a significant direct effect on self-reported use of e-cigarettes $b = -.850$, $p < .05$ and perceived benefits, $b = -.071$, 95% CI [-.118, -.035], and costs had indirect effects of self-reported use, $b = -.134$, 95% CI [-.197, -.077]. Hierarchical multiple regressions were used to conduct the moderation analyses with perceived benefits and costs as the moderators, however no interactions were significant. Moderated mediation analyses were run to determine if gender would moderate the mediation effect of perceived benefits/costs on the peer use and self-use association. Results indicated that none of these moderated mediation pathways were statistically significant. These findings support previous research claims that peer use is a significant risk factor for adolescent e-cigarette use and adds to the literature by suggesting that perceptions about outcomes of e-cigarette use (costs and benefits) may play an important role in the association between peer and self-reported use. Additionally, this study informs future targeted strategies (e.g., social pressures or perceptions) to reduce youth e-cigarette use.

Key words: electronic cigarettes, peer use, expectations

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Examining the Association between Expected Costs and Benefits, Peer Use and Self-Reported Use of Electronic Cigarettes in Adolescents

Adolescents' experimentation with risk-taking behaviors can result in lasting and deleterious effects on their long-term health. For this reason, it is important for research efforts to be focused on the identification of factors that could contribute to an adolescent's choice to engage in risky behaviors, such as smoking and use of nicotine delivery devices. Investigation into smoking behavior patterns in adolescence has resulted in a large and comprehensive body of research. National studies reveal that 9 out of 10 smokers had tried their first cigarette by age 18 and 99% had attempted by age 26 (CDC, 2015). As a result, mass media antismoking campaigns and health organizations have targeted decreasing smoking behaviors in adolescents. Recent research shows that some antismoking efforts have been successful as reports indicate a pattern of decline in youth cigarette smoking over the past several years. Specifically, the Center for Disease Control and the U.S. Department of Health and Human Services reported in 2014 that only 9 out of 100 high school students had indicated that they had smoked cigarettes in the past 30 days, a decline from 15 in 100 reported for 2011 (CDC, 2015).

However, while conventional cigarette smoking is decreasing in adolescents, use of a new product, the electronic cigarette (e-cigarette), has been gaining popularity. Invented by Hon Lik in 2005, the device first became available in the United States in 2007. The e-cigarette contains a liquid solution comprised of propylene glycol, vegetable glycerin (also called "glycerol"), and nicotine (i.e. Bell & Keane, 2012; Hajek, Etter, Benowitz, Eissenberg, & McRobbie, 2014). When heated, the device produces an aerosol that is directly inhaled by the user through a mouthpiece. Since the device became available, use of e-cigarettes by the adolescent population in the United States has steadily increased (CDC, 2015). A recent

international tobacco control survey encompassing participants from four countries, reported that most e-cigarette users are young, non-daily users who perceive e-cigarettes as less harmful than conventional cigarettes (Adkison et al., 2013). The Monitoring for the Future study (MTF), an ongoing research effort with an aim to collect data on behavior, attitudes, and values of middle school through college age students, determined that more adolescents used e-cigarettes than traditional tobacco cigarettes or any other tobacco product in the past 30 days (Miech, O'Malley, Johnston, & Patrick, 2015). A review of the National Youth Tobacco Survey data from 2011 and 2012 indicated that ever use of e-cigarettes among grade 6 through 12 students increased from 3.3% to 6.8% (Singh et al., 2016). Additionally, national reports of current use of e-cigarettes (prolonged exposure) in adolescence increased from 1.1% in 2011 to 2.1% in the same time period (Durtra & Glantz, 2014). Evaluations of the most recent National Youth Tobacco Survey data collected revealed that the number of adolescents who had used an e-cigarette in the past 30 days had substantially increased from 6.5% in 2012 to 16.0% in 2015 (Singh et al., 2016). The review concluded that the number of high school and middle school students nationwide who had tried e-cigarettes had reached three million in 2015. Further, new research has shown that 51% of adolescents who had initiated tobacco use started with e-cigarettes and that middle school students were more likely than high school students to report that an e-cigarette was the first nicotine delivery product they had used (Krishnan-Sarin, Morean, Camenga, Cavallo, & Kong, 2015).

The recent rise in popularity of e-cigarette use in youth may be attributed to a number of factors. For instance, the ability to purchase nicotine liquid in a variety of flavors could be particularly appealing to adolescents (i.e. Farsalinos et al., 2013; Grana & Ling, 2014). In fact, flavored cigarettes were banned in the United States when studies showed that these products

were disproportionately used by youth and new initiators (Etter & Bullen, 2011). Flavors for e-cigarettes include a variety of fruit (e.g., cherry, strawberry), drink (e.g., coffee), and dessert (e.g., apple pie) options, among others. Using a validated behavioral choice paradigm, researchers determined that adolescent participants worked harder to earn points for flavored e-cigarette puffs versus unflavored e-cigarette puffs and therefore, rated the reward value of flavored e-cigarettes as greater compared to unflavored (Audrain-McGovern, Strasser, & Wileyto, 2016), suggesting that flavoring may play a role in the attractiveness of e-cigarettes to youth.

Another reason for youth interest in e-cigarettes could be their physical design. Three different "generations" of e-cigarettes have been released (Bhatnagar et al., 2014). The first generation devices most resembled conventional cigarettes in color, size, and physical appearance and were therefore termed "cigalikes." Cigalikes are not rechargeable or refillable and are intended for single use. The design consists of a cartridge with atomizer to heat a solution, and a battery. The devices from the second generation, called "tanks," are much larger, contain manual switches to regulate puffs, and typically have large refillable cartridges. This generation allowed for some new features including flavors of e-liquid and a longer battery life. The most recent versions of the e-cigarette, called "mods," can be personalized to the user (Grana & Ling 2014). In addition to providing choices between different designs, colors, and flavored liquids, these latter devices have been adapted to allow users to refill liquid cartridges and to individualize devices through customization of the heating element. Additionally, there are a variety of batteries, wicks, and atomizers available. This unique customization aspect of an e-cigarette may be particularly attractive to youth.

Moreover, as e-cigarettes have become widely available, marketing and advertisement campaigns, often funded by existing tobacco companies, have used a number of strategies to promote the "benefits" of the product's use (Singh et al., 2016). A review of advertisements has identified consistent claims that e-cigarettes are healthier alternatives to traditional cigarette smoking, that e-cigarettes will aid in conventional cigarette smoking cessation, and that they can be used in places where conventional cigarette smoking is banned (e.g., Bhatnagar et al., 2014; Grana & Ling, 2014). These products are advertised by celebrities and are marketed on television, social media, and other Internet outlets (Williams & Knight, 2015). National data review suggests that the association between exposure to advertisements and use of these products might be particularly salient for adolescents (Singh et al., 2016). Further, adolescents report acceptance of marketing campaigns' claim that e-cigarettes are a healthier alternative to conventional cigarettes (Farrelly et al., 2015). Consequently, adolescents' relative perceptions of potential harm and benefits in using e-cigarettes may play a role in the recent popularity of this newer nicotine delivery device.

Health Risk of Using Electronic Cigarettes

Although advertisements claim that e-cigarettes are healthier alternatives to conventional cigarettes, these assertions have not been substantiated. In fact, several possible negative health outcomes have been identified related to electronic cigarette use (e.g., the toxicity of the e-liquid, the presence of heavy metals in the e-cigarette aerosol, the presence of nicotine in the e-liquid, and the overall physiological effects of long term use of electronic cigarettes) (Grana & Ling, 2014). When an individual uses an e-cigarette, e-liquid is aerosolized and inhaled. For this reason, determining the safety of inhaling the aerosolized e-liquid is of primary importance to determining the effects of e-cigarettes on health. There have been mixed findings regarding the

toxicity of e-liquid (i.e. Goniewicz et al., 2014; Paschke, Scherer, & Heller, 2002). The two primary solvents that comprise e-liquid are vegetable glycerin (e.g., vegetable oil) and propylene glycol. While these solvents have been shown to be harmless when ingested (National Institute of Health 2010, 2012), there is some evidence indicating the components change in composition and become toxic when they are heated (Paschke, Scherer, & Heller, 2002). Further, formaldehyde and acetaldehyde, which are carcinogenic substances, have been discovered in aerosolized e-liquid when it is heated (McAuley, Hopke, Zhao, & Babaian, 2012). Additionally, heavy metals have been shown to be present in electronic cigarette aerosol (Williams et al., 2013). When a user exhales, the e-cigarette releases an aerosol into the air. This aerosol contains particles that include some trace levels of heavy metals such as tin, chromium, and nickel (Williams et al., 2013). The particle size distribution has been shown to be similar to the particles in the smoke exhaled from conventional cigarettes (Ingebrethsen, Cole, & Alderman, 2012). That being said, research shows that while there are harmful substances in e-liquid, the levels are still substantially lower than those found in conventional cigarettes (i.e. Goniewicz et al., 2014; McAuley et al., 2012).

Advocates for stringent regulations of e-cigarettes also emphasize that there have been significant inconsistencies with quality control of these products, particularly when it comes to the nicotine concentrations in the solutions used to generate the aerosol (Grana & Ling, 2014). Research has shown that there is no concordance between the amount of nicotine listed on the label and the actual content; consequently, there is no uniformity of nicotine delivery across e-cigarettes of the same dose (Hajek et al., 2014). This inconsistency means that it is impossible for users to verify how much nicotine they are inhaling each time they use the product. Additionally, it has yet to be determined how much nicotine is absorbed by the throat and upper

airway when a user inhales e-cigarette aerosol (Bhatnagar et al., 2014). Although using e-cigarettes in lieu of conventional cigarettes eliminates some of the health concerns associated with smoke inhalation, e-cigarette users are still exposed to nicotine. This is of particular importance for adolescents because exposure to nicotine has been shown to result in problems in brain development. Animal models show that when the adolescent brain is exposed to nicotine, reward pathways and important mechanisms that control learning, memory, and mood result in increased addictive properties and behavior problems (e.g., Dwyer, McQuown, & Leslie. 2009; Slotkin, 2002).

The majority of studies on the physiological effects of using e-cigarettes, to date, have evaluated short-term health consequences, largely as a function of the fact that these devices have not been available long enough to investigate long-term effects. For example, cardiovascular effects of e-cigarette use have produced mixed results. Review of findings indicated that using e-cigarettes increased heart rate and blood pressure, likely due to exposure to nicotine, but did not cause diastolic dysfunction, as seen with conventional cigarette smoking (Farsalinos et al., 2013). Additionally, using e-cigarettes has been shown in some trials to cause lung irritation and one in-vivo study determined that e-cigarettes could increase risk of respiratory infection by disrupting pulmonary bacterial clearance (Sussan et al., 2015). The long-term effects of using e-cigarettes have not been adequately explored and should be of priority with the increase in youth users.

Peer Influence and E-cigarette Use

In adolescence, peers play a key social role, particularly with respect to risk behaviors. Indeed, peer influence has been shown to be significantly correlated with adolescent conventional cigarette smoking, and studies have found this to be a stronger relation compared to

other social environmental factors, including parental influence (e.g., Hoffman, Sussman, Unger, & Valente, 2006; Wang, Fitzhugh, Westerfield, & Eddy, 1995). The strong relation between peer influence and smoking behavior is consistent with the Behavioral Intention Model, which predicts that an individual's decision to engage in a behavior is influenced by two components: the individual's attitude toward the behavior, and the normative influence enacted on the behavior by others (Ajezen & Fishbein, 1970). Urberg and colleagues (1990) applied the Behavioral Intention Model to adolescent cigarette smoking behavior and found that normative pressure to smoke significantly increased the likelihood that an adolescent would engage in smoking behavior. The study also demonstrated that the transmission of peer influence to cigarette smoking on adolescents is primarily based on the perceptions about smoking held by adolescents themselves rather than direct pressure from their peers (Urberg, Shyu, & Liang, 1990). The use of the Behavioral Intention Model components to explain adolescent smoking behavior is further supported by research showing that the smoking status of a same-sex best friend was the strongest predictor of smoking behaviors among adolescents (Wang et al, 1995). It is important to note, however, that the cross-sectional methodology of these studies restricts researchers' capability to make causal statements about peer influence as a predictor of adolescent smoking behavior.

Thus far, limited research has been conducted to explore the relation of peer use and self-reported use of e-cigarettes. Barrington-Trimis and colleagues (2016) sampled over 2,000 adolescents and found that 24% reported having used an e-cigarette. Significant associations for psychosocial factors and peer perceptions with use of e-cigarettes were observed. Specifically, an individual was significantly more likely to use e-cigarettes if his or her friends were using the product than if he or she had no friends using e-cigarettes (Barrington-Trimis et al., 2016). Also

observed was an increased likelihood for e-cigarette use if an individual's best friends reacted positively (e.g., displayed approval) to his or her e-cigarette use (Barrington-Trimis et al., 2016). Other researchers found that middle school and high school adolescents reported that peers were their primary source for obtaining e-cigarette products (Krishnan-Sarin et al., 2015). Although multiple studies have demonstrated this association between peer- and self-use of e-cigarettes, a major limitation is that researchers have not yet examined the mechanisms by which these variables are related.

Furthermore, the possibility exists that the mechanisms for the relation of peer- and self-reported use of e-cigarettes may differ by gender. Specifically, as part of the 2014 Health Behavior in School-aged Children study, researchers examined self-reported use of conventional cigarette and e-cigarette use in a sample of 15-year-old students in Greece (Fotiou, Kanavou, Stavrou, Richardson, & Kokkevi, 2015). Results showed that having "peers who smoke" was a significant correlate of e-cigarette use in adolescents. Additionally, discrete differences in patterns of use between different genders was observed, with adolescent male conventional cigarette smokers being significantly more likely to experiment with e-cigarettes use than female conventional smokers and non-smoking students (Fotiou et al., 2015). These findings are consistent with previous research that indicates that male adolescents appraise lower risk associated with e-cigarette use than females and avoid risky behaviors only when they anticipate serious negative outcomes (Harris, Jenkins, & Glaser, 2006). The very narrow age sample, however, limits the generalizability of the findings (Fotiou et al., 2015). Moreover, this study pertains to youth in Greece and thus the results may not generalize to adolescents in the U.S. Consequently, further research is necessary to understand possible gender variations in peer

influence and self-reported use of e-cigarettes across a wider adolescent age range and within the U.S.

Adolescent Expectancies of Electronic Cigarettes Use

Several studies have evaluated the ability of other social environmental factors, such as attitudes and beliefs about smoking, to predict smoking behavior. Drug expectancies are determined by identifying behavioral choices an individual makes with the idea that this choice is a function of anticipating certain outcomes for that particular behavior (Doran & Brikmanis, 2016). Drug expectancies encompass a number of dimensions including the negative and positive physical feelings, social benefits and costs, as well as health-related benefits and costs (Harrell et al., 2014).

Many studies have been conducted to determine the factors that might influence what outcomes adolescents predict will occur as a result of engaging in conventional cigarette smoking (e.g., Ashare et al., 2007; Krosnick, Chang, Sherman, Chassin, & Presson, 2006; Malow-Iroff, 2006; Peters et al., 2005). In a seminal study on conventional cigarette smoking outcome expectancies, Chassin and colleagues (1991) collected data on over 5,000 adolescents and young adults annually from 1980 to 1983. Participants were asked to report about a number of attitudes and beliefs around smoking including global attitudes, normative beliefs about smoking (i.e., parents' and friends' reactions), and personally relevant perceived consequences (i.e., health, social, and psychological consequences). The results of this study showed that negative health consequences of cigarette smoking were more important to young adults (ages 21-25) than to adolescents (ages 11-18). However, adolescents reported that social consequences of smoking, as well as beliefs about academic success and independence, were more important influencing factors on their decision to smoke cigarettes (Chassin, Presson, Sherman, &

Edwards, 1991). These findings suggest that social-psychological factors that influence adolescents to engage in smoking behaviors might differ from young adult groups. A recent study compared perceived peer use and social norms between college student cigarette, e-cigarette, and/or hookah users and nonusers (Noland et al., 2016). Adolescents were asked to rate their acceptance of alterative tobacco products (e.g., e-cigarettes, hookah). Results indicated that adolescents had a greater acceptance of alternative tobacco products over cigarettes. These results could indicate that there is a connection between the adolescent's acceptance of a product and their expectations of the outcomes of its use.

Specifically related to social outcomes, moderation analyses were utilized to determine if the relation between positive outcome expectations (POE) and experimentation with cigarettes is moderated by subjective social status (SSS) in a group of 1,143 Mexican American adolescents between the ages of 11 and 13 years (Wilkinson et al., 2009). SSS was defined as adolescents' subjective view of their position in their school's hierarchy. Applying a longitudinal or repeated measures design, smoking habits were assessed using the questions, "Have you ever smoked a whole cigarette?" and "Have you ever tried a cigarette, even a puff?" Adolescents who responded that they had not smoked a cigarette at baseline, but responded they had smoked a cigarette at a follow-up visit were categorized as experimenters. Results indicated that adolescents with low SSS report different expectations associated with smoking as compared to their higher SSS peers. That is, adolescents who held high POE and reported low-moderate SSS were more likely to experiment with cigarettes. Therefore, variables related to an adolescent's social environment appear to be associated with positive outcome expectations of smoking and experimentation with cigarette smoking.

Although many studies have explored the relation between outcome expectancies and adolescent cigarette smoking (Chassin et al., 1991; Wilkinson et al., 2009), only a few have tested the relation of expectancies to e-cigarette use for this population (e.g., Doran & Brikmanis, 2016). As e-cigarettes continue to rise in popularity, studies have contrasted the expectancies an individual develops related to different nicotine delivery products with those for conventional cigarettes. For example, Harrell and colleagues (2014) found that adult e-cigarette users rated e-cigarettes as less harmful (e.g., less likely to result in addiction or cancer diagnosis) than conventional cigarettes and nicotine replacement therapies, as well as yielding less negative physical feelings and resulting in a lower likelihood of cravings. These findings were somewhat limited by the fact that participants were self-selected and former or current conventional cigarette smokers. It is important for further research to replicate this study with a broader sample to determine if the findings can generalize to other adult populations, such as e-cigarette users.

To date, a few studies have evaluated adolescent expectancies related to e-cigarette use. Doran and Brikmanis (2016) examined adolescent expectancies related to the use of e-cigarettes and hookah. They used a tobacco expectancies tool devised specifically for the purpose of the study; it included items related to health, affect control, social facilitation, and as an alternative to conventional cigarettes. Data from this measure showed that positive expectations of using e-cigarettes were significantly associated with higher odds of e-cigarette use (Doran & Brikmanis, 2016). Nonetheless, given that their measure was devised specifically for the purpose of that study, its psychometric properties (i.e., reliability and validity) have not been well substantiated. Additionally, only recent use of e-cigarettes was measured; therefore, researchers did not

evaluate expectations of individuals who had previously used an e-cigarette and quit (Doran & Brikmanis, 2016).

A second study aimed to determine some of the factors that influence young people to start and stop using e-cigarettes and to see if these decisions differed by school level or by cigarette smoking status (Kong, Morean, Cavallo, Camenga, & Krishnan-Sarin, 2015). These researchers employed a multimethod approach by gathering data through focus groups and questionnaires. They recruited a large sample of middle, high school, and college students. The focus groups revealed that adolescents and young adults have a number of reasons for engaging in e-cigarette use. The most popular reasons discussed were curiosity, flavors, family/peer influence (e.g., perceived approval, modeling), easy access to devices, and perceptions of e-cigarettes being "cool" and a healthier alternative to cigarettes (Kong et al., 2015). These themes were then used to create response options for a survey item, "Why did you try an e-cigarette?" Surveys were administered to 1,175 students from middle schools, high schools, and colleges in Connecticut. Results showed that the most popular reasons selected for trying an e-cigarette were curiosity (54.4%), appealing flavors (43.8%), and peer influence (31.6%) (Kong et al., 2015). This study was able to identify themes that provide important information as to why adolescents and young adults experiment with e-cigarettes. Many of the reasons for using an e-cigarette (i.e. e-cigarettes being "cool", and healthier alternative to cigarettes) would fall under the category of "positive expectancies," given that adolescents anticipate social and health benefits as an outcome of using e-cigarettes. Although existing studies identified an association between adolescents' expectancies related to using e-cigarettes and their decision to use an e-cigarette, further research efforts need to focus on understanding the mechanism of how these expectancies influence an adolescent's decision.

Summary and Critique of Literature

The use of e-cigarettes has grown in popularity with adolescents, despite declines in conventional cigarette use over recent years (CDC, 2015). As few regulations have been set in place, there is significant exposure of e-cigarettes to youth through advertisements on multiple forms of media (Farrelly et al., 2015). These advertisements claim that e-cigarettes are healthier than conventional cigarettes and that these devices can be used as a way to quit smoking conventional cigarettes despite a lack of consistent evidence to support such assertions (Farsalinos et al., 2013). Research has shown mixed results on the potential health consequences associated with short-term use of e-cigarettes, and given the novelty of these devices, little is known about the long-term health effects (e.g., Bhatnagar et al., 2014; McAuley et al., 2012; Williams et al., 2013). Regardless, it is clear that these devices deliver nicotine and the adolescent developing brain is vulnerable to the effects of nicotine (e.g., Dwyer et al., 2009; Slotkin, 2002), so it can be assumed that e-cigarettes are not a healthy alternative for youth. As the effects of these products are not well understood, reports that show a marked increase in adolescent e-cigarette use is cause for concern.

Given the reported increase in e-cigarette use amongst adolescents and the potential associated health concerns, research efforts are needed to identify how specific factors, such as peer-use, play a role in adolescents using e-cigarettes. While initial investigations into this topic have identified an association between peer- and self-reported use of e-cigarettes (e.g., Barrington-Trimis et al., 2016), little is known about the underlying mechanisms that lead to these variables being associated with one another. Moreover, these studies have not determined the mechanism by which these variables are related and are somewhat limited by samples that do not encompass a wide age range (e.g., Fotiou et al., 2015; Krishnan-Sarin et al., 2015). Further

research is necessary to determine the mechanism by which these variables are associated across a wide adolescent age range.

Additionally, there is evidence that positive expectancies can be a strong predictor of continued use for adult e-cigarette users (Doran & Brikmanis, 2016). However, adolescents report different motivations for initiating e-cigarette use than young adults (Kong et al., 2015) and therefore, they may have different expectations of what will be the positive and negative consequences associated with regular e-cigarette use. Few studies have explored adolescent expectancies of e-cigarette use and those that exist use study specific measures that could limit the construct validity of their findings (e.g., Doran & Brikmanis, 2016; Kong et al., 2015).

No existing study has evaluated the mechanism underlying the associations among expectancies, peer use of e-cigarettes, and adolescent e-cigarette use. Yet, these findings can be used to identify factors to target for prevention and intervention efforts to curtail e-cigarette use in adolescents, thereby preventing or reducing negative health consequences of long-term use. Conducting mediation and moderation analyses will allow us to better understand how peer use and expectations of using e-cigarettes relate to one another in predicting self-reported use, not just the association of these variables, as existing literature has shown.

Aims of the Current Study

The overall objective of this study is to examine the role that peer use of e-cigarettes and perceived risks and benefits play in adolescent self-reported use of e-cigarettes. Having peers who smoke may create normative influence on an adolescent's decision to use e-cigarettes (Barrington-Trimis et al., 2016). Normative influence and attitudes towards behavior are considered the best predictors of engaging in behavior (Ashare et al., 2007; Ajzen & Fishbein, 1970; Malow-Iroff, 2006). Indeed, numerous studies have shown that normative influence is

directly associated with an adolescent's intention to smoke conventional cigarettes (e.g., Chassin et al., 1981; Wilkinson et al., 2009). As such, this and other previous research was used as a framework to guide our study in exploring the role that expectancies (regarding e-cigarette use) and peer use of e-cigarettes plays in adolescents choosing to use e-cigarettes.

Expectancies of benefits and costs (e.g., social benefits, appearance-presentation costs) were evaluated using the *Smoking Expectances Scale for Adolescents* (SESA), though adapted to determine expectations specifically for e-cigarette use. Peer and self-reported use of e-cigarettes was measured via the *Youth Risk Behavior Survey* (YRBS). Through these measures, we evaluated the associations between expectancies of benefits and costs, peer use, and self-reported use. To address the main objective, the proposed study has three specific aims.

Aim 1. The first aim of this study was to examine a mediation model of expectations of benefits and costs of e-cigarette use on the relation between peer-use and self-reported e-cigarette use. It was hypothesized that expectations of benefits and costs of using e-cigarettes would mediate the association between peer use and self-reported e-cigarette use.

Aim 2. The second aim of this study was to conduct a moderation analysis to determine if the association between peer- and self-use changes as a function of perceived costs and benefits (i.e., expectancies) of e-cigarette use. Based somewhat on previous literature (e.g., Barrington-Trimis et al., 2016), it was expected that higher benefits and lower costs would strengthen the extent to which peer use predicts self-reported use of e-cigarettes.

Aim 3. For the third aim, we applied a moderated mediation analysis to investigate whether the effect of peer use on self-use through the pathway of the mediating variable (benefits or costs, respectively) differs by gender (see Figure 1). Based in part on previous literature (e.g., Fotiou et al., 2015), it was hypothesized that gender would have a moderating effect on the

relation between peer use and expectations of costs and benefits, and the association between the expectation of costs and benefits and self-reported ever use.

Method

Participants

The proposed project is part of a larger, ongoing study investigating e-cigarette use in youth. A sample of 574 adolescents was obtained from multiple recruitment sites in West Virginia, Ohio, and Pennsylvania. These youth were recruited from middle and high schools as well as an adolescent medicine clinic in north central West Virginia. Of this larger sample, our sample included 569 individuals who were (1) enrolled in high school; (2) between the ages of 11 and 18 years; and (3) English speaking. Potential participants were excluded from the study if they exhibited significant cognitive impairment, as they would not have been able to independently complete the battery of questionnaires. Teachers and clinic staff assisted in identifying those youth who exhibited significant cognitive deficits.

Procedure

The Institutional Review Board at West Virginia University provided approval for the current study. All collaborating schools and clinic provided consent before data collection was initiated. Data collection in schools occurred during regular class periods. At the first school visit, research staff members introduced the study to potential participants as well as distributed invitation letters and consent forms. Students were asked to review and sign the consent/assent form and acquire signatures from parents, regardless of their interest in participating. That way, the research team could more accurately calculate refusal rates. At the second school visit, which typically occurred 2-7 days after the first, researchers collected signed consent forms. To enhance the validity of refusal rate calculations, youth were incentivized to return a completed

consent form (regardless of decision to participate or not) by receiving an opportunity to win a gift card in a study lottery. Winners were chosen at the end of recruitment in order to ensure all participants have an equal chance of receiving a prize.

After consent and assent forms were collected, youth who chose to participate were given a packet of questionnaires to complete that included (but is not limited to) the following measures: (1) *Student Information Form*; (2) *Youth Risk Behavior Survey*; and (3) *Smoking Expectancy Scale for Adolescents*. Participants completed the packets during regular class time. Names of youth who completed the questionnaires were entered into an additional lottery drawing for the chance to win a gift card (one of at least 40 $20 gift cards). Similarly, names were not chosen until the completion of the study.

At the adolescent medicine clinic, participants who met study inclusion criteria were identified by physicians and briefly introduced to the study. Physicians then asked youth and parent(s) if they would like to hear more about the study from research staff. Research staff explained participation requirements for the study and obtain informed consent from parents as well as youth aged 18 years, and assent from youth aged 11 to 17 years. Youth completed the same packet of questionnaires described in the school data collection procedure. Following the completion of forms, the adolescent was entered into the lottery for the opportunity to win a $20 gift card.

Measures

Student Information Form (SIF) (Appendix A). The *Student Information Form* was created to collect participant demographic information for this study. The measure contained questions regarding participant age, gender, grade, ethnicity, family structure, place of residence, and socioeconomic variables. Additionally, youth were asked to report on family history of drug (including nicotine) dependence and of treatment associated with dependence. The current study

used the SIF responses to describe the characteristics of the sample and to create sociodemographic variables (e.g., age, gender, race) for analyses.

Smoking Expectancy Scale for Adolescents (Hine, Honan, Marks, & Brettschneider, 2007). The *Smoking Expectancy Scale for Adolescents* (SESA) is a 43-item, self-report questionnaire that measures adolescent attitudes towards potential consequences of smoking cigarettes. As there is no current measure of attitudes for e-cigarettes, the SESA was adapted from a measure of conventional cigarette smoking for this study. The only modification, however, was to replace "cigarette" with "e-cigarette" throughout the measure. Adolescents indicated their beliefs about the likelihood of a particular outcome related to e-cigarette smoking on a 10-point Likert-type scale, ranging from 0 ("completely unlikely") to 9 ("completely likely"). There are two second-order scales that group items into expected Benefits and Costs. Additionally, the items are scored to create eight subscales that pertain to a range of smoking expectancies (i.e., Affect control, Social benefits, Boredom reduction, Weight control, Appearance presentation, Health costs, Social costs, and Addiction). The current study used the second-order scales to determine adolescent beliefs about the Expected Costs and Expected Benefits of smoking e-cigarettes. Internal consistencies for the scales, Benefits (α=.89) and Costs (α=.86), have been shown to be at acceptable levels in prior research (Hine et al., 2007). Previous research has indicated that social and health outcomes are salient consequences for adolescents (Ashare et al., 2007; Chassin et al., 1991; Malow-Iroff, 2006). Studies have shown that the SESA subscale scores are correlated with other smoking variables such as intentions to smoke and smoking behavior, providing construct validity for the measure (e.g., Foster, Racicot & McGrath, 2012). Cronbach's alpha analyses revealed satisfactory levels of internal consistency for Benefits (.90) and Costs (.94) for the current sample.

Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2015). The *Youth Risk Behavior Survey* (YRBS) contains 89 items that assess six dimensions of health-related risk behaviors. The dimensions include: unintentional injuries and violence, use of tobacco products, alcohol and other drug use, risky sex behaviors, diet, and physical activity. Each item is scored independently for this measure. Therefore, no total score or subscale scores are calculated. The YRBS is revised regularly by the Centers for Disease Control and Prevention; hence, data on the most current 2015 version is not yet available. However, a number of studies have found psychometric evidence to support the test-retest reliability (Brener et al., 2002) and validity of the YRBS scores (e.g., association to relevant biomarkers of substance use; Brener, Billy & Grady, 2003) for earlier versions of this measure.

The current study used the electronic cigarette questions of the YRBS to determine adolescents' current e-cigarette use. As the primary aim of this study was to determine factors related to adolescent's choice to try an e-cigarette and not necessarily sustain use, participants were not stratified into groups based on current and ever use. Rather, adolescent lifetime use of e-cigarettes was determined from the response on the item, "Have you ever used an electronic vapor product?" (0=no, 1=yes). Participants who indicated "yes" were considered a lifetime user and were included in the analyses as such; those who endorsed "no" were classified as non-users.

Peer smoking behavior was measured using an item that asks adolescents to indicate how many of their five closest friends have "tried an e-cigarette," with response options ranging from 0 *(None)* to 5 *(Five)*. Consequently, this variable was analyzed as a continuous variable.

Results

Power Analyses

A priori power analysis, implemented in G*Power (Faul et al., 2007), suggested that a sample size of N = 120 would be sufficient (power = .95) to detect a small-to-moderate sized effect (F^2 = .15) at $p < .05$. Thus, our final sample of 569 should be well powered for the mediation and moderation tests. That being said, Hayes and colleagues (2012) suggest that because mediation analyses represent multiple regression equations, typical power analyses are insufficient for estimating power for these analyses.

Data Management & Preliminary Analyses

All statistical analyses were conducted with Statistical Package for the Social Sciences (SPSS 21). Any measure with data missing for more than 10% of its items for a given participant was not included in analyses. Frequencies revealed that no variable measure had 5% or more of data missing. However, frequencies also revealed measures, self-reported use of e-cigarettes and peer use had some missingness (less than 5%). Little's MCAR test was performed to determine if the data was missing completely at random. A statistically nonsignificant result, $p = 1.00$ indicates that the probability that the pattern of missing diverges from randomness is greater than .05, so MCAR may be inferred. To address the missing data, Expectation-Maximization (EM) was chosen because it does not reduce the variance or increase central tendency. No significant changes in mean and standard deviations were observed after conducting EM on the data.

Preliminary analyses were conducted to determine if violations occurred in linearity, normality, homoscedasticity, and multicollinearity. Normality of data was confirmed as skewness and kurtosis values were within acceptable limits between -2 and +2 (George & Mallery, 2010). Scatterplots were evaluated and linear associations between the predictor

variable and the outcomes of self-use were observed. Visual inspection of residual scatterplots with standardized residual values plotted against standardized predicted values was conducted to examine homoscedasticity. No violations of multicollinearity were observed in the analysis of variance inflation factor and tolerance levels.

Descriptive Statistics

Demographic characteristics are presented in Table 1 and descriptive statistics for participants' e-cigarette and other tobacco product use are shown in Table 2. Means and correlations between all study variables are depicted in Table 3. The age of participants ranged from 14-18 (M=15.87, SD=1.26). A correlation matrix was completed for all three variables (i.e., perceived benefits and costs, peer use, and self-use). Pearson correlation coefficients were calculated between the peer use variable (range = 0-5) and second-order scale scores (Expected Costs and Expected Benefits) on the SESA. Results revealed a significant correlation between self-use and costs $r(567) = .412$, $p < .001$; As user was coded as 1 and non-user was coded as 2, increased perceived costs was associated with being a non-user of e-cigarettes. There was a negative correlation between self-use and perceived benefits, $r(569) = -.311$, $p < .001$ and self-use and peer use, $r(56) = -.644$, $p < .001$. There was also a significant positive correlation between peer use and perceived benefits $r(567) = .299$ $p < .001$ and peer use and costs $r(564) = .407$, $p < .001$.

Aim 1 – Mediation Analyses

Dimensions of expectations (benefits and costs) were tested as mediation in the association between peer use and self-reported use of e-cigarettes. To test the hypothesis that the association between peer use and self-reported use is mediated by perceived benefits and costs, respectively, mediation analyses were conducted in SPSS utilizing the PROCESS version 2.15

add-on (Hayes, 2013). The PROCESS program, which uses a bootstrapping method, was chosen over other methods (i.e. Barron and Kenny's approach, 1976) because it produces a specific statistical effect of the indirect effect of the mediator. Evidence for mediation is concluded if the 95% confidence interval (CI) for the indirect effect does not contain zero. The model was repeated for the second SESA scale (Expected Costs) as the hypothesized mediator.

Results of the mediation analysis for Expected Benefits and Expected Costs are displayed in Figures 2 and 3, respectively. An analysis of direct and indirect effects demonstrates that peer use had a significant direct effect on self-reported use of e-cigarettes $b = -.817$, $p < .001$. Perceived benefits had an indirect effect of self-reported use, $b = -.073$, 95% CI [-.124, -.037]. The effect of the mediator indicates that increased report of perceived benefits is associated with a 23% reduced odds of being in the non-smoking group. Results suggest that the pathway from peer to self-reported use through perceived benefits significantly predicts self-reported use. In other words, higher peer use is associated with greater self-reported use when adolescents perceive more benefits.

Perceived costs had an indirect effect on self-reported use, $b = -.134$, 95% CI [-.206, -.081]. The effect of the mediator indicates that an increased report of perceived costs is associated with an 87% increased odds of being in the non-smoking group. Therefore, the pathway from peer to self-reported use through perceived costs significantly predicts self-reported use. These results suggest that lower peer use is associated with lower self-reported use when adolescents perceive more costs.

When both mediators were entered into the model at the same step, the pathway of peer use to self-use through perceived benefits and through perceived costs was shown to be significant (see Figure 4). Results indicate that neither pathway was shown to be significantly

stronger in predicting the outcome and therefore, both perceived costs and perceived benefits uniquely contribute to the association between peer use and self reported use of e-cigarettes.

Aim 2 – Moderation Analyses

Hierarchical multiple regression was used to conduct the moderation analyses. The predictor variable (peer use) and the hypothesized moderator, SESA Expected Benefits score, were centered on the means because they are continuous variables (see Table 4). In PROCESS, variables are centered and then a series of hierarchical regression analyses are conducted and an interaction term is computed to determine moderation. The centered predictor (peer use) and the centered hypothesized moderator (SESA Expected Benefits) were entered into block one. The interaction between the predictor and the hypothesized moderator were entered into block two. This process was repeated with the SESA Expected Cost subscale (see Table 5).

At step 1 of the hierarchical logistic regression, peer use and SESA benefits predicted self-use, $F(2, 564) = 378.85$, $p < .001$, $R^2 = .53$, with peer use uniquely predicting self-use ($b = -.86$, $p < .01$). At step 2, the interaction term (peer use * SESA benefits) was entered into the model, and it was not significant ($b = -.08$, $p > .05$). The Johnson-Neyman technique was utilized to examine if there was a certain level of perceived benefits that interacted with peer use. However, no interactions were significant among all levels of perceived benefits.

SESA Costs was found to be significant in the association between peer use and self-reported use. At step 1 of the hierarchical logistic regression, peer use and SESA costs significantly predicted self-use $F(2, 562) = 287.11$, $p < .001$, $R^2 = .54$, with peer use uniquely predicting skill ($b = -.82$, $p < .01$). At step 2, the interaction term (peer use * SESA costs) was entered into the model, and it no longer significantly predicted self-reported use ($b = -.01$, $p < .05$). The Johnson-Neyman statistic was not significant, indicating that no interaction was

significant among levels of perceived costs.

Aim 3 – Moderated Mediation Analyses

A moderated mediation model was examined as proposed in Aim 3 in PROCESS to see if the mediation effect of expectations of costs and benefits on peer use to self-reported e-cigarette use varied as a function of gender (see Footnote 1). We used the PROCESS to test the moderated mediation models with both SESA Benefits and Costs as the mediator with 5,000 samples bias-corrected bootstrap procedure (see Tables 6-7). At step 1 of the logistic regression, peer use predicted self-use $F(1, 561) = 57.51$, $p < .001$, $R^2 = .09$. We tested if gender would moderate the mediation effect (e.g., would the indirect effects be significantly different among males and females) of perceived benefits/costs on the peer use and self-use association. Gender was entered as a moderator between peer use and perceived benefits, perceived benefits and self-use, peer use and perceived costs, and perceived costs and self-use. None of these moderated mediation pathways were statistically significant. Thus, the indirect effects via perceived benefits and costs are the same for both males and females.

Discussion

E-cigarette use continues to increase in the adolescent population (CDC, 2015). Consistent with these reports, a high rate of e-cigarette use was found in the current sample with 38.3% of adolescents reporting lifetime e-cigarettes use. These results are proportional to other studies on e-cigarette use in adolescent (e.g., Doran & Brikmanis, 2016). Further, a recent study found that 25% of U.S. high school students who had never used e-cigarettes reported curiosity about these products, and high levels of curiosity were associated with lower perceptions of harm (Margolis, Nguyen, Slavit, & King, 2016). Therefore, it is imperative to determine potential

factors related to adolescent use of e-cigarettes to better inform public policy efforts to curtail e-cigarette popularity among this population.

The aim of this research was to determine if expectations of benefits and costs to e-cigarette use contributes to the association between reported peer use and self-use of e-cigarettes, either as mediating or moderator variables. The current study did not provide evidence for perceived costs and benefits as moderators of the association between peer use and self-reported use as this association did not differ significantly by the levels of perceived costs and benefits. However, results indicated that expectations of benefits and the expectations of costs each mediated the association between peer use and self-use. Evidence of a mediation suggests that the pathway between peer use and self-use is better explained through perceived costs and benefits.

Mediation

The findings from the current study on the association of expectations of costs and benefits with adolescent e-cigarette use are consistent with previous research pertaining to conventional cigarettes and other tobacco products (e.g.. Ashare et al., 2007; Krosnick et al., 2006; Peters, Meshack, Lin, Hill, & Abughosh, 2013). Existing studies suggest that adolescents perceive e-cigarettes as less addictive and lower in health risk relative to conventional cigarettes and that these perceptions are given as a reason to initiate e-cigarette use (Margolis et al., 2016; Pepper, Ribisl, Emery, & Brewer, 2014). In the same vein, Roditis and colleagues (2015) found that adolescents were able to accurately describe negative consequences of conventional cigarette use, but were not able to accurately describe consequences of e-cigarette or marijuana use. Further, in that study, adolescents noted multiple benefits of e-cigarette and marijuana use, but did not provide as many benefits for cigarette use. Moreover, current young adult users of e-

cigarettes have reported belief that these products result in fewer health consequences, were less likely to cause withdrawal and addiction, and were more satisfying relative to conventional cigarettes (Harrell et al., 2014). As current study findings suggest that perceived benefits and costs associated with e-cigarette use predicts self-use, a clearer understanding of how these expectations are developed (e.g., media, peer and family influence) is essential to prevention efforts.

The process of normalization also can be used to help explain the associations between expectations of costs and benefits and self-reported e-cigarette use (Harakeh et al., 2011). The current study findings suggest that adolescents who expect more benefits (i.e., social acceptance, weight loss) are less likely to be in the non-user group. Additionally, the association between perceived costs and benefits and self-use is similar to conventional and other tobacco use (e.g. hookah) (Noland et al., 2016).

Similarly, results of this study indicated that expectations of perceived costs mediated the association between peer use and self-use, suggesting that when adolescents expect costs associated with their use (i.e., addiction, disapproval from parents), they are more likely to be in the non-smoking group. Studies have shown an association between exposure to e-cigarettes and self-reported use (Singh et al., 2016). Indeed, this finding is in line with previous research that has found that adolescents who used e-cigarettes were more likely to perceive e-cigarettes as less harmful (Amrock, Zakhar, Zhou, & Weitzman, 2014). Young people may know the health risks of using e-cigarettes, yet minimize the risk effect when they observe peers engaging in the activity and rationalize that their young age and perceived ability to stop at any point will protect them from costs associated with e-cigarette use as it has done for their peers. Therefore, it

follows that adolescents that are exposed to e-cigarettes through peers may have their expectations about the benefits and costs related to use shaped by their environment.

The number of their five closest friends that an adolescent reported used was significantly associated with their own e-cigarette use. This association is important to consider in light of the fact that 63.4% of adolescents in this sample reported that at least one of their closest friends had tried an e-cigarette. Results indicate that individuals who have multiple close friends engaging in e-cigarette use may be more vulnerable to self-use. Some researchers have suggested this association stems from peer pressure to use (i.e., peer offers adolescent e-cigarette or ridicules them for not participating). However, one previous study concluded that passive peer influence (i.e., environmental cues and peers using around them) was more powerful than active pressure from peers in predicting if an adolescent engaged in e-cigarette use (Harakeh et al., 2011). The later study presents an alternative theory of cue-reactivity, suggesting that when an adolescent's environment is full of potential cues for e-cigarette use (i.e., e-liquid, e-cigarette devices), normalization of e-cigarettes occurs and results in higher e-cigarette use.

Moderated Mediation

The current study did not provide evidence for gender as a moderator for the effects of perceived costs and benefits on the association between peer use and self-use. This contradicts previous research that has found discrete differences in patterns of use between males and females. For example, Fotiou and colleagues (2015) found that a sample of adolescent male conventional cigarette smokers were significantly more likely to experiment with e-cigarettes than female conventional smokers and non-using students. These findings also diverge from previous research that indicates that male adolescents appraise lower risk associated with e-cigarette use than females (Harris, Jenkins, & Glaser, 2006). However, these previous studies

had assessed differences in gender and e-cigarette using expectations and gender and peer use influence independently while the current study evaluated how gender may influence the pathway of peer use to self-use through expectations. This difference in experimental approach may account for the discrepancies.

Limitations

The findings of this study should be interpreted in light of several limitations. The data were collected using a cross-sectional design, and therefore causal statements about e-cigarette use, peer use, and expectations of costs and benefits associated with use cannot be made. Longitudinal research should be conducted to determine temporal and directional associations between variables. Second, adolescent e-cigarette use was self-reported and therefore, could be subject to bias (i.e., social desirability, recall bias). Due to unequal cell sizes, the current study was unable to evaluate differences in the sample based on recruitment site (e.g., clinic versus school). This is problematic because differences in recruitment sites may elicit different response patterns for adolescents. Additionally, the current study classified use as ever use (lifetime) and never use and therefore, degrees of use (e.g., current use versus trying once) have not been accounted for in the results. Future research should measure degrees of use, as there are likely differences in expectations for individuals who have simply tried an e-cigarette and those who have engaged in continued use. Further, dual use of e-cigarettes and cigarettes was not addressed and should be considered further in future research efforts. Also, the current study was conducted in one geographic area – a somewhat limited section of the Appalachian region of the United States. However, this geographic area has been identified as being at particularly high risk for tobacco use (Owusu et al., 2016), as rural Appalachia reports the highest rates of conventional cigarette use (CDC, 2013). Finally, adolescents only reported on up to five closest friends' e-

cigarette use. Based on previous studies, it is possible that the passive influence of peers could extend to a larger community such as in school setting that encompasses their social environment as a whole (Harakeh et al., 2011). Further, the current study did not ascertain the specific relationship of the peers (e.g., same sex versus different) to the adolescent. Previous research has found that best friends and same-sex friends, in particular, influence an adolescent's decision to use e-cigarettes (Barrington-Trimis et al., 2016; Wang et al, 1995). Therefore, a clearer understanding of how a peer's relationship to an adolescent may influence expectations of costs and benefits should be explored further in future research.

Clinical Implications

The expectations adolescents' form about e-cigarette could be related to lack of regulatory legislation about the product as compared to conventional cigarettes. It is known that adolescent's perceptions are strongly influenced by media campaigns, and therefore, labeling requirements and advertising restrictions could serve as a way to highlight the costs associated with e-cigarette use (Singh et al., 2016). As this study indicated, even when peer use is present, high perceptions of costs still results in a decreased likelihood of e-cigarettes experimentation (Harrell et al., 2014). Policies that regulate these devices should be enacted to limit their use in public spaces to decrease normalization. Additionally, health warnings and age limits could serve to alter adolescents' expectations about e-cigarettes being a healthier alternative to conventional cigarettes.

Interventions to reduce e-cigarette use should be implemented on multiple levels. At the school level, administrations should consider implementing peer-led smoking prevention programs. These programs have been shown to be as effective, if not more effective, than adult led programs in reducing conventional cigarette smoking (Wilkinson et al., 2009). Future

research efforts should aim to validate these types of programs with for the reduction of e-cigarette using. Physicians should discuss with adolescents common misconceptions and risks related to e-cigarette use. The current study suggests that interventions do not need to be tailored based on gender. However, this is contrary to some previous findings that have shown that gender does play a role in the development of expectations (Fitou et al., 2015) and, therefore, additional research is needed to determine how gender contributes to expectations related to e-cigarette using.

Health care providers should also consider that an adolescent's social environment, in particular, peer e-cigarette use might have a large impact on the individual's choice to engage in e-cigarette use. Social environments in various geographic areas could differ vastly. As stated previously, research has shown that tobacco use rates are significantly higher in rural populations as compared to urban (CDC, 2013). Frequent use of tobacco products by individuals of all ages in this environment might account for the fact that adolescents report that their primary source of information about e-cigarettes comes from peers and family members (Krishnan-Sarin et al., 2015).

Future Research Directions

E-cigarette use in adolescents has been shown to be associated with willingness to try other tobacco products (Wills et al., 2016; Barrington-Trimis et al., 2016). Consistent with methodology in the existent literature, adolescents in this study reported on use of tobacco products other than e-cigarettes. In this sample, 25% of adolescents had tried conventional cigarettes, 6.9% had tried smoking cigars and 6.5% had tried other tobacco products (i.e. chew, dip, snuff). Previous researchers determined that the association between e-cigarette use and willingness to smoke conventional cigarettes was partially mediated by positive expectancies

about smoking (Wills et al., 2016). Further, an existing study found that a pro-e-cigarette social environment increased an adolescent's risk of engaging in conventional cigarette smoking (Barrington-Trimis et al., 2016). These findings indicate that e-cigarette use may be a first step for adolescents who have never used a nicotine delivery product to initiate conventional cigarette smoking. Future research should aim to determine the role of e-cigarette use in initiation of conventional cigarette smoking.

Further, the influence of environmental factors on e-cigarette use has extended to younger children. Recent surveys have shown that e-cigarette use has increased in middle school age children (CDC, 2015). One study indicated that 83% of middle school students reported awareness of e-cigarettes and although only 3% reported use, 25% of those who had not reported use were deemed susceptible for future use (Krishnan-Sarin et al., 2015). Future researcher should target the middle school population in order to determine specific factors related to this age group.

The current study has provided a mechanism through which social influence from peers and development of expectations of benefits and costs related to using e-cigarettes may be related to adolescent e-cigarette use. These factors should be targeted in order to develop tailored interventions and policies designed to prevent or reduce negative health consequences of long-term e-cigarette use.

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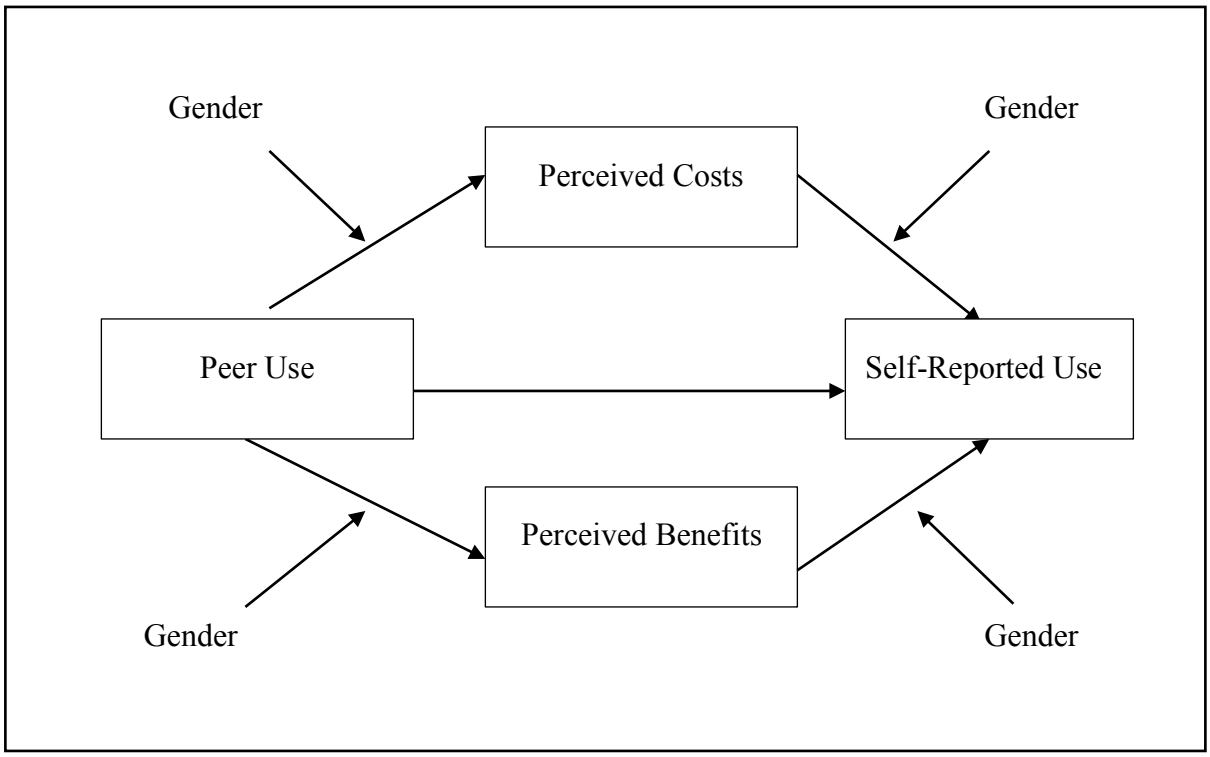

Figure 1. Proposed moderated mediation model of the association between peer use, expected costs and benefits, and self-reported use of electronic cigarettes.

Table 1

Demographic Information (n=569)

	N	%
Gender		
Female	250	60.1
Male	231	39.8
Race		
Caucasian	483	83
Bi-Racial/Mixed Race	32	5.5
Asian American	24	4.1
African American	20	3.4
Hispanic American	10	1.7
Other	6	1.0

Table 2

E-cigarette and other tobacco product use

	N	%
Tried an E-cigarette		
No	356	61.5
Yes	223	38.5
Tried a Conventional Cigarette		
No	421	73.9
Yes	148	25.4
Tried other tobacco products (i.e. chew, dip, snuff)		
No	532	93.0
Yes	37	6.50
Tried a cigar		
No	530	93.1
Yes	39	6.85
Number of closest friends who have tried an e-cigarette		
None	216	37.6
One	75	13.1
Two	64	11.1
Three	77	13.4
Four	40	7.0
Five or More	102	17.8

Table 3

Correlations Among and Descriptive Statistics for Key Study Variables

	M (*SD*)	Self-Reported Use	Peer Use	Perceived Benefits	Perceived Costs
Self-Reported Use	1.61 (.48)	-	-	-	-
Number of Peer Use	2.92 (1.91)	-.644**	-	-	-
Perceived Benefits	2.60 (1.57)	-.314**	.302**	-	-
Perceived Costs	3.44 (1.06)	.412**	-.410**	-.020	-

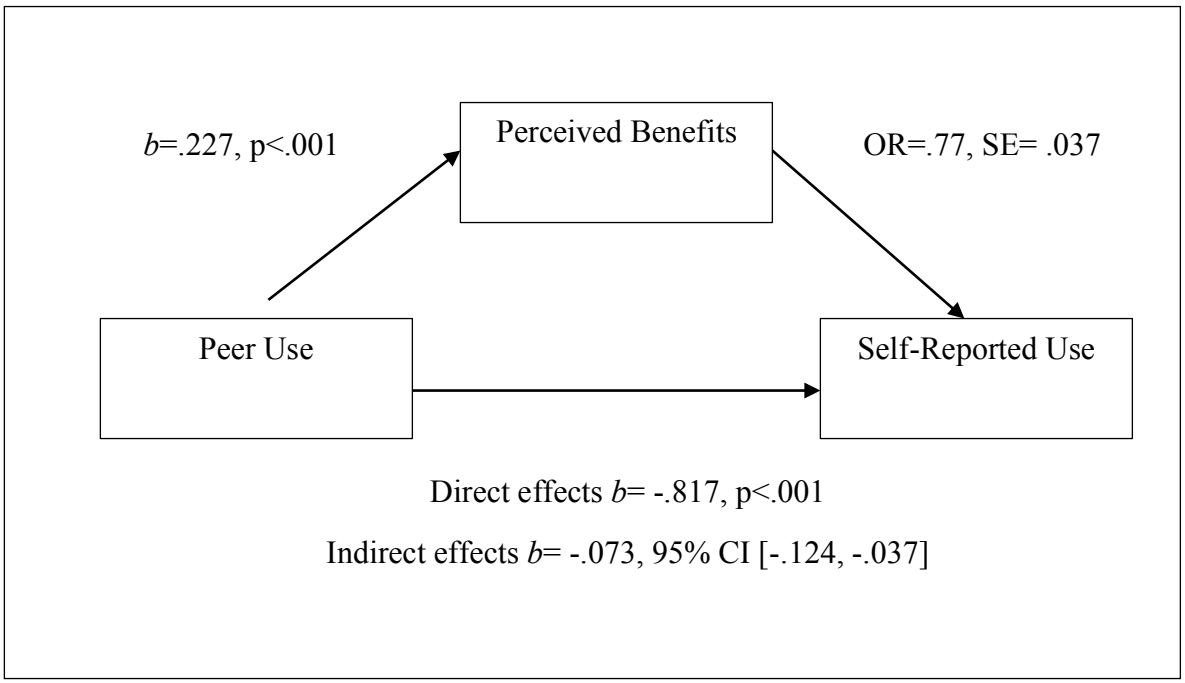

Figure 2. Mediation model of the association between peer use, perceived benefits, and self-reported use of electronic cigarettes.

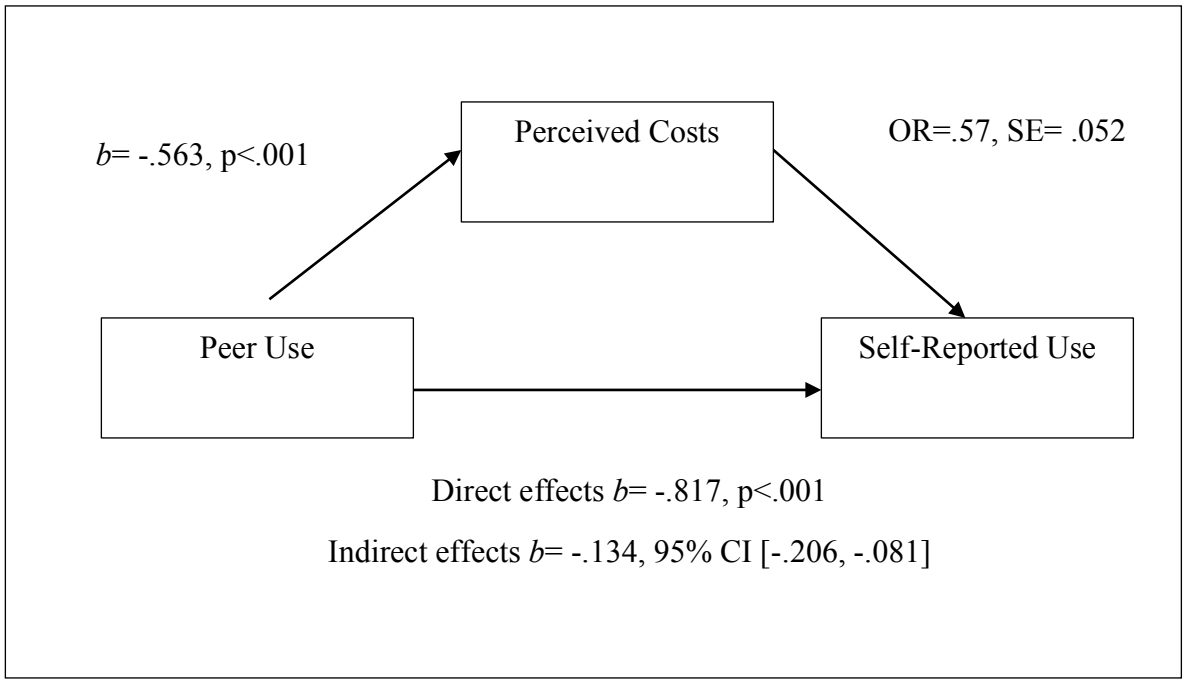

Figure 3. Mediation model of the association between peer use, perceived costs, and self-reported use of electronic cigarettes.

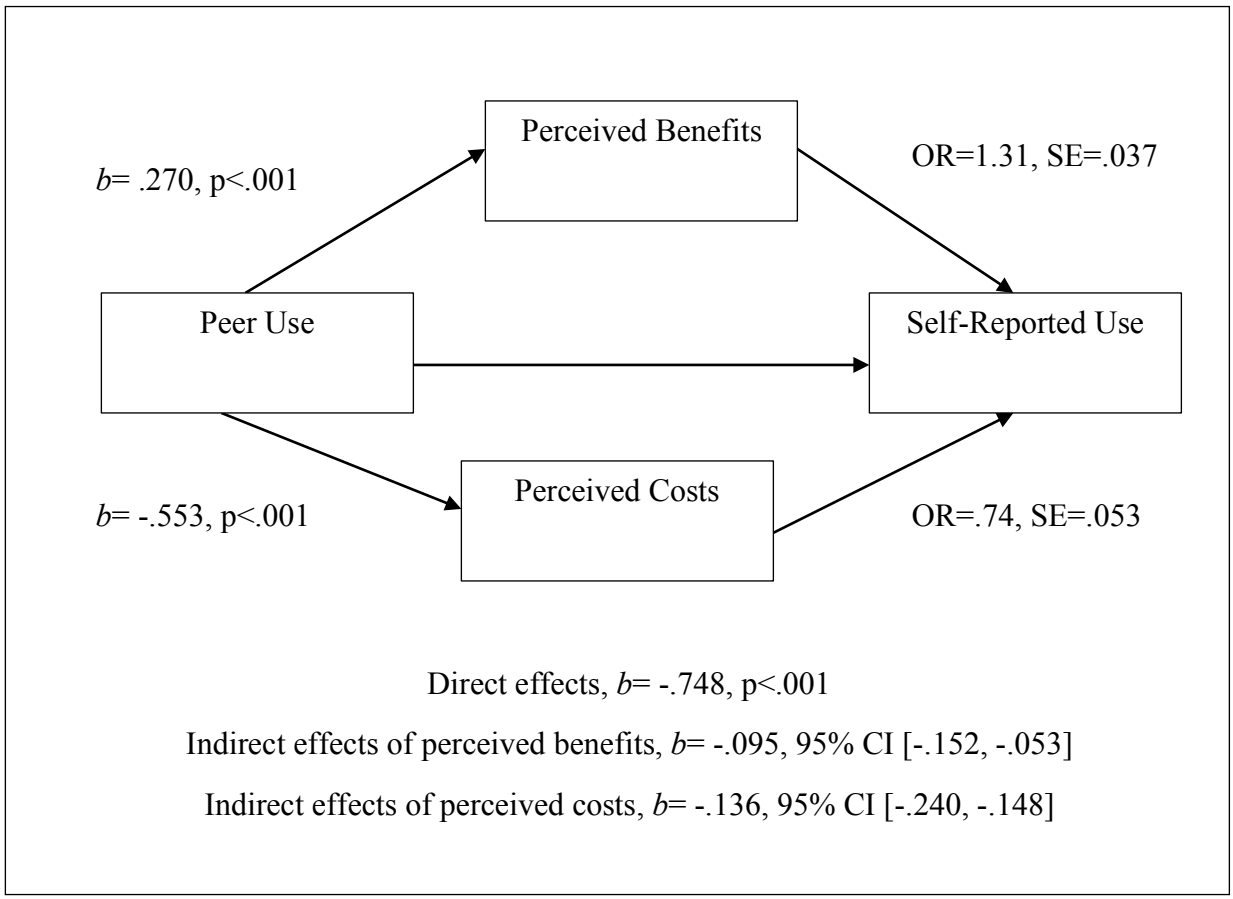

Figure 4. Mediation model of the association between peer use, expected costs and expected benefits, and self-reported use of electronic cigarettes.

Table 4

Moderation Analysis: Self-Reported Use Predicted from Peer Use and Perceived Benefits

Variable	*b*	*SE*	*p Value*	*95% CI*	
Peer Use	-.859	0.72	> .001	-.999,	-.718
Perceived Benefits	-.252	0.73	>..001	-.395,	-.110
Peer Use x Perceived Benefits	-.082	0.47		-.174,	-.009

Table 5

Moderation Analysis: Self-Reported Use Predicted from Peer Use and Perceived Costs

Variable	*b*	*SE*	*p Value*	95% CI	
Peer Use	-.821	0.72	> .001	-.096,	-.680
SESA Costs	-.243	0.48	> .001	.148,	.337
Peer Use x Perceived Costs	-.010	0.28	.	-.066,	.045

Table 6

Moderated Mediation Analysis: Predictors for Self-Reported Use

Variable	*b*	*SE*	*p Value*
Perceived Benefits	-.562	.280	.0409
Perceived Costs	.397	.350	.005
Peer Use	-.755	.072	> .001
Gender	-.127	.537	.814
Peer Use X Gender	-.129	.0738	.862
Perceived Costs X Gender	-.059	.112	.598
Perceived Benefits X Gender	.125	.161	.438

Table 7

Moderated Mediation Analysis: Index of Moderated Mediation

Variable	*Index*	95% CI	
Perceived Costs	.046	-.088	.198
Perceived Benefits	.039	-.070	.161

Table 8

Moderated Mediation Analysis: Predictors for Self-Reported Use

Variable	*b*	*SE*	*p Value*
Perceived Benefits	-.389	.251	.121
Peer Use	-.856	.071	> .001
Gender	-.060	.419	.886
Perceived Benefits X Gender	.076	.146	

Table 9

Moderated Mediation Analysis: Conditional Effects of Peer Use and Self-Reported at the Levels of Gender

Gender	*b*	95% CI	
Female	-.0736	-.167	-.028
Male	-.0745	-.127,	-.019

Table 10

Moderated Mediation Analysis: Predictors for Self-Reported Use

Variable	*b*	*SE*	*p Value*
SESA Costs	.274	.170	.105
Peer Use	-.816	.071	> .001
Gender	.076	.460	.869
SESA Costs X Gender	-.020	.010	.841

Table 11

Moderated Mediation: Conditional Effects of Peer Use and Self-Reported at the Levels of Gender

Gender	*b*	95% CI	
Female	-.144	-.250	-.054
Male	-.132	-.213	-.061

Appendix A: Student Information Form

Student Information Form

Study ID #: _____ Today's date: _____

Demographic Information

Child's gender (circle): Male Female Age: _____

Child's Race (circle): Caucasian African-American Asian-American

Hispanic-American Bi-Racial/Mixed Race

Other: _____

1. Grade in school (circle): Freshman Sophomore Junior Senior

2. Average Grades (circle):

All or Mostly A's	A/B's	All or Mostly B's	B/C's	All or Mostly C's	C/D's	All or Mostly D's	D/F's	All or Mostly F's

3. Where do you live?
    a. City/Town:_____
    b. County:_____
    c. State:_____

Family Demographic Information

The following family information is asked to provide an overall description of our entire sample:

4. Please make a check in front of each family member that is *CURRENTLY* living in your home.

_____	Biological Mother	_____	Biological Father
_____	Adoptive or Step-Mother	_____	Adoptive or Step-Father
_____	Brother (How many? _____)	_____	Sister (How many? _____)
_____	Grandparent (How many? _____)		
_____	Other (list by relationship to you) _____		

5. Please make a check in front of your parents' marital status.

_____ Never Been Married / Single	_____ Separated
_____ Divorced / Single	_____ Married to other biological parent
_____ Remarried to step-parent	_____ Living with boyfriend / girlfriend
_____ Widowed (other biological parent is deceased)	

6. Please check your family's total, **YEARLY** income:

_____ Less than $10,000
_____ $10,000 - $19,999
_____ $20,000 - $29,999
_____ $30,000 - $39,999
_____ $40,000 - $49,999
_____ $50,000 - $59,999
_____ $60,000 - $69,999
_____ $70,000 - $79,999
_____ $80,000 - $89,999
_____ $90,000 - $99,999
_____ $100,000 or more

For the following questions on this page, please list/describe those people (typically, the parents) that PROVIDE FOR THE HOUSEHOLD (help to pay bills, buy food, buy clothes, etc.).

1	=	6th grade or less
2	=	7th, 8th, or 9th grade
3	=	Some high school (10th or 11th grade)
4	=	Graduate from high school
5	=	Some college (at least 1 year) or specialized training (Vocational)
6	=	Bachelor's degree, graduated from a 4-year college (WVU, Pitt., etc.)
7	=	Master's degree, doctoral degree

7. Using the above scale in the box, please show the *highest* level of education *completed* by the people who PROVIDE for you (help pay bills, buy food, buy clothes). If the person listed is NOT your mother or father, please write who this person is (for example: step-parent, grandparent) next to it.

Mother = _____

Father = _____

8. Please provide a job title & description for the persons listed in Question # 7.

Mother (or other): _____

Father (or other): _____

9. Has anyone from your **immediate family** (e.g., parents, siblings) ever been dependent upon alcohol, illicit drugs (e.g., marijuana, cocaine), or prescription drugs (e.g., oxycodone)? In other words, was the family member unable to control his/her use despite this use causing harm to him or her? Or was the family member unable to quit using, even though he/she wanted to do so? Or did the person have to use increasingly more amounts of the substance to get the same effect?

Yes No

10. Has any of your **extended family** (e.g., aunts/uncles, cousins, grandparents) ever been dependent upon alcohol, illicit drugs (e.g., marijuana, cocaine), or prescription drugs (e.g., oxycodone)? In other words, was the family member unable to control his/her use despite this use causing harm to him or her? Or was the family member unable to quit using, even though he/she wanted to do so? Or did the person have to use increasingly more amounts of the substance to get the same effect?

Yes No

Footnotes

[1]To assess if gender would moderate the mediation effect of benefits and costs, independently, on the peer use and self-use association, two mediated moderation analyses were conducted. None of the moderated mediation pathways were statistically significant and, thus, the indirect effects of perceived costs on self-use and perceived benefits on self-use are the same for both genders (see Tables 8-11)