**Factors associated with intentions to use e-cigarettes among Australian young adult
non-smokers**

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Running Head: Non-smokers' intentions to use e-cigarettes

Abstract

Introduction and Aims: A growing body of evidence suggests e-cigarette use increases the risk of conventional cigarette use. Assessing the factors associated with intentions to use e-cigarettes can inform programs designed to minimise uptake, potentially assisting in preventing a new population of smokers. This study developed and tested a model assessing the importance of various factors that may be associated with intentions to use e-cigarettes among young adults who have never used e-cigarettes or tobacco cigarettes.

Design and Methods: A web panel provider recruited 429 Australian 18- to 25-year-olds who had never used e-cigarettes or smoked tobacco cigarettes (56% female, mean age=21.17 years). Various individual and social factors were assessed as potential direct and indirect predictors of e-cigarette use intentions.

Results: The developed model provided an excellent fit to the data and accounted for 49% of the variance in use intentions. Males had greater intentions to use e-cigarettes compared to females ($\beta=-0.13$). Having a greater number of friends who smoke tobacco cigarettes ($\beta=0.11$) and curiosity about e-cigarette use ($\beta=0.58$) were also directly associated with greater use intentions. Positive expectancies about e-cigarettes ($\beta=0.14$), having family members who use e-cigarettes ($\beta=0.11$), and having friends who smoke tobacco cigarettes ($\beta=0.07$) were indirectly associated with intentions via curiosity.

Discussion and Conclusions: Curiosity about e-cigarette use was strongly associated with use intentions. Aspects of the social environment were also important. Further research is needed to identify effective means of challenging positive e-cigarette expectancies given these were found to be strongly associated with intentions via curiosity.

Keywords: e-cigarettes; young adults; curiosity; intentions.

Introduction

Recent years have seen substantial increases in the use of e-cigarettes around the world [1-3]. For example, ever use of e-cigarettes among adults increased from 4% in 2013 to 9% in 2016 in Australia [3], from 7% in 2012 to 15% in 2017 in Europe [4, 5], and from 13% in 2014 to 15% in 2016 in the US [2]. Uptake of these devices has been strongest among young adults, with prevalence highest among members of this population segment relative to other age groups [1, 2, 6]. In Australia, the context of the present study, 19% of 18- to 24-year-olds report having used an e-cigarette in their lifetime compared to 9% of all adults aged 18⁺ [3]. For current use of e-cigarettes (defined by the Australian Institute of Health and Welfare as currently using e-cigarettes daily, weekly, or less than weekly), these figures are 7% and 4%, respectively [3]. These figures should be considered in the context of the strict regulations imposed on e-cigarettes in Australia. The sale of nicotine-containing e-cigarettes is prohibited in all jurisdictions, and non-nicotine e-cigarettes are regulated in the same way as conventional cigarettes in all jurisdictions except the state of Western Australia where the sale of these devices is prohibited.

E-cigarette use may pose significant health risks, with some of the substances used in the devices found to expose users to carcinogens and heavy metals [7-12]. In addition to direct health harms, evidence indicates that e-cigarettes can serve as a gateway product to conventional tobacco use, thereby contributing to the development of a new population of smokers who are at risk of the harms associated with tobacco cigarette smoking [13-15]. For example, recent longitudinal research in young adults has found that e-cigarette use increases

the risk of tobacco cigarette initiation among never smokers [16, 17]. The documented progression from e-cigarette use to initiation of conventional tobacco cigarette smoking indicates that minimising uptake of e-cigarettes in never smokers is important to prevent future tobacco cigarette use.

A growing body of evidence has demonstrated the influence of social norms in facilitating e-cigarette use among young adults. For example, use among college students is more likely among those who have friends, family, or peers who use e-cigarettes and/or have a positive and accepting attitude to these devices [18-20]. E-cigarette use is also more likely among those who have friends who smoke conventional cigarettes [21]. These findings are consistent with various behavioural theories that consider perceptions of others' beliefs and observations of others' behaviours as important determinants of one's own behaviour (e.g., Social Learning Theory [22]; Theory of Reasoned Action [23]).

The individual factors related to e-cigarette use in young adults that have been examined to date include gender, attitudes, and sensation seeking traits. Findings indicate that males are more likely to use e-cigarettes than females [18, 21, 24, 25]. The limited literature on young adults' attitudes as a precursor to e-cigarette use has focused predominantly on beliefs about the risk of harm of e-cigarette use [18, 26]. This research indicates that individuals who believe e-cigarettes are less harmful than conventional cigarettes are more likely than those who do not hold this belief to use the devices [18, 26]. Some evidence is beginning to emerge on e-cigarette expectancies, with research suggesting that beliefs about the positive

experiences associated with e-cigarette use (e.g., feeling relaxed) are linked with use of the devices [27]. Although previous research suggests that sensation seeking traits are a major correlate of drug use and conventional cigarette smoking [28, 29], just one study to date appears to have been conducted assessing the association between this individual personality trait and e-cigarette use in young adults [24]. In this study of college students, sensation seeking traits did not significantly predict use of e-cigarettes.

There are several notable gaps in the literature. First, although research assessing the factors associated with intentions to use e-cigarettes among young adults may inform the development of effective programs designed to minimise uptake of these devices in this population segment, such research is lacking. Second, research assessing curiosity about e-cigarette use among young adults is needed. Curiosity is considered a critical motivational state influencing human behaviour [30]. In the context of tobacco smoking, curiosity about smoking a tobacco cigarette has been found to be an important psychological precursor to smoking initiation [31]. Furthermore, research among users of e-cigarettes has found that curiosity is retrospectively reported to be an important reason for initiating use [32-34]. Research examining the relationship between curiosity about e-cigarette use and intentions to use e-cigarettes among never users and never smokers is therefore warranted. Given previous research conducted with adolescents suggests that individual factors such as perceptions of e-cigarette harm are associated with curiosity about e-cigarette use, it is also important to assess curiosity as a mediator between individual and social variables and use intentions [35].

Third, several social factors relating to e-cigarette use found to be important in other population segments have yet to be examined in young adults (e.g., having parents who smoke conventional cigarettes and/or living in a household where conventional cigarettes are smoked [36-40]). Finally, the vast majority of research to date has been conducted in countries with liberal regulations on the marketing, sale, and use of e-cigarettes. Research assessing the factors associated with intentions to use e-cigarettes in more restrictive regulatory environments such as Australia is needed to identify which factors contribute to use intentions in such environments and whether these differ from those identified in countries such as the US and UK where e-cigarettes are more readily available and used.

To address these research gaps, the present study sought to identify the relative importance of various factors that are likely to be associated with intentions to use e-cigarettes among young adults who have never smoked conventional tobacco cigarettes and have never used e-cigarettes. Never smokers/users were the focus of the present study as the postulated harm minimisation and cessation benefits associated with e-cigarette use [41, 42] do not apply to these individuals. Results have the potential to inform the development of effective strategies and policies aimed at reducing e-cigarette initiation among young adults.

Method

Recruitment and sample

As part of a larger study assessing e-cigarette use among Australian young adults, an ISO-accredited web panel provider recruited 429 Australian 18- to 25-year-olds who had never used e-cigarettes and had never smoked a conventional tobacco cigarette. Eligibility was

determined based on responses to two questions assessing whether respondents had ever tried (i) tobacco cigarettes (even just one time) and (ii) e-cigarettes (even just one or two puffs).

The web-panel provider (PureProfile) uses a number of strategies to maintain their database of over 350 000 Australians, including Internet and radio advertising and referral programs. Panel members receive small incentives for participating in surveys. The study received ethical approval from a university Human Research Ethics Committee.

The sample comprised 56% females, and respondents had an average age of 21.17 years ($SD = 2.34$). Two-thirds of the sample lived in mid and high socioeconomic status (SES) neighbourhoods (low SES = 34%, mid SES = 41%, high SES = 25%; calculated from respondents' postcode using the Australian Bureau of Statistics' Socio-Economic Indexes for Areas [43]).

Measures

The dependent variable under investigation was e-cigarette use intentions. This was assessed by asking respondents to respond to the statement: *I intend to use an e-cigarette in the next 6 months* on a 4-point scale of 1 (*definitely not*) to 4 (*definitely yes*) (adapted from Primack, Soneji, Stoolmiller, Fine, and Sargent [15]). Consistent with previous research [44], intentions to use e-cigarettes was treated as a continuous variable.

Independent variables - social. Perceived pressure from others regarding use of e-cigarettes and conventional cigarettes was assessed by asking respondents 10 questions: *Do the*

following people or groups place any pressure on you about using [smoking] e-cigarettes [tobacco cigarettes]?, with five different social groups presented – *my family, my friends, my partner (if applicable), my colleagues (if applicable), and society*. Responses to each item were made on a 5-point scale of 1 (*pressure me not to use*) to 5 (*pressure me to use*). Two variables were created comprising the grand means of scores for all five groups for pressure to use (i) e-cigarettes (Cronbach's alpha = 0.92) and (ii) conventional cigarettes (Cronbach's alpha = 0.96). To maximise the information available for analyses, the grand means of scores for respondents for whom the 'partner' and 'colleagues' items were not applicable were calculated based on responses to the applicable items.

Use of e-cigarettes and conventional cigarettes among family, friends, and those living in the respondent's home was assessed by asking: *How many members of your immediate family currently use [smoke] e-cigarettes [tobacco cigarettes] (either socially or regularly)?* (six response options: 0 = 0 to 5 = *more than 4*); *How many of your four closest friends currently use [smoke] e-cigarettes [tobacco cigarettes] (either socially or regularly)?* (five response options: 0 = 0 to 4 = 4); and *Does anyone who lives with you now currently use [smoke] e-cigarettes [tobacco cigarettes] (either socially or regularly)?* (dichotomous yes or no response options) (items adapted from Barrington-Trimis et al. [45]). Perceived disapproval of e-cigarettes and tobacco cigarettes was assessed with two questions: *In general, to what extent do people who are important to you disapprove of using [smoking] e-cigarettes [tobacco cigarettes]?*. Responses were made on a scale of 1 (*not at all*) to 5 (*a great deal*).

Independent variables - individual. Respondents reported on their gender and age. Beliefs relating to the harms associated with e-cigarette use were assessed with a single item that asked respondents to indicate how harmful they believe e-cigarettes are to health (1 = *not at all harmful* to 5 = *very harmful*). A *don't know* option was made available, with these responses treated as missing data. To assess general attitudes, respondents were presented with 5-point semantic differential scales and asked to rate the use of e-cigarettes on several characteristics (*boring/fun, unenjoyable/enjoyable, stupid/smart, uncool/cool, unattractive/attractive*), each presented in random order (adapted from Farrelly et al. [46]). A grand mean was produced, with a higher score indicative of a more favourable attitude to e-cigarettes (Cronbach's alpha = 0.96).

Positive expectancies were assessed by asking respondents to indicate the extent to which they agreed or disagreed with the following seven statements on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*): *Using e-cigarettes helps people feel more self-confident; Using e-cigarettes helps people calm down when they're feeling tense; Using e-cigarettes helps people when they're feeling angry; Using e-cigarettes makes people feel more relaxed; Using e-cigarettes cheers people up when they're in a bad mood; Using e-cigarettes helps people feel better if they've been feeling down; and Using e-cigarettes helps people think better* (as per Wills, Knight, Sargent, Gibbons, Pagano, & Williams [47] and Pokhrel, Little, Fagan, Muranaka & Herszog [48]). For analysis purposes, a grand mean of all items was produced, with a higher score indicating more favourable expectancies about e-cigarette use (Cronbach's alpha = 0.97).

Sensation seeking was measured using four items adapted from the Brief Sensation Seeking Scale [49]: *I like to explore strange places; I like to do frightening things; I prefer friends who are exciting and unpredictable; and I love to have new and exciting experiences, even if I have to break the rules.* Responses were made on a 5-point scale (1 = *strongly disagree* to 5 = *strongly agree*). A grand mean was produced, with a higher score indicative of stronger sensation seeking characteristics (Cronbach's alpha = 0.83).

Curiosity was measured by asking respondents: *How curious are you about using e-cigarettes?* Responses were made on a scale of 1 (*not at all curious*) to 5 (*very curious*) (adapted from Mantey, Cooper, Clendennen, Pasch, & Perry [50]).

Procedure

The measures were administered in an online survey disseminated via the web panel provider. All respondents provided informed consent. An initial question assessed respondents' awareness of e-cigarettes, with most ($n = 310$, 72%) reporting that they had heard of the devices. To reduce reporting error, a description of e-cigarettes was provided to all respondents.

Statistical analysis

Descriptive statistics were calculated to determine the extent to which respondents were curious about using e-cigarettes and intended to use the devices in the future. Univariate

linear regression analyses were conducted to assess the individual and social factors associated with curiosity and intentions to use e-cigarettes. Factors that were significantly associated with either curiosity or intentions at $P < 0.05$ were then combined into a multivariate mediational model in which curiosity about e-cigarette use was postulated to mediate the relationship between the assessed individual and social variables and intentions to use e-cigarettes in the next six months. This model was tested in *MPlus*, with the model indirect function used to assess the statistical significance of indirect effects.

Results

Descriptive statistics

Table 1 presents descriptive statistics for the independent and dependent variables under investigation. Curiosity about e-cigarette use and intentions to use the devices in the next six months were low. Just over one-quarter (28%) of respondents reported being at all curious about the devices (i.e., selected 2, 3, 4, or 5 on a 5-point scale of 1 = *not at all curious* to 5 = *very curious*). Only 3% indicated they would ‘probably’ or ‘definitely’ use an e-cigarette in the next six months.

Mediational model of factors associated with intentions to use e-cigarettes

Significant predictors emerging from the univariate analyses (presented in the online supplementary tables SI and SII) assessing the factors associated with curiosity about e-cigarette use and intentions to use e-cigarettes in the next six months were combined into a multivariate mediational model. Curiosity was specified as the mediator and intentions was

the outcome. This model provided an excellent fit to the data ($\chi^2(4) = 4.08$, $P = 0.395$; $\chi^2/\text{df} = 1.02$, CFI = 1.00; TLI = 1.00, RMSEA = 0.01 (95% confidence interval = 0.00, 0.08), SRMR = 0.02) and accounted for 49% of the variance in intentions.

Unstandardised and standardised parameter estimates are presented in Table 2 and a schematic of the model showing significant direct effects is presented in Figure 1. Few variables were found to be directly associated with intentions to use e-cigarettes. Of these, the strongest parameter estimates were observed for curiosity, followed by gender (males reported greater intention to use e-cigarettes than did females) and then having a larger number of friends who smoke tobacco cigarettes.

Several variables were found to be indirectly associated with use intentions via curiosity (Table 3). Specifically, greater belief in the positive outcomes of e-cigarette use, having a larger number of family members who use e-cigarettes, and having a larger number of friends who smoke tobacco cigarettes were associated with greater curiosity about e-cigarette use, which in turn resulted in greater intentions to use the devices.

Discussion

The present study developed and tested a multivariate model assessing the relative importance of various factors that may be associated with intentions to use e-cigarettes among Australian young adult never smokers. Results have the potential to inform (i) the development of effective strategies to reduce e-cigarette initiation in this population segment

and (ii) public health policy globally. The developed model was robust, accounting for a substantial proportion of the variance in e-cigarette use intentions.

Three variables were found to be directly associated with e-cigarette use intentions: curiosity about use, gender (being male), and having a larger number of friends who smoke conventional tobacco cigarettes. Of these variables, curiosity about e-cigarette use was found to be the most strongly associated with intentions to use the devices in the future, supporting previous research in the context of tobacco cigarette smoking [31, 51]. Given just over one-quarter of young adult never users and never smokers in this Australian sample reported any curiosity about using e-cigarettes, the results indicate that a substantial minority of young adults are potentially at risk of initiation of use.

Three variables were found to be associated with use intentions via curiosity: positive expectancies about e-cigarettes, having a larger number of family members who use e-cigarettes, and having a larger number of friends who smoke conventional tobacco cigarettes. Of these, positive expectancies were found to be the most important, consistent with previous research on the factors associated with e-cigarette use [27, 48]. Given previous research on the effects of e-cigarette advertising among young adult non-smokers has shown that positive portrayals of e-cigarettes result in more favourable attitudes to the devices [52], maintaining existing regulations on the marketing of e-cigarettes in Australia and other countries with similarly restrictive regulatory environments (e.g., Canada) should be prioritised in control efforts [53]. In countries with liberal regulations on the marketing of e-cigarettes (e.g., the US

and the UK), policymakers should consider introducing laws that subject e-cigarettes to the same marketing restrictions that apply to conventional cigarettes [54]. These restrictions may constitute a means of reducing youth exposure to the favourable claims made by the vaping industry about their products.

The strong direct and indirect associations between various social variables and intentions to use e-cigarettes are consistent with behavioural theories that emphasise the importance of social norms [23], and support previous research in the context of e-cigarette use indicating that the social environment is an important determinant of intentions to use e-cigarettes among young adults [21]. Prior recommendations for a social norms approach to initiation prevention are therefore supported [55]. For example, campaigns could be implemented that focus on the social undesirability of vaping and peer disapproval of this behaviour. Such an approach has been found to be a potentially effective means of preventing tobacco cigarette smoking [56], and may therefore constitute a means of preventing initiation of e-cigarette use. Maintaining existing regulations in countries that restrict the marketing, sale, and use of e-cigarettes and tightening regulations in those that do not are also likely to be important in ensuring e-cigarette use is not normalised among influential family and peer groups.

Despite evidence suggesting that sensation seeking traits are a major correlate of drug use and conventional cigarette smoking [28, 29], these traits were not found to be associated with curiosity about or intentions to use e-cigarettes in the present study. This null finding is consistent with previous research in a study of college students that found sensation seeking

traits did not significantly predict use of e-cigarettes [24]. Such traits may be more relevant in explaining the risk behaviours of adolescents than young adults.

Limitations

There were several limitations to the present study. First, the cross-sectional design means causality cannot be established. In particular, it is possible that reciprocal relationships exist between some of the independent and outcome variables. For example, although use intentions may be influenced by positive expectancies, it is also possible that use intentions may increase positive expectancies as these young adults who have never smoked cigarettes or used e-cigarettes attempt to reduce any cognitive dissonance associated with their intentions to try e-cigarettes. Further research using longitudinal designs is required to verify the direct and indirect associations observed in this study. Second, as an online web panel provider was commissioned to recruit respondents and varied methods were used to disseminate the survey link, response rates could not be determined. Given the absence of representative data that provide the demographic characteristics of the population segment from which the target sample was drawn (i.e., 18- to 25-year-old never smokers and never users of e-cigarettes), the extent to which the present results can be generalised is unknown.

Third, although the tested model accounted for a substantial proportion of the variance in use intentions, there are other variables that may be associated with intentions that were not examined. For example, recent qualitative research conducted with college students indicates that perceived behavioural control over e-cigarette use may be an important variable to

consider in future research [57]. Fourth, few respondents reported intending to try e-cigarettes in the next six months, limiting the variability of scores on the use intentions variable.

Finally, this study was conducted in Australia, a country with some of the most restrictive e-cigarette policies in the world [58]. Care should thus be taken in generalising these findings to other contexts in which e-cigarettes are more heavily promoted and readily available.

Conclusion

The present study identified several factors that could be the focus of efforts to minimise uptake of e-cigarettes among young adult never smokers. Of these, curiosity about e-cigarette use was found to have the strongest association with use intentions, suggesting that efforts to minimise uptake may need to focus on reducing curiosity and that surveillance studies could consider measuring curiosity as a potential early indicator of e-cigarette initiation. Given positive e-cigarette expectancies were found to have the strongest association with curiosity and were indirectly associated with use intentions via this variable, further research is needed to identify the source of these expectancies and identify effective means of challenging such beliefs. Maintaining current regulation of e-cigarettes in Australia to ensure e-cigarette use is not normalised may constitute an effective approach to minimising uptake.

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Figure 1. Schematic of the significant direct associations observed in the tested model. A ‘+’ sign indicates a positive relationship between variables.

Table 1. *Descriptive statistics for the independent and dependent variables under investigation*

	M (SD)	Scale range
Independent variables		
<i>Individual</i>		
Sensation seeking	2.91 (0.85)	1 – 5
Positive e-cigarette expectancies	2.60 (0.97)	1 – 5
Perceived harm associated with e-cigarettes	3.59 (1.26)	1 – 5
General attitude to e-cigarettes	2.31 (1.17)	1 – 5
<i>Social</i>		
Social pressure to use e-cigarettes	2.43 (0.86)	1 – 4
Social disapproval of e-cigarettes	3.36 (1.34)	1 – 5
# family members using e-cigarettes	0.14 (0.50)	0 – 5
# friends using e-cigarettes	0.18 (0.60)	0 – 4
Lives with someone who uses e-cigarettes (% yes)	4	n/a
Social pressure to smoke cigarettes	2.25 (0.85)	1 – 4
Social disapproval of cigarettes	3.90 (1.28)	1 – 5
# family members who smoke cigarettes	0.61 (1.09)	0 – 5
# friends who smoke cigarettes	0.52 (0.89)	0 – 4
Lives with someone who smokes cigarettes (% yes)	18	n/a
Dependent variables		
Curiosity about e-cigarette use	1.53 (0.99)	1 – 5
Intentions to use e-cigarettes	1.21 (0.50)	1 – 4

M = Mean, SD = standard deviation, n/a = not applicable.

Table 2. *Unstandardised and standardised parameter estimates from the tested model*

Independent variable	Curiosity				Intentions			
	B (SE)	β	95% CI for β	<i>p</i>	B (SE)	β	95% CI for β	<i>p</i>
Individual								
Gender (0 = male, 1 = female)	–	–	–	–	-0.13 (0.04)	-0.13	-0.21, -0.06	0.001
Sensation seeking	0.09 (0.06)	0.07	-0.03, 0.17	0.145	0.01 (0.02)	0.03	-0.07, 0.09	0.549
Positive e-cigarette expectancies	0.24 (0.06)	0.25	0.14, 0.35	< 0.001	0.00 (0.02)	-0.00	-0.11, 0.07	0.987
Perceived harm associated with e-cigs	-0.02 (0.04)	-0.02	-0.12, 0.08	0.638	-0.01 (0.02)	-0.03	-0.09, 0.07	0.515
General attitude to e-cigs	0.05 (0.05)	0.06	-0.05, 0.17	0.260	-0.01 (0.02)	-0.01	-0.10, 0.07	0.791
Social								
Social pressure to use e-cigs	0.05 (0.06)	0.05	-0.05, 0.15	0.371	0.03 (0.02)	0.05	-0.05, 0.11	0.202
Social disapproval of e-cigs	–	–	–	–	–	–	–	–
# family members using e-cigs	0.36 (0.12)	0.19	0.07, 0.32	0.002	-0.05 (0.05)	-0.06	-0.16, 0.04	0.253
# friends using e-cigs	-0.02 (0.10)	-0.01	-0.14, 0.12	0.872	0.07 (0.04)	0.09	0.02, 0.24	0.090
Lives with someone who uses e-cigs	–	–	–	–	0.15 (0.11)	0.06	-0.03, 0.13	0.175
Social pressure to smoke cigarettes	–	–	–	–	–	–	–	–
Social disapproval of cigarettes	–	–	–	–	-0.03 (0.02)	-0.08	-0.16, 0.00	0.063
# family members who smoke cigarettes	0.07 (0.05)	0.07	-0.03, 0.17	0.162	0.02 (0.02)	0.04	-0.05, 0.12	0.346
# friends who smoke cigarettes	0.13 (0.06)	0.12	0.01, 0.22	0.033	0.06 (0.02)	0.11	-0.01, 0.16	0.019
Lives with someone who smokes cigarettes	–	–	–	–	0.05 (0.05)	0.04	-0.04, 0.12	0.310
Mediator								
Curiosity about e-cigarette use	–	–	–	–	0.28 (0.02)	0.58	0.31, 0.53	< 0.001

Significant results presented in bold. Number of observations in the model = 337. A dash indicates the effect was not tested as the individual or social variable of interest was not

found to be correlated with the dependent variable (i.e., curiosity or intentions) in univariate analyses. B = unstandardised regression coefficient, SE = standard error, β = standardised regression coefficient.

Table 3. *Unstandardised and standardised parameter estimates for the indirect effects observed in the tested model*

Independent variable	Curiosity		
	B (SE)	β	p
Individual			
Gender (0 = male, 1 = female)	–	–	–
Sensation seeking	0.02 (0.02)	0.04	0.147
Positive e-cigarette expectancies	0.07 (0.02)	0.14	< 0.001
Perceived harm associated with e-cigarettes	-0.01 (0.01)	-0.01	0.638
General attitudes to e-cigarettes	0.01 (0.01)	0.04	0.262
Social			
Social pressure to use e-cigarettes	0.01 (0.02)	0.03	0.372
Social disapproval of e-cigarettes	–	–	–
# family members using e-cigarettes	0.10 (0.03)	0.11	0.003
# friends using e-cigarettes	-0.01 (0.03)	-0.01	0.872
Lives with someone who uses e-cigarettes	–	–	–
Social pressure to smoke cigarettes	–	–	–
Social disapproval of cigarettes	–	–	–
# family members who smoke cigarettes	0.02 (0.01)	0.04	0.164
# friends who smoke cigarettes	0.04 (0.02)	0.07	0.035
Lives with someone who smokes cigarettes	–	–	–

Significant results presented in bold. A dash indicates the indirect effect was not tested as the individual or social variable of interest was not found to be correlated with the mediator (i.e., curiosity). B = unstandardised regression coefficient, SE = standard error, β = standardised regression coefficient.

22nd May 2019

Dear Professor Livingston,

Thank you for the opportunity to revise our manuscript “Factors associated with intentions to use e-cigarettes among Australian young adult non-smokers” (CDAR-2019-0054) according to the reviewers’ helpful suggestions. The table below outlines the changes that have been made to the manuscript in response to each comment. New text added to the manuscript is shown in italics within the table.

We hope we have addressed the comments to your satisfaction, but please do not hesitate to advise if further changes are required.

Best wishes,

The authors

<p>Reviewer 1</p> <p>1. This is a very relevant paper that can inform policy globally. The research findings have at least two important policy implications. One is the importance of positive expectancies in the formation of curiosity and the role of advertising in forming these expectancies. This strongly suggests current bans on marketing of e-cigarettes in Australia and elsewhere [see https://tobaccocontrol.bmj.com/content/26/4/440 and http://globaltobaccocontrol.org/e-cigarette/country-laws-regulating-e-cigarettes] should be maintained. The authors should make reference to the potential global applicability of this finding to other countries (with or without restrictions on advertising or promotion).</p>	<p>Thank you for this positive feedback. The following now appears in the manuscript to highlight the relevance of the paper to public health policy globally.</p> <p>Pg 12: Results have the potential to inform (i) the development of effective strategies to reduce e-cigarette initiation in this population segment <i>and (ii) public health policy globally.</i></p> <p>Pg 13: Given previous research on the effects of e-cigarette advertising among young adult non-smokers has shown that positive portrayals of e-cigarettes result in more favourable attitudes to the devices [53], <i>maintaining existing regulations on the marketing of e-cigarettes in Australia and other countries with similarly restrictive regulatory environments (e.g., Canada) should be prioritised in control efforts [54]. In countries with liberal regulations on the marketing of e-cigarettes (e.g., the US and the UK), policymakers should consider introducing laws that subject e-cigarettes to the same marketing restrictions that apply to conventional cigarettes [55]. These restrictions may constitute a means of reducing youth exposure to the favourable claims made by the vaping industry about their products.</i></p>
<p>2. The second is the important role that social norms (e.g., other people using e-cigarettes) play in determining intention to use e-cigarettes. The authors rightly draw the conclusion that maintaining current restrictions on the sale and use of e-cigarettes will prevent the social normalization of their use – and will thus minimize intention to use, and ultimately use of e-cigarettes. Again the authors should make reference of the relevance of this finding to other countries which maintain restrictions on the sale and use of e-cigarettes</p>	<p>The following now appears in the manuscript, making reference to the relevance of the results to other countries:</p> <p>Pg 14: <i>Maintaining existing regulations in countries that restrict the marketing, sale, and use of e-cigarettes and tightening regulations in those that do not are also likely to be important in ensuring e-cigarette use is not normalised among influential family and peer groups.</i></p>
<p>Reviewer 2</p> <p>3. This paper covers an area of emerging policy interest and research growth. The paper is well written and the research methodology is sound. The manuscript would benefit from a few additional details, as per the points below, as well as further discussion of the practical implications of the research so its benefit to practice and policy is clear.</p>	<p>Thank you for this positive feedback. We hope our changes (outlined below) address these comments to your satisfaction.</p>

<p>4. Abstract – suggest adding data to the abstract so it is more informative.</p>	<p>Beta values for the factors found to be significantly associated with intentions to use e-cigarettes have now been added to the abstract. Minor changes have been made to the abstract to accommodate these additions and ensure the abstract remains within the word limit.</p> <p>Pg 3: The developed model provided an excellent fit to the data and accounted for 49% of the variance in use intentions. <i>Males had greater intentions to use e-cigarettes compared to females ($\beta=-0.13$).</i> Having a greater number of friends who smoke tobacco cigarettes ($\beta=0.11$) and curiosity about e-cigarette use ($\beta=0.58$) were also directly associated with greater use intentions. Positive expectancies about e-cigarettes ($\beta=0.14$), having family members who use e-cigarettes ($\beta=0.11$), and having friends who smoke tobacco cigarettes ($\beta=0.07$) were indirectly associated with intentions via curiosity.</p>
<p>5. Introduction (page 4, line 6) – suggest adding data to support and illustrate statement that “Recent years have seen substantial increases in the use of e-cigarettes around the world”.</p>	<p>Data supporting this statement has now been added to the manuscript:</p> <p>Pg 4: Recent years have seen substantial increases in the use of e-cigarettes around the world [1-3]. <i>For example, ever use of e-cigarettes among adults increased from 4% in 2013 to 9% in 2016 in Australia [3], from 7% in 2012 to 15% in 2017 in Europe [4, 5], and from 13% in 2014 to 15% in 2016 in the US [2].</i></p>
<p>6. Introduction (page 6, line 45) – suggest naming countries, including Australia, when you refer to countries with a “more restrictive regulatory environment” and provide a brief description of what this means in terms of availability, particularly for young adults. This is important to provide context and to revisit this in your discussion.</p>	<p>Australia is now explicitly mentioned in the relevant section of the paper:</p> <p>Pg 6: Research assessing the factors associated with intentions to use e-cigarettes in more restrictive regulatory environments <i>such as Australia</i> is needed to identify which factors contribute to use intentions in such environments and whether these differ from those identified in countries such as the US and UK where e-cigarettes are more readily available and used.</p> <p>A description of Australia’s regulatory environment is now provided:</p> <p>Pg 4: In Australia, the context of the present study, 19% of 18- to 24-</p>

	<p>year-olds report having used an e-cigarette in their lifetime compared to 9% of all adults aged 18⁺ [3]. For current use of e-cigarettes (defined by the Australian Institute of Health and Welfare as <i>currently</i> using e-cigarettes daily, weekly, or less than weekly), these figures are 7% and 4%, respectively [3]. <i>These figures should be considered in the context of the strict regulations imposed on e-cigarettes in Australia. The sale of nicotine-containing e-cigarettes is prohibited in all jurisdictions, and non-nicotine e-cigarettes are regulated in the same way as conventional cigarettes in all jurisdictions except the state of Western Australia where the sale of these devices is prohibited.</i></p> <p>The discussion has been expanded upon as follows:</p> <p>Pg 13: Given previous research on the effects of e-cigarette advertising among young adult non-smokers has shown that positive portrayals of e-cigarettes result in more favourable attitudes to the devices [53], <i>maintaining existing regulations on the marketing of e-cigarettes in Australia and other countries with similarly restrictive regulatory environments (e.g., Canada) should be prioritised in control efforts [54]. In countries with liberal regulations on the marketing of e-cigarettes (e.g., the US and the UK), policymakers should consider introducing laws that subject e-cigarettes to the same marketing restrictions that apply to conventional cigarettes [55]. These restrictions may constitute a means of reducing youth exposure to the favourable claims made by the vaping industry about their products.</i></p> <p>Pg 14: <i>Maintaining existing regulations in countries that restrict the marketing, sale, and use of e-cigarettes and tightening regulations in those that do not</i> are also likely to be important in ensuring e-cigarette use is not normalised among influential family and peer groups.</p>
<p>7. Introduction (page 7, line 3) – provide a reference for the statement “...the postulated harm minimization and cessation benefits associated with e-cigarette use”.</p>	<p>References have now been provided for this statement:</p> <p>Pg 7: Never smokers/users were the focus of the present study as the postulated harm minimisation and cessation benefits associated with e-</p>

	cigarette use [42, 43] do not apply to these individuals.
8. Methods (page 10, line 29) – it is mentioned that 72% of participants reported that they had heard of e-cigarettes, which I’m assuming meant that 28% hadn’t. Did the authors consider these potential subgroups in their analysis in order to assess if factors associated with intention to use e-cigarettes differed for these two groups?	We have now conducted analyses examining differences according to awareness of e-cigarettes. Awareness was not found to be associated with any of the dependent variables under investigation. These results have been added to Supplementary Tables SI and SII.
9. Results – there is no description of the sample provided in the results, only a brief breakdown of male/female and age in the methods. Was additional information collected on the demographics of the sample, which would allow the representativeness of the sample to be determined? At this stage it is unclear how representative the sample is of young people in this age group and therefore if the results can be generalized further. If additional data are not available, this is a limitation that needs to be discussed. If these data are available, did the authors consider weighting the sample to maximize representativeness?	<p>Information was collected on respondents’ socioeconomic status. This is now reported in the manuscript as follows:</p> <p>Pg 7: The sample comprised 56% females, and respondents had an average age of 21.17 years ($SD = 2.34$). <i>Two-thirds of the sample lived in mid and high socioeconomic status (SES) neighbourhoods (low SES = 34%, mid SES = 41%, high SES = 25%; calculated from respondents’ postcode using the Australian Bureau of Statistics’ Socio-Economic Indexes for Areas [44]).</i></p> <p>There is an absence of representative data that provide the demographic characteristics of the population segment from which the target sample was drawn (i.e., 18- to 25-year-old never smokers and never users of e-cigarettes). As such, we are unable to determine sample representativeness. We have now discussed this in the limitations section of the manuscript as follows:</p> <p>Pg 15: Second, as an online web panel provider was commissioned to recruit respondents and varied methods were used to disseminate the survey link, response rates could not be determined. <i>Given the absence of representative data that provide the demographic characteristics of the population segment from which the target sample was drawn (i.e., 18- to 25-year-old never smokers and never users of e-cigarettes), the extent to which the present results can be generalised is unknown.</i></p> <p>The sample was not weighted as weighting has been shown to increase bias in non-probability-based samples (Gittelman et al., 2015).</p>

	<p>Reference: Gittelman, S. H., Thomas, R. K., Lavrakas, P. J., & Lange, V. (2015). Quota controls in survey research: A test of accuracy and intersource reliability in online samples. <i>Journal of Advertising Research</i>, 55(4), 368.</p>
10. Results - did the authors look at whether the results differed according to age? i.e., was there any difference by age within the 18-24 year olds?	<p>We have now run analyses examining age differences. This demographic factor was not significantly associated with any of the dependent variables in univariate analyses and was therefore not included in the multivariate model. Results from the univariate analyses have been added to Supplementary Tables SI and SII.</p>
11. Discussion (page 13, line 10) – the authors mention that there is a need to “...identify effective means of challenging such beliefs.” It would be beneficial to expand on this with some examples of what these “means” might be in order to demonstrate the potential that such beliefs could be modified. This will help to better justify the need for this study by demonstrating the practical implications of the results.	<p>The discussion has been expanded upon as follows:</p> <p>Pg 13: Of these, positive expectancies were found to be the most important, consistent with previous research on the factors associated with e-cigarette use [27, 49]. Given previous research on the effects of e-cigarette advertising among young adult non-smokers has shown that positive portrayals of e-cigarettes result in more favourable attitudes to the devices [53], <i>maintaining existing regulations on the marketing of e-cigarettes in Australia and other countries with similarly restrictive regulatory environments (e.g., Canada) should be prioritised in control efforts [54]. In countries with liberal regulations on the marketing of e-cigarettes (e.g., the US and the UK), policymakers should consider introducing laws that subject e-cigarettes to the same marketing restrictions that apply to conventional cigarettes [55]. These restrictions may constitute a means of reducing youth exposure to the favourable claims made by the vaping industry about their products.</i></p>
12. Discussion (page 13, line 35) - the authors state that “... prior recommendations for a social norms approach to initiation prevention are therefore supported” – again, it would be good to further translate this into what this social norms approach would look like in terms of policy or practice.	<p>The discussion to which you refer has been expanded upon as follows:</p> <p>Pg 14: Prior recommendations for a social norms approach to initiation prevention are therefore supported [56]. <i>For example, campaigns could be implemented that focus on the social undesirability of vaping and peer disapproval of this behaviour. Such an approach has been found to</i></p>

	<i>be a potentially effective means of preventing tobacco cigarette smoking [57], and may therefore constitute a means of preventing initiation of e-cigarette use. Maintaining existing regulations in countries that restrict the marketing, sale, and use of e-cigarettes and tightening regulations in those that do not are also likely to be important in ensuring e-cigarette use is not normalised among influential family and peer groups.</i>
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