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The Effects of a Value-Affirmation Writing Exercise on Stress and Craving for Nicotine in Electronic Nicotine Delivery System Users

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The Effects of a Value-Affirmation Writing Exercise on Stress and Craving for Nicotine in Electronic Nicotine Delivery System Users

by

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Abstract

Electronic nicotine delivery systems (ENDS) have become an increasingly popular choice to ingest nicotine, especially among adolescents. It is assumed that with a rise of ENDS usage, more people will be looking for strategies to help quit the devices. As previous research has revealed the efficacy of stress reduction interventions to aid in the cessation of nicotine, a stress reducing writing intervention based in self-affirmation, value affirmation, was evaluated for its ability to reduce anxiety and craving for nicotine in individuals using ENDS. Nicotine dependent participants (N = 92) using ENDS were randomly assigned to complete either a value affirmation writing exercise or a control writing exercise prior to viewing a video designed to induce anxiety. While anxiety and craving for nicotine significantly increased across conditions following the video stressor, no significant differences were observed between groups. Commentary on the results and implications of this study are discussed.

Keywords: Self-affirmation, ENDS, nicotine, anxiety, craving, dependence

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Unsurprisingly, stress is associated with maladaptive coping mechanisms, behaviors that

provide quick relief from the discomfort of stress, but may be harmful to the individual. Where

some may choose to eat a bit too much chocolate to cope with stressful events, others may

pursue drugs or alcohol. Stressful events may lead to negative affective states, contributing to the

development of substance use disorders, which in turn contributes to the development of

affective disorders (Karkhanis et al., 2017). Vaping, or the use of electronic nicotine delivery

systems (ENDS), has become a rapidly preferred method of ingestion of the drug nicotine, and

their use is linked with motivations to reduce stress (e.g., Harrell et al., 2019; Rutten et al., 2015;

Sharma et al., 2016). However, little research has specifically examined methods for ENDS users

to combat stress. Therefore, it is important to research and develop new strategies for ENDS

users to cope with stressful situations, especially during peak moments of distress such as during

nicotine withdrawal. Interventions based in self-affirmation, such as value affirmation writing

exercises, are such an example of a promising strategy for ENDS users to combat their stress in a

healthy way.

ENDS Usage Motivations

ENDS, colloquially known as vapes or e-cigarettes, are becoming an increasingly popular

method of nicotine ingestion. The number of people using ENDs globally has increased from

seven million in 2011 to over 41 million users in 2018, with estimates that this number will reach

almost 55 million by 2021 (Jones, 2019). Users appear to see vaping as a healthier alternative to

smoking, with 33% of adults who vape reporting using ENDS as a tool to stop smoking (Jones,

2019).

ENDS users may perceive their devices as a healthier tool to reduce stress than smoking, as previous literature has discovered stress reduction to be a primary motivation to use ENDS. Rutten et al. (2015) examined the self-reported reasons to use ENDS by individuals who were current smokers. Rutten and colleagues found smokers commonly reported the reduction of stress as a primary reason to use ENDS. Revealing relationships between concerns about health effects of smoking and the reduction of stress, smokers who reported using ENDS to reduce stress were more likely to report intentions to quit. Research by Sharma and colleagues in 2016 supported the motivations to use ENDS reported by Rutten et al. (2015). By analyzing online discussions of vaping on the popular message board Reddit, the authors discovered the self-medication of anxiety was a popularly reported motivation to vape nicotine/use ENDS (Sharma et al., 2016)

While the study of ENDS is in its relative infancy, smoking literature has already developed a link between nicotine and stress reduction. Previous research has found craving for cigarettes increases following psychosocial stressors (Buchmann et al., 2008; Childs & de Wit, 2010). Stress exposure also plays a role in the development of nicotine use, where chronic stress is a risk factor for the development of substance use behaviors, including dependence to nicotine (Sinha, 2008). Like the users of ENDS, smokers commonly report relaxation and stress relief as primary reasons for why they smoke, and that stressors in their life seem to exacerbate their cravings to smoke (Bruijnzeel, 2012).

Withdrawal from nicotine also influences the motivation to use nicotine, partially through the role of stress and anxiety. Withdrawal begins approximately 4-24 hours following the cessation of regular nicotine usage (McLaughlin et al., 2015). Symptoms of nicotine withdrawal are quite uncomfortable and include increases in negative affect, anxiety, irritability, and

restlessness (Bruijnzeel, 2012). Perceived stress also seems to increase with stronger reported withdrawal symptomology (Lawless, et al., 2015),

These uncomfortable symptoms tend to peak during the 3rd day of abstinence and then decrease over the next 3-4 weeks (McLaughlin et al., 2015). This makes the first week of abstinence for individuals attempting to quit nicotine crucial, and a majority of smokers tend to relapse within this first week of attempting to quit when withdrawal symptoms are reported to be their most severe (Hughes et al., 2004). Prior work has discovered these relapsing individuals briefly decrease their subjective stress by consuming nicotine, achieving their intention to combat stress associated with withdrawal. However, by consuming nicotine, systems of the brain associated with a stress response (e.g., the hypocretin system, norepinephrine system) are further dysregulated, leading to exacerbation of withdrawal symptoms (Bruijnzeel, 2012). It is a momentary relief that potentially makes it more difficult to quit. These results, combined with research linking life stressors and difficulty quitting nicotine (Ayyagari & Sindelar, 2010), emphasize the important relationship between stress, anxiety, and motivations to use nicotine during withdrawal. The current study follows previous conclusions of this literature emphasizing the importance of stress reduction in the successful cessation of nicotine (Lawless et al., 2015).

Negative Health Impacts of ENDS Usage

Despite the potential benefits of ENDS related to the reduction of stress and anxiety, these devices are not without harms, including harms not present when smoking. A study of the two main ingredient chemicals in e-liquids (the liquid vaporized to give the user nicotine and create a vapor 'cloud' when exhaled), propylene glycol and vegetable glycerin, are likely to expose a user to high levels of toxins (Sassano et al., 2018). As the number of ingredients increases in an e-liquid formula, the greater the toxicity to the user (Sassano et al., 2018). Other

research has detected the presence of lung disease and heart disease causing chemicals acetaldehyde and formaldehyde, as well as the herbicide acrolein (Bein, 2011; Ogunwale et al., 2017). Mid-term and long-term health effects of the devices are relatively unknown due to the creation and rise of the devices occurring only in the past two decades. There is also the danger of young people using the devices. Ten percent of 11-18-year olds in the U.S. have tried the devices, with many manufacturers receiving criticism for their use of flavors and designs attractive to young people (Jones, 2019). College student use of these devices also rose 10%, from 6% to 16% between 2017 and 2018 (Jones, 2019). It can be assumed that as numbers of users continue to rise and the negative health effects become more known, more users will be looking for strategies to quit the devices.

Self-Affirmation & Stress

Research with nicotine dependent individuals has already supported the ability of stress management and reduction programs to aid in the cessation of smoking (Michou et al., 2013; Yalsin et al., 2014). However, the time consuming and potentially expensive nature of these programs presents some potential barriers to accessibility. Therefore, simple writing interventions demonstrated to reduce stress, such as value affirmation writing interventions, may be an effective and accessible alternative.

Value affirmation writing interventions, designed to induce self-affirmation with a focus on values important to the individual, were born out of self-affirmation theory (Steele, 1988). The theory posits that individuals use cognitive resources to maintain a view of oneself as a good and moral individual and to fight off threats to this sort of self-integrity (Sherman & Cohen, 2006). While individuals tend to target threats to integrity by accommodating them (e.g., accepting a failure in their life and reevaluating one's self) or directly challenging them (e.g.,

dismissing or ignoring the threat all together), self-affirmation theory posits a third strategy

which allows the individual to maintain self-integrity while also pursuing behavioral change

(Sherman & Cohen, 2006). In a self-affirmation strategy, an individual becomes aware of

alternative self-resources not necessarily related to the impending threat, but which allow the

individual to focus on positive aspects of their self-integrity and demagnify the threat itself. In

this way, the individual is able to realize their self-integrity, their view of themselves as a

fundamentally good person, is not dependent solely on the threat in front of them (Sherman &

Cohen, 2006). This defense has been described as a "psychological immune system" which

works to buffer the self against both real and perceived threats (Gilbert, et al., 1998; Sherman &

Hartson, 2011). Previous research has discovered the ability for self-affirmation strategies to

reduce negative emotional responses to a wide array of threats to the self, including stereotype

threat, threatening health information, and a potential threat of failure (Sherman, 2013). This

ability for this strategy to 'soften' the impact of threats faced to the self tends to be referred to as

self-affirmation 'buffering' the self (Sherman & Cohen, 2006).

As stressors in an individual's life have been demonstrated to provoke the self and

threaten one's self-integrity (Keough & Markus, 1998), affirming oneself and one's values can

buffer against negative reactions to stress. Typically, this stress-buffering effect has been

demonstrated using value-affirmation writing interventions. The ability of self-affirmation to

buffer an individual from stress and unhealthy coping mechanisms have been exhibited using

value-affirmation interventions. These interventions derive their benefits from their ability to

broaden an individual's perspective to include the many positive aspects of themselves that exist

outside of the impending threat (Sherman & Hartson, 2011). Examples of such a writing exercise

includes the Social Belonging Exercise: Values Affirmation Task, developed by Dr. Geoffrey L.

Cohen and colleagues (Cohen et al., 2009). The task's original purpose was for minority students

in a seventh-grade class to reinforce values in their life they found to be important, so that they

might buffer themselves from the negative effects of stereotype threat. Minority students who

completed the task were found in the following year to have a greater sense of belonging, as well

as increased resiliency to the stressful transition into middle school (Cohen et al., 2009).

In the more general population, value-affirmation writing exercises have been

demonstrated to reduce physiological responses to social stress tasks (Creswell et al., 2005), as

well as buffer individuals completing the tasks from everyday stressors, by way of attenuating

the central nervous system's response to stress (Sherman et al., 2009). The ability of value-

affirmation tasks to reduce physiological stress reactions, may be due to the task's relationship

with self-resources, or psychological resources that help a person manage stress (e.g., optimism,

sense of control). Self-resources have been linked to reduced stress appraisal prior to and

following a stressful situation (Taylor et al., 2003), and Creswell et al. (2005) found that self-

resources moderated the relationship between value affirmation and psychological stress

appraisal. Specifically, individuals who were high in self-resources and completed a value

affirmation writing task reported a greater decrease in stress versus those low in self-resources.

Value-affirmation exercises can also boost problem-solving abilities in chronically

stressed individuals (Creswell et al., 2013). These results indicate the possibility for self-

affirmation to broaden an individual's ability to consider a healthier solution when faced with the

dilemma of properly handling stress. The ability for positive emotions to broaden an individual's

perspective to consider more positive actions, in turn building the individual's positive resources,

is described in Barbara Frederickson's broaden-and-build theory of positive emotions

(Fredrickson, 2004). The theory describes that negative affective states narrow an individual's

attention and cognition, creating an inability to consider alternative positive actions when trapped in negative thinking states, providing yet another theoretical basis for the observed benefits of self-affirmation interventions.

Self-Affirmation & Stress Coping Behaviors

Research supports self-affirmation as a promising tool to increase self-control during stress and to reduce unhealthy coping mechanisms used to manage or self-medicate stress and anxiety. A study of overweight women looking to manage their weight issues found a value-affirmation writing exercise improved their self-regulation, as well as led to a higher percentage of weight loss compared to participants who completed a non-self-affirming writing exercise (Logel & Cohen, 2012). Self-affirmation also has been demonstrated to remedy the phenomenon of overeating observed due to stress caused by a sports fan watching their favorite team lose (Cornil & Chandon, 2013).

Addressing the purpose of the current study, recent research has begun to examine relationships between self-affirmation and substance use and alcohol use behaviors. Typically, these studies have combined self-affirmation with health-related messages that discourage use of alcohol or nicotine, to reduce the defensive processing that can develop when a person encounters messaging that could harm their self-integrity. For example, Armitage et al. (2011) had participants self-affirm before encountering information about the risks of consuming alcohol. The study found that self-affirming reduced alcohol consumption and led to more positive reactions to the alcohol risk information and less derogation of the message. However, results of this method have been somewhat mixed. Norman and Clarke (2016), for example, utilized a similar strategy by having university students complete a value affirmation writing exercise before reading information about the risks of binge drinking. Participants also

completed an implementation intervention, for the purpose of translating the positive intentions manifested by self-affirmation into behavioral change. However, the study found that self-affirming did not seem to reduce binge drinking frequency and did not change derogation of the health information (Norman & Clarke, 2016). In fact, it has been recommended that self-affirmation not be utilized as a strategy to reduce alcohol consumption in university students, as more effective strategies are available (Meier et al., 2015).

       We are aware of very few studies that have attempted to address self-affirmation in the context of attenuating the symptoms of nicotine dependence. Like work on alcohol consumption, self-affirmation has been paired with health interventions that advertise the risks of nicotine use. Findings seem to support this paired strategy's ability to reduce smoking in heavier users (Memish et al., 2017). Other research has reported self-affirmation to be detrimental in a nicotine use cessation context. Taber et al. (2019) utilized a self-affirmation intervention as part of a mobile application for smokers looking to quit smoking, where participants read messages about the health risks associated with smoking. Contrary to the intended effects of the intervention, results demonstrated self-affirmation seemed to weaken intentions to quit smoking and reduced perceptions of risk. While the authors considered the added time it took to complete the self-affirmation to be the cause of the unexpected results (added writing to other programs in mobile application may have been unnecessarily burdensome in time and effort), it is possible that the self-affirmation was technically effective, in that it may have reduced the stress associated with processing the negative outcomes of nicotine usage, hence making users more confident in their own actions. Nevertheless, the conflicting results of Taber et al. (2019) were collected in the context of self-affirmation and health messaging, not in the context of buffering an individual from a stressor.

To the knowledge of the authors, few studies have ever isolated the use of a self-affirmation intervention to target affective states associated with nicotine use disorder, especially when the individual primarily consumes nicotine with ENDS. The current study attempted to examine a value affirmation writing exercise as a tool to buffer nicotine dependent individuals from the anxiety effects of a stressor and reduce the craving for nicotine using ENDS. It is predicted that (1), completing a value affirmation exercise will buffer a nicotine dependent individual from anxiety following a video stressor; (2) completing a value affirmation exercise will reduce craving to vape nicotine following a video stressor. As an exploratory hypothesis, we also predict that completing a value affirmation exercise will reduce psychological appraisals of the video as stressful, threatening, and difficult to watch.

The current study has the potential to inform current and future treatments for the cessation of nicotine. This research specifically examines the use of ENDS to ingest nicotine. As ENDS have been widely available for a relatively short time compared to other nicotine products, few interventions have been evaluated for their effectiveness in reducing the use of ENDS (O'Connor et al., 2019). The current study also further aims to explore the ability of a positive intervention, a value affirmation exercise, to reduce negative affective states (i.e., craving and stress) associated with use disorders.

Methods

Participants

The initial sample consisted of 151 participants (104 males, 47 females) recruited through an online survey from two online participant pools, Qualtrics Survey Panels and Amazon Mechanical Turk. The study was advertised as seeking individuals who used ENDS regularly to consume nicotine.

Prior to beginning the study, participants completed the Penn State Electronic Cigarette Dependence Index (Foulds et al., 2015) to confirm their dependence on ENDS, based on the perceived pervasiveness of social ENDS users who are not dependent on their devices (Katz et al., 2019). Participants were included in the study if they scored a 9 or higher on the questionnaire, indicating a medium dependence or stronger for nicotine. Scores on this dependence questionnaire ranged from 9 to 19 ($M = 12.3$). See Table 1 for demographic characteristics of the initial sample divided by group assignment.

Participants in this study were randomly assigned to either be in a value-affirmation writing condition or a control condition. In the original assignment, 79 participants (57 males, 22 females) were randomly assigned to the value-affirmation writing condition and 72 participants (47 males, 25 females) were placed into the control condition. Two coders, one unaware of the hypotheses of the experiment and the other the PI, coded the written responses following a procedure described by Rozek et al. (2015) to code for compliance of the value affirmation procedure. Responses by participants were considered to comply with the value affirmation condition if they 1) referred to any of the values given in the intervention and 2) stated in some way that a value was important to themselves. Responses by participants were considered to comply with the control condition if they mentioned any of the values but did not refer to themselves in their writing. According to the coding procedure, 56 participants failed to answer their assigned prompt correctly, either by providing a nonsense response (i.e., gibberish) or by not completing the correct affirmation directions. There was a 91% agreement rate between raters. In addition, one participant was removed for failing to answer one of the two attention checks in the survey that asked participants to select a specific option from a multiple-choice

question. Two participants were excluded for stating they primarily consumed 0% nicotine juice when using ENDS.

Of the final analyzed sample ($N = 92$), 89.1% of individuals reported their race as "White", 5.4% as "Black or African American", and 1.1% as "Asian". Another 4.4% of the sample reported as mixed race, with 1.1% reporting "American Indian or Alaskan Native, Black or African American, and White," 1.1% reporting "Asian and Native Hawaiian or Pacific Islander" and 2.2% reporting "Asian and White." See Table 1 for a comparison of the full demographic descriptions of the original and final sample.

Regarding their nicotine use, 67.4% of the final sample reported their age of first using ENDS as 21 years or older, while 32.6% had tried ENDS for the first time before turning 21. JUUL was the most reported brand used as a primary device by participants (35.9%), with brands Vaporesso (14.1%), SMOK (12.0%), Vuse (7.6%), and Joyetech (6.5%) also common in the sample. Another portion of the sample (6.5%) reported using a custom device to ingest nicotine and 17.4% of the sample used a device not listed in the provided options but provided their device in a text-entry box (Devices reported included Blu, Eleaf, and Uwell). Participants also provided the level of nicotine they primarily consume when using ENDS (i.e., nicotine concentration in their e-juice or pod). The most reported nicotine concentrations were 3mg and 6mg nicotine (both 21.7%), followed by 10mg (20.7%), 12mg (14.1%), and 18mg (7.6%). Twelve percent of participants reported primarily consuming concentrations 18mg or higher, 2.2% reported they were unsure what nicotine concentration they used.

Of the final analyzed sample, 56.5% of participants reported they also use an electronic device for the consumption of "marijuana/THC based products." A majority of the sample (66.3%) reported regularly using other tobacco products other than their ENDS device. A

minority of the final sample (30.4%) reported being currently "under the influence of any mind-
or mood-altering chemicals other than nicotine and other than those that are currently
prescribed" to them. However, to maintain a sample size for the exploratory purposes of the
current study, these individuals were not excluded from analysis.

Measures & Procedure

Self-report measures

  Questionnaire of Vaping Craving (QVC). The QVC is a 10 item questionnaire
intended to capture craving for vaping nicotine (Dowd et al., 2018), where participants provided
their agreement to statements such as "I need to vape now." and "Nothing would be better than
vaping right now." on a scale from 1 to 7 (1 = strongly disagree, 7 = strongly agree). The QVC
has demonstrated adequate reliability and validity in a large sample of e-cigarette users (Dowd et
al., 2019), and demonstrated high reliability in the current study ($\alpha = .97$).

  Penn State Electronic Cigarette Dependence Index. The Penn State Electronic
Cigarette Dependence Index is a 10 item questionnaire intended to assess the degree of
dependence an individual has for electronic cigarettes, adapted from the Penn State Cigarette
Dependence Index (Foulds et al., 2015). Participants provided information on their behavior
related to their ENDS usage. These items were scored to gather a rating which could be
classified to meet a range of no dependence, low dependence, medium dependence, or high
dependence. The Penn State Electronic Cigarette Dependence Index has demonstrated adequate
reliability and validity in a large, majority e-cigarette user sample (Morean et al., 2019).

  Minnesota Tobacco Withdrawal Scale (MTWS). The MTWS is a widely used 15 item
questionnaire intended to assess for symptoms of withdrawal from nicotine (Hughes &
Hatsukami, 1986). Participants provided their severity of feeling certain symptoms associated

with nicotine withdrawal on scale from 0 to 4 (0 = none, 1 = slight, 2 = mild, 3 = moderate, 4 = severe). The MTWS has demonstrated adequate reliability and validity in a large sample of smokers (Toll et al., 2007), and demonstrated high reliability in the current study (α = .96).

State-Trait Anxiety Inventory (STAI) - State Subscale. The STAI (State Subscale) is a widely used 20 item subscale of the STAI questionnaire that specifically captures an individual's current degree of anxiety (Spielberger, 1983). STAI has demonstrated adequate reliability and validity in a large sample of adults and adolescents and has been deemed appropriate for examining anxiety in a research setting (Julian, 2011). The STAI demonstrated high reliability in the current study (α = .94).

Value Affirmation Writing Task. The value affirmation task used in this study is adapted from Cohen and Sherman (2014). In the experimental task, participants were asked to think about personal values from a list provided, and then circle 2-3 that are most important to them. Examples of such values included "Athletic Ability,"; "Living in the Moment" and "Success in my Career". Participants were asked to describe in writing why the selected values were important to them in a short paragraph. In the control task, participants were asked to think about the same list of values, but then describe in writing why some values they did not select might be important to someone else. Previous research has demonstrated this task reduces physiological and psychological response to threat during stress tasks (Cohen & Sherman, 2014).

Procedure

After being brought to the online survey, completing the consent forms, and being determined eligible for the study by receiving a score of 9 or higher on Penn State Electronic Cigarette Dependence Index (indicating medium dependence or higher on nicotine using ENDS), participants were asked to provide demographic info pertaining to their gender, age, ethnicity,

and race. Participants were also asked a few brief questions about their ENDS and nicotine use,

including the age they first used ENDS, their primary ENDS brand or device, and the

concentration of nicotine they typically consume when using ENDS. Participants then completed

a battery of questionnaires, including the QVC and STAI (state subscale), to capture their

baseline emotional, affective, and physiological status. Following these questionnaires, all

participants were randomly assigned to complete either the value affirmation writing task or the

control writing task. Participants first listed their chosen values in one textbox, then were told

they should take five minutes to write about their assigned prompt in a second textbox. In the

final analyzed sample, time to read and complete the value affirmation writing task ranged from

60.39 to 999.30 seconds ($M = 377.27$ seconds). In the control group, time to complete ranged

from 68.37 to 1193.39 seconds ($M = 335.53$ seconds).

All participants, regardless of assignment, were then brought to a page to watch a brief,

two minute video, derived from Bebbington et al. (2017). The video was divided into two, one-

minute clips. The first video was narrated footage of a rally car crash from an extreme sports

highlight TV show. The second video was amateur footage of individuals performing daredevil

high-rise stunts (e.g., hanging from tall cranes, standing at the edges of skyscrapers). Bebbington

and colleagues had previously demonstrated the video to significantly increase anxiety after their

induction, so they served as a virtual stressor for the purposes of this study. Immediately

following the video, participants completed three, Likert scale questions, adapted from stress

appraisal items in Creswell et al. (2005). These questions asked participants to rate how stressful

(from very calming to very stressful), threatening (from very not threatening to very threatening),

and how difficult to watch (from very easy to watch to very difficult to watch) the videos were.

All participants then completed the battery of questionnaires, including the STAI and

QVC, once more to capture emotional and affective status following the writing block and video

stressor. Before leaving the survey, all participants were asked to provide how honest they were

in completing the study. All participants in the final analysis reported they were honest or very

honest while completing the study.

Data Reduction

Questionnaire responses were scored and summed according to their scoring guidelines

prior to analysis. Each questionnaire was analyzed to determine if any missing data was

present. Each questionnaire analyzed in the current study was then analyzed with an outlier

identification strategy to determine the existence and exclusion of outlier cases. This strategy

consisted of determining the interquartile range (IQR) and 25th and 75th percentiles. Cases

were considered to be outliers and excluded if they were less than the sum of 1.5 times the IQR

and the 25th percentile, or greater than the sum of 1.5 times the IQR and the 75th percentile. In

the final analyzed sample, 7% of participants were identified as outliers and excluded in

analysis of STAI scores. No other participants were excluded in the other performed analyses.

A 2 Affirmation Condition $\times$ 2 Time Repeated measures analysis of variance (ANOVA)

was used to analyze changes in both stress (STAI scores) and craving (QVC ratings) across the

two time points (before and after the writing block and video manipulation). To examine the

effectiveness of the video manipulation to increase anxiety, the main effect of anxiety was

examined. To explore the ability of the video manipulation to increase craving for vaping

nicotine, the main effect of craving was assessed. The anxiety $\times$ affirmation writing condition

interaction was examined to test hypothesis 1. The craving $\times$ affirmation writing condition

interaction was examined to test hypothesis 2. As an exploratory analysis, independent sample

t-tests were performed to compare mean scores on the three psychological appraisal questions

adapted from et al. (2005). These tests were explored to determine whether the affirmation writing condition affected psychological appraisals of stress, threat, and difficulty watching the video.

Results

Main Analyses

As a preliminary analysis, mean scores on the Penn State Electronic Cigarette Dependence Index were compared between groups with an independent samples t-test to determine if there was any significant difference in dependence. There was not a significant difference in the dependence scores for the affirmation (M = 12.44, SD = 2.76) and control (M = 12.63, SD = 2.27) group conditions; $t(90)$ = -.34, p = .73. These results indicate that the groups did not differ in dependence levels and differences in dependence would therefore not contribute to any of the effects reported in the current study. There was also not a significant difference in the withdrawal scores for the affirmation (M = 18.63, SD = 14.56) and control (M = 15.74, SD = 14.03) group conditions; $t(90)$ = .62, p = .54. Means, standard deviations and correlations were also generated for the variables of interest, with these values included in Table 2.

To address the first hypothesis and determine whether the affirmation writing exercise had an effect on participants' reported anxiety, a repeated measures ANOVA was conducted to compare the effect of the writing condition on scores of the STAI (State Subscale) in the value affirmation and control conditions. Due to identification of their scores as outliers, six participants were excluded from this analysis. There was a significant main effect of anxiety across the two time points, $F(1, 84)$ = 39.33, $p < .001$, η_p^2 = .319, indicating state anxiety increased from timepoint 1 and timepoint 2. The mean STAI score for timepoint 1 was 38.87,

95% *CI* [35.93, 41.82]. The mean STAI score for timepoint 2 was 47.77, 95% *CI* [44.90,

50.64]. There was not a significant anxiety by group assignment interaction effect, $F(1, 84) =$

2.68, $p = .11$, $\eta_p^2 = .031$. The mean of the self-affirmation group at timepoint 1 was 38.75, 95%

CI [34.99, 43.50], and 49.96 at timepoint 2, 95% *CI* [46.30, 53.62]. The mean of the control

group at timepoint 1 was 39.00, 95% *CI* [34.47, 43.53], and 45.57 at timepoint 2, 95% *CI*

[41.15, 49.99]. These results suggest that while the video manipulation may have been

effective in increasing participants' anxiety, the writing condition had no effect on reported

levels of anxiety across the two time points. See Figure 1 for the results of this analysis.

To address the second hypothesis and determine whether the affirmation writing

exercise had an effect on participants' reported craving for vaping nicotine, a repeated

measures ANOVA was conducted to compare the effect of the writing condition on scores of

the QVC in the value affirmation and control conditions. There was a significant effect of

craving across the two time points, $F(1, 90) = 10.43$, $p = .002$, $\eta_p^2 = .104$. The mean QVC

score for timepoint 1 was 38.87, 95% *CI* [35.20, 42.55]. The mean score for timepoint 2 was

42.69, 95% *CI* [38.46, 46.93]. These results suggest craving for vaping nicotine increased from

timepoint 1 to timepoint 2. There was not a significant group $\times$ time interaction for craving

scores, $F(1, 90) = .001$, $p = .979$, $\eta_p^2 = .000$. The mean of the self-affirmation group at

timepoint 1 was 40.17, 95% CI [35.45, 44.89], and 44.02 at timepoint 2, 95% *CI* [38.58,

49.46]. The mean of the control group at timepoint 1 was 37.58, 95% *CI* [31.95, 43.21], and

41.37 at timepoint 2, 95% *CI* [34.88, 47.85]. The writing condition did not affect reported

levels of craving for vaping nicotine across the two time points. See Figure 2 for the results of

this analysis.

To determine whether the writing condition had an effect on participants' appraisal of

the video as stressful, threatening, and difficult to watch, independent samples t-tests were

conducted to compare scores on the appraisal questions adapted from Creswell et al. (2005) in

the affirmation and control conditions. There was not a significant difference in the stress

appraisal scores for the affirmation (M = 5.70, SD = 1.50), and control (M = 5.39, SD = 1.37)

group conditions; $t(90)$ = 1.00, p = .32, 95% CI [-.30, .92]. Also, the mean scores of the two

groups fell within the 'somewhat stressful' to 'stressful' range, indicative most participants

found the video stressful. There was not a significant difference in the threat appraisal scores

for the affirmation (M = 5.33, SD = 1.53) and control (M = 4.82, SD = 1.74) conditions; $t(90)$ =

1.51, p = .13, 95% CI [-.16, 1.20]. There was not a significant difference in the difficulty

watching appraisal scores for the affirmation (M = 4.56, SD = 1.92) and control (M = 4.37, SD

= 1.90) conditions; $t(90)$ = .46, p = .65, 95% CI [-.62, .99]. These results suggest the writing

affirmation did not seem to have any effect on individual's appraisal of the video as stressful,

threatening, or difficult to watch.

Covariate Analyses

Analyses of the initial substance behavior information provided by the participants, as

well as the degree that they followed the writing intervention directions revealed some

potential confounds in our results. Specifically, a significant portion of the participants reported

being currently intoxicated on a substance other than nicotine or what was prescribed to them

(30.4%). Also, a significant portion of participants (49%) completed their assigned writing

prompt in less than the 5 minutes that was assigned to them in the directions of the

intervention.

Therefore, repeated measures ANCOVAs was conducted to compare the influence of

the value-affirmation intervention and control group on anxiety and craving for nicotine whilst

controlling for reported intoxication (yes vs. no) and whether participants submitted their

writing intervention after 5 minutes (yes vs. no). Levene's test and normality checks were

carried out and the assumptions met. When state anxiety was the outcome variable, there was a

significant main effect of state anxiety across the two time points, $F(1, 82) = 42.30$, $p < .001$,

$\eta_p^2 = .340$, indicating state anxiety increased from timepoint 1 and timepoint 2. The mean STAI

score for timepoint 1 was 39.12, 95% CI [36.37, 41.88]. The mean STAI score for timepoint 2

was 47.76, 95% CI [44.85, 50.66]. There was also a significant anxiety by group assignment

interaction effect when controlling for the covariates, $F(1, 82) = 7.29$, $p = .008$, $\eta_p^2 = .082$. The

mean of the self-affirmation group at timepoint 1 was 37.65, 95% CI [34.08, 41.22], and 50.00

at timepoint 2, 95% CI [46.23, 53.76]. The mean of the control group at timepoint 1 was 40.60,

95% CI [36.26, 44.94], and 45.52 at timepoint 2, 95% CI [40.94, 50.10].These results indicate

that, when controlling for the two covariates, the value affirmation group seemed to experience

a greater increase in state anxiety versus the control group. See Figure 3 for the results of this

analysis.

When craving for nicotine was the outcome variable, there was a significant effect of

craving across the two time points, $F(1, 88) = 6.90$, $p = .010$, $\eta_p^2 = .073$. The mean QVC score

for timepoint 1 was 39,02, 95% CI [35.40, 42.63]. The mean score for timepoint 2 was 42.75,

95% CI [35.40, 42.63]. These results suggest craving for vaping nicotine increased from

timepoint 1 to timepoint 2. There was not a significant group $\times$ time interaction for craving

scores, $F(1, 88) = .173$, $p = .678$, $\eta_p^2 = .002$. The mean of the self-affirmation group at

timepoint 1 was 39.49, 95% CI [34.80, 44.18], and 43.73 at timepoint 2, 95% CI [38.18,

49.28]. The mean of the control group at timepoint 1 was 38.54, 95% CI [32.92, 44.16], and

41.78 at timepoint 2, 95% CI [35.14, 48.42]. Whilst controlling for the covariates, the writing

condition did not appear to affect reported levels of craving for vaping nicotine across the two time points. See Figure 4 for the results of this analysis.

Discussion

The present study explored the use of a self-affirmation-based writing intervention (value affirmation) as a tool to reduce adverse reactions to a stressor in individuals who are dependent on nicotine using electronic nicotine delivery systems (ENDS). While the video-based stressor was successful in increasing anxiety and craving for nicotine, the value affirmation exercise did not appear to buffer individuals from any increased craving for nicotine or anxiety as a result of the stressor. Specifically, individuals in the value affirmation group did not report significantly lower levels of craving for vaping nicotine, nor state anxiety, compared to the control group following the stressor. In addition, individuals in the value affirmation group did not appraise the stressor to be significantly less stressful, threatening, or difficult to watch than the control group. However, when the variables of reported intoxication and adequate time taken in the intervention were controlled for, participants in the value affirmation group seemed to report a greater increase in state anxiety than the control group.

The results of this study are not consistent with past literature supporting the ability for self-affirmation exercises, like value affirmation, to attenuate psychological and physiological responses to stressors (Creswell et al., 2005, 2013; Sherman et al., 2009; Sherman, 2013). Typically, in both laboratory conditions (e.g., Creswell et al., 2005, 2013) and field studies (e.g., Sherman et al., 2009), self-affirmation has been associated with a reduction in anxiety and other negative stress-related responses when encountering a stressor. It is worth noting however, that the measures of anxiety captured in the current study were primarily psychological and self-report based. Some previous work supporting a physiological reduction in stress response by

self-affirmation has failed to find a reduction in self-reported, psychological stress (Creswell et al., 2005). Future work examining value affirmation in this context should work to capture both self-reported, psychological anxiety or stress, as well as physiological stress responses.

The failure of this study to find a stress buffering effect from the self-affirmation exercise may have been due to the nature of the stressor. As the results of the analyses demonstrated when the covariates of intoxication and adequate amount of time taken on the intervention were controlled for, individuals who self-affirmed in the value affirmation exercise experienced a greater increase in state anxiety than the control group following the video. Previous literature has demonstrated conditions under which self-affirmation interventions may exacerbate anxious reactions to stress rather than calming the individual (Finley et al., 2018; Jessop et al., 2018).

A key component of value affirmation intervention, as derived from self-affirmation theory, is their ability to reduce defensive processing in response to threats, allowing the individual to respond openly rather than keeping processing of threats at bay (Cohen & Sherman, 2014). While this reduction of defensive processing is typically considered in a positive light, such as when self-affirmation allows individuals to consider health information about their behaviors with less resistance (e.g., Armitage et al., 2011), the potential of downsides of reducing advantageous coping mechanisms associated with defensive processing have been considered. Munro and Stansbury (2009), for instance, demonstrated the ability of self-affirmation to cause individuals to display more cognitive biases and less accurate judgements towards misleading, threatening information, because their beneficial, defensive responses like skepticism were reduced.

The influence of the nature of the stressor on the effects of self-affirmation has also been considered in this context. Jessop et al. (2018) considered how self-affirmation might make individuals more vulnerable to stressors that derive from areas of low control in an individual's life. Examples provided for such areas included experiencing grief, facing death, or a living through a traumatic incident. They also hypothesized that individuals who were particularly vulnerable towards these type of stressors (had the greatest fear about such an event occurring) would experience the greatest exacerbation of adverse reactions when they self-affirmed prior to the stressor. Specifically, in their experiment, they assigned women to a value affirmation or control activity and then had them read vignettes of a woman experiencing a difficult, traumatic birth scenario marked by low levels of control, and asked the participants to imagine themselves in the role of the character as they read the narrative. The study found individuals in the self-affirmation group experienced a greater increase in anxiety following the stressor than the control group, and that fear of childbirth moderated this effect, where greater fear of childbirth led to a greater exacerbation of anxiety. These results suggest the sort of perspective-widening and reduced defensive processing effects by self-affirmation may be helpful when being evaluated on a speech or encountering threatening health information (e.g, Creswell et al., 2005; Armitage et al., 2011), but may not helpful when encountering stressors associated with a low sense of control that activate deeply held fears, like a traumatic situation or facing death or serious injury.

The current study utilized a video stressor from Bebbington et al. (2017) that might be considered the sort of stressor characterized by Jessop et al. (2018) as possessing low sense of control and activating deeply held fears. In the video, individuals performed high dare devil stunts in which they risked death, by hanging from the edges of tall buildings and walking along

cranes suspended high off the ground. The video also featured a high-speed rally car crash, an

instance of an individual quite literally losing control over their vehicle and crashing into a

crowd, potentially severely injuring or killing individuals in or outside the car. These potentially

traumatic moments, marked by levels of low control, may have acted in a similar way as the

stressor in Jessop et al. (2018). By reducing defensive processing and strategies that would help

an individual disengage with a threat of this type, the individual experiences greater anxiety.

This notion is supported by event related potential (ERP) research on self-affirmation. Research

that has found individuals who self-affirmed prior to task where they viewed differently

valanced pictures experienced enhanced processing of negative emotional pictures versus those

who were not self-affirmed (Finley et al., 2018). Again, like Jessop et al. (2018), these authors

concluded that the ability of self-affirmation to reduce defensive coping strategies that allow

individuals to disengage or move away from a threat caused self-affirmed individuals to process

the negative information to greater degree than the control participants.

    The results of the current study, combined with the conclusions of Jessop et al. (2018)

and Finley et al. (2018), reveal the potential drawbacks of influence of self-affirmation on

defensive processing outlined by self-affirmation theory. As the scenes of the stressor utilized in

this study were incredibly negative and derived from domain in life marked by a low sense of

control (experiencing death/risking death), the reduction in defensive processing actually served

to exacerbate anxiety rather than reduce it. We might also consider the influence of the

'daredevil stunts at tall heights' portion of the video stressor in the context of the moderation

effect found by Jessop et al. (2018), where participants who possessed a high fear of childbirth

experienced the greatest exacerbation in anxiety after self-affirming. While the current study did

not gather the degree that participants possessed a fear of heights, research on prevalence rates

of specific phobias in the general population has determined it to be one of the most commonly

held phobias (Eaton et al., 2018). It is possible that a certain portion of the participants who

possessed a particular fear of heights may have had their anxiety exacerbated even greater by the

stressor. We recommend future research on self-affirmation capture pre-conceptions of the fears

that may be activated by the stressor, to determine if a moderating effect for individuals

particularly vulnerable to the stressor may be occurring.

   Another perspective to consider is that this intervention may not be particularly effective

in the context of nicotine usage cessation. Previous studies have supported the notion that self-

affirmation as an intervention strategy may not be particularly useful in preventing or changing

high risk substance-related behaviors. For example, Meier et al. (2015) attempted to curb

drinking behavior with a self-affirmation strategy designed for heavy drinking for college

students. Their strategy was not reported to be effective in reducing alcohol use and the authors

recommended pursuing more person-centered strategies that can influence beliefs about alcohol

and motivate an individual to pursue change, factors that have a greater effect on substance use

behavior than reducing defensive processing or increasing protective behavioral strategies.

Taber et al. (2019) was similarly ineffective in reducing intentions to quit nicotine by using self-

affirmation as part of an app designed to aid in smoking cessation. These studies, combined with

the results of the current study, reveal that self-affirmation may not be the most effective

intervention for a substance cessation context. Similar, positive interventions, like motivational

interviewing (specifically recommended by Meier et al.) or mindfulness seem to have a greater

track record in clinical and research contexts with individuals who are struggling with symptoms

of substance use.

This research is not without limitations. Part of its limitations lie in its reliance on an online sample for data collection. Variables that may influence a participant's experience during the survey, including the environment and what distractions they are experiencing, become inherently more difficult to control than if the research was conducted in a laboratory setting. However, a vast majority of studies comparing online data collection platforms (i.e., Amazon Mechanical Turk) and conventional research methods have supported the use of online platforms for academic research, reporting that the data is often statistically comparable to data collected with conventional research methods (Mortensen & Hughes, 2018).

Another limitation derives from the quality of the data and degree that individuals in this study followed directions, especially during the writing portion of the procedure. Analysis revealed that some participants completed their writing section in as little as 60 seconds, much quicker than the advised time of 5 minutes. Only 45 of 92 participants or 49% submitted their writing section after 5 minutes had elapsed, where 29 of these participants (54% of the group) were assigned to the value affirmation condition and 16 participants (42%) were assigned to the control condition. These results mean less than half the analyzed sample received the adequate 'dosage' of self-affirmation as recommended by Cohen and Sherman (2014). Some research work has recommended even longer, allotting 10 minutes for writing and assigning the writing intervention multiple times over several weeks (Sherman et al., 2009). Including whether individuals completed the intervention after 5 minutes as a covariate allowed us to control for this discrepancy. However, future research should examine the role of the time taken by participants to complete the intervention and consider the use of timing tools (e.g, timer, stopwatch, etc.) to control the length of time participants take to write.

The content of the writing of many participants in the original sample was of poor quality (i.e., non-sense writing, little attempt to address the prompt). This limitation was partially mitigated through the coding procedure described in our description of the sample, but exclusion based on this procedure led to a good amount of the original sample being excluded. We, therefore, did not meet our intended sample size of 120 participants, selected from the effect size of a stress reduction effect of a self-affirmation exercise reported in Sherman et al. (2009).

The reported differences in ENDS usage, as well as other substance use behaviors is also important to note when considering the conclusions of this research. There was a wide variety of vaping devices and nicotine concentrations of e-juices reported by participants to be their primary modes of ENDS consumption. It is possible that different nicotine concentrations or devices may have influenced behavior or cognitions during this experiment. Also, almost a third of participants reported currently being intoxicated while completing the survey, bringing up questions of how much their reported levels of affect, anxiety, or craving were affected by the substances they were intoxicated by. As this study was conducted online, it was impossible to control whether an individual was actively using nicotine during the activity or verify when they had last used nicotine. We attempted to mitigate this limitation by capturing self-reported withdrawal and determined that withdrawal levels were not significantly different between the final analyzed writing assignment groups.

Despite these limitations and the reported findings being contradictory to prior literature, this study has potential implications on our understanding of self-affirmation and its related interventions. As discussed previously, the inability of this study to find any stress buffering effects of the value affirmation intervention reveals the need for further research that explores

where self-affirmation may not be effective in reducing stress, or may even exacerbate anxiety by reducing defensive processing. This research also supports the potential for online research to examine issues related to ENDS usage. While vaping appears to be increasingly popular, the pervasiveness of occasional, social users and recent restrictions placed on accessing ENDS products (Katz et al., 2019) can make it difficult to access the population dependent on nicotine using ENDS, especially those looking to stop. Assuming trends of ENDS usage continue, these individuals will become increasingly important and previous research exclusively examining cigarette use or other tobacco-based products may need to be reexamined in the context of ENDS usage. This study reveals the power and limitations of online data collection to access individuals dependent on nicotine using ENDS and ability to evaluate interventions through these online platforms.

This study and its limitations also reveal great potential for future work on self-affirmation and the mechanisms behind its effects. One potential direction is to explore is the demographic characteristics of participants that may have influenced the results of the current study. Gender is one direction to explore in future research. While previous studies have explored the ability of self-affirmation to help bridge gender academic achievement gaps (e.g., Miyake et al., 2010), we are aware of few studies that have looked at potential differences in the effects of self-affirmation based on gender or what mechanisms drive the efficacy or non-efficacy of the intervention based on gender. This is especially important as the main study we cited as reasoning for why the intervention may have been ineffective used a sample exclusively of women (Jessop et al., 2018). Another area to explore that was brought up over the course of this research was exploring differences in culture and language. One potential reason for the extreme amount of attrition due to lack of compliance to the writing intervention may have been

a lack of comprehension of the prompt, or a lack of English skill to respond effectively. Future research should explore the reading comprehension of participants on these surveys if administering an intervention that involves having to understand, process, and respond to a certain prompt. Also, researchers should introduce instruction comprehension checks to verify their participants understand the instructions of the task, as originally suggested by Mellis & Bickel (2020). The cultural of participants may also be an important direction, as previous studies have found self-affirmation interventions to be less effective in certain cultural groups that are apt to select values based on what they believe is expected of them, rather than what is personally important to them (de Jong et al., 2016).

Finally, analyzing the writing of the self-affirmation responses on relational qualities may be an important direction to pursue. One potential moderating factor of the task relates to the relational nature of the value affirmation intervention. As many of the values listed for participants are related to affirming close, positive relationships the individual holds (e.g., "my community"; "relationships with friends and family"; "membership in my community"), it is possible that affirming these relationships plays a factor in the efficacy of the intervention, or that the degree an individual perceives social support prior to the intervention plays a role. Previous research has revealed that even thinking of a romantic partner significantly reduces an individual's physiological stress response to a stressor, perhaps indicating a similar buffering effect to stress as self-affirmation (Bourassa et al., 2019). Future research should compare effects between individuals who chose values that include relational qualities against those who did not.

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Appendix A

Table 1

Demographic Information for Original and Coding Compliant (Analyzed) Sample

Factor	Original Sample		Coding Compliant Sample	
	Value Affirmation	Control Group	Value Affirmation	Control Group
Gender				
n	79	72	54	38
% Male	72.2	65.3	72.2	65.8
% Female	27.8	34.7	27.8	34.2
Age				
Mean in Years	43.6	42.1	45.6	44.0
Race				
% White	88.6	84.7	96.3	78.9
% Black	11.4	6.9	3.7	7.9
% Asian	0	3.0	0	2.6
% Multiracial	0	5.6	0	10.5
% Other	0	1.4	0	0
Ethnicity				
% Hispanic	20.3	19.4	13.0	15.8
% Not Hispanic	79.7	80.6	87.0	84.2
Dependence				
Mean Score	12.3	12.2	12.4	12.6

Note. This table includes demographic information for originally collected sample, as well as the final sample following exclusionary criteria and the coding procedure. Both samples are divided into group assignment (Value affirmation condition and the control condition). This table also includes mean scores on the Penn State Electronic Cigarette Dependence Index for the conditions of each sample.

Appendix B

Table 2

*Means, standard deviations, and correlations for variables of interest*

Measure	*M*	*SD*	1	2	3	4	5	6	7
1. STAI – TP1	37.78	13.59							
2. STAI – TP2	46.35	14.57	.58**						
3. QVC – TP1	39.10	17.41	.29**	.30**					
4. QVC – TP2	42.92	20.05	.19	.37**	.83**				
5. Stressful	5.58	1.45	.02	.42**	.63	.12			
6. Threatening	5.12	1.63	.16	.49**	.41**	.38**	.409**		
7. Difficulty Watching	4.48	1.90	-.10	.34**	-.07	.00	.534**	.343**	

Note. M and *SD* are used to stand for mean and standard deviation, respectively. * indicates

correlation significant at .05 level and ** indicates correlation significant at .01 level.

Appendix C

Figure 1

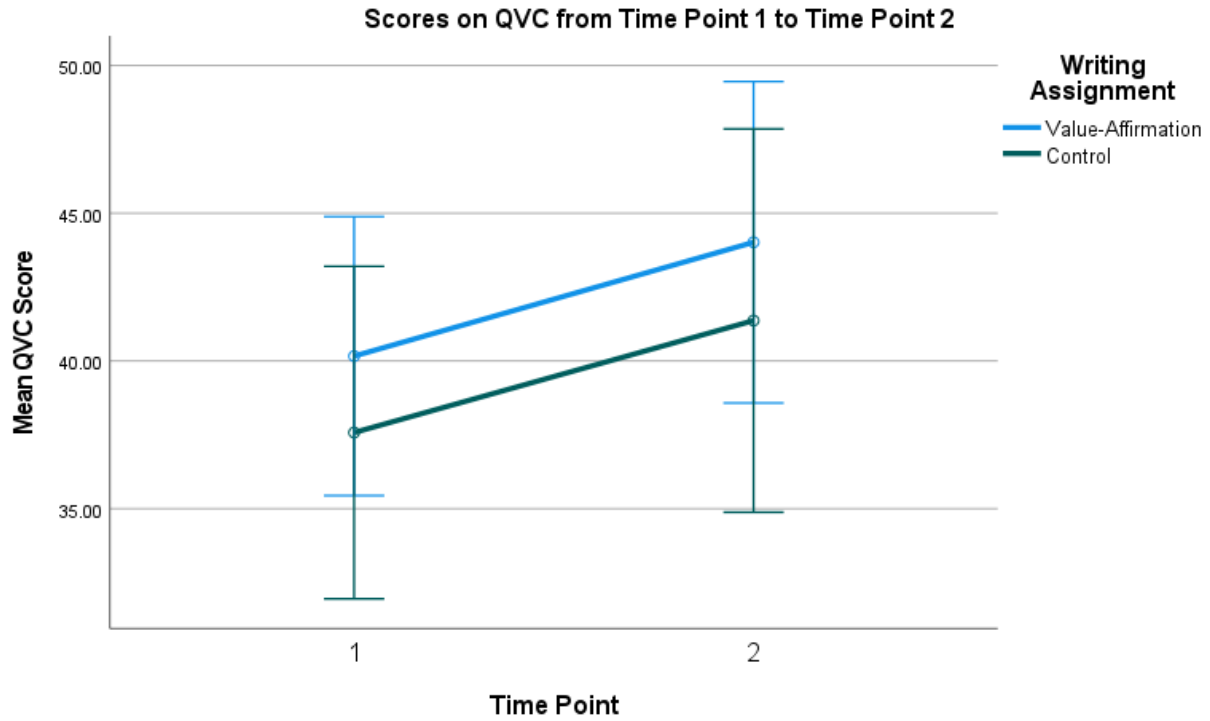*Scores on STAI from Time Point 1 to Time Point 2*
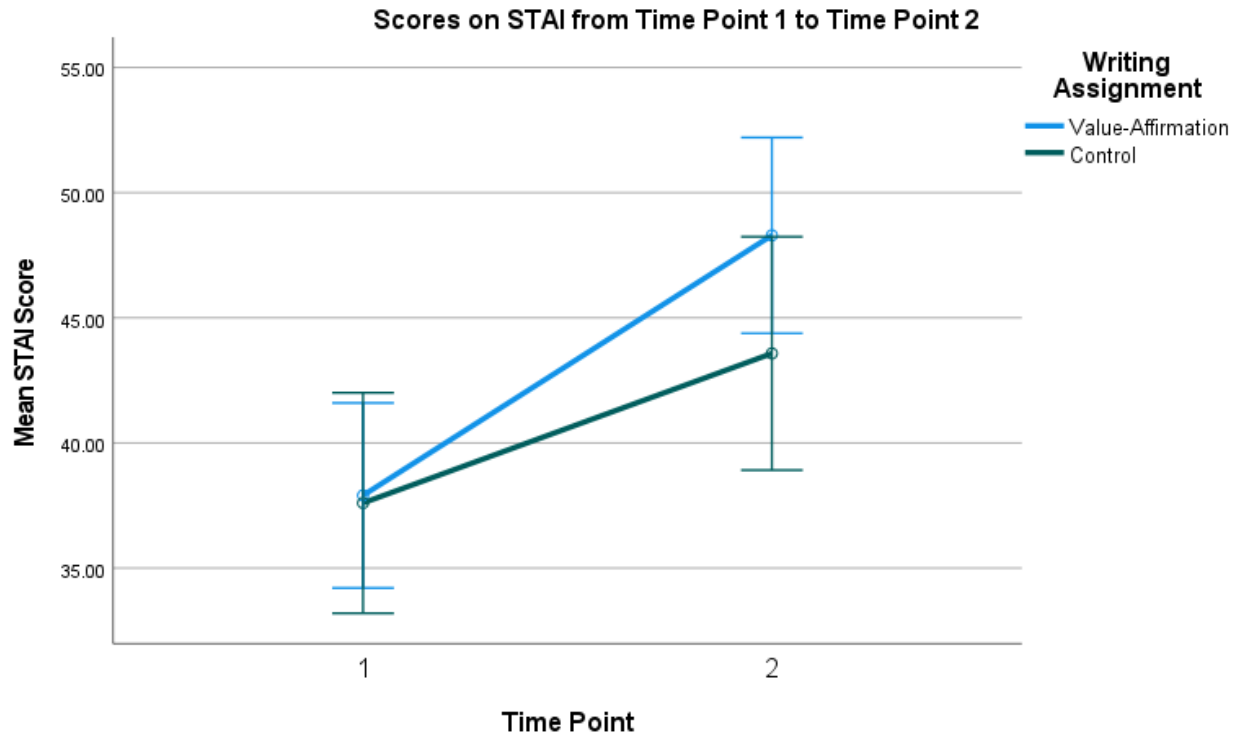
Note. This figure compares mean scores on the State-Trait Anxiety Index (STAI, State Subscale) between writing assignment groups across time point one, before the writing intervention and video, and time point two, after the writing intervention and video. Error bars are set at 95% confidence intervals.

Appendix D

Figure 2

Scores on QVC from Time Point 1 to Time Point 2


Scores on QVC from Time Point 1 to Time Point 2

Note. This figure compares mean scores on the Questionnaire of Vaping Craving (QVC) between writing assignment groups across time point one, before the writing intervention and video, and time point two, after the writing intervention and video. Error bars are set at 95% confidence intervals.

Appendix F

Figure 3

Scores on STAI from Time Point 1 to Time Point 2 (Covariate Analysis)
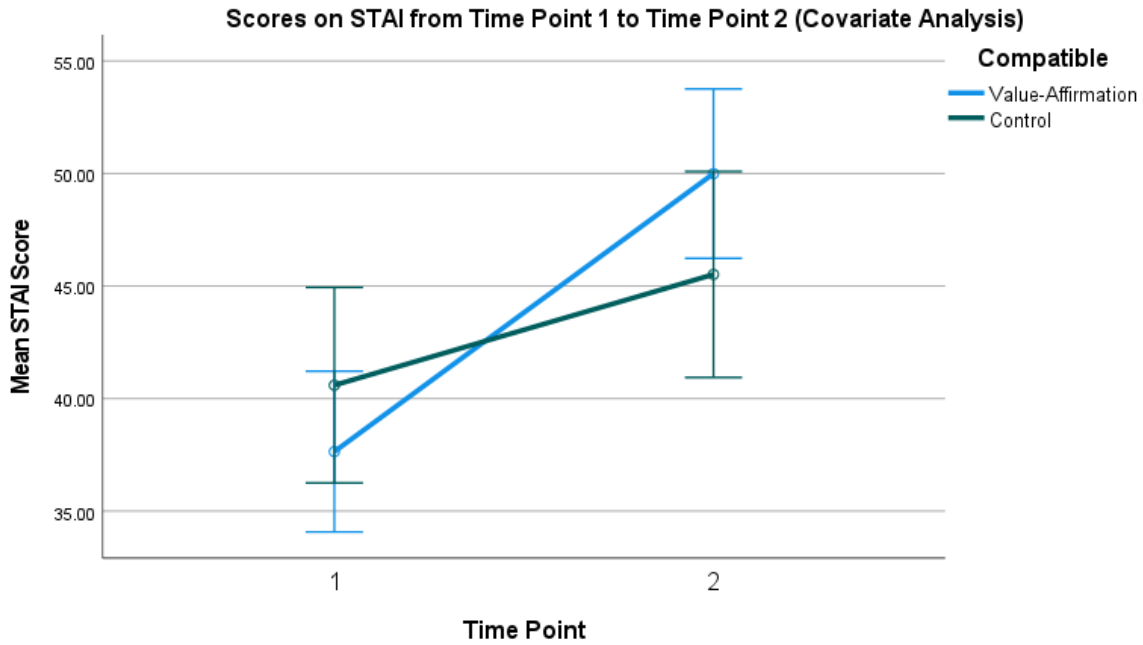
Scores on STAI from Time Point 1 to Time Point 2 (Covariate Analysis)
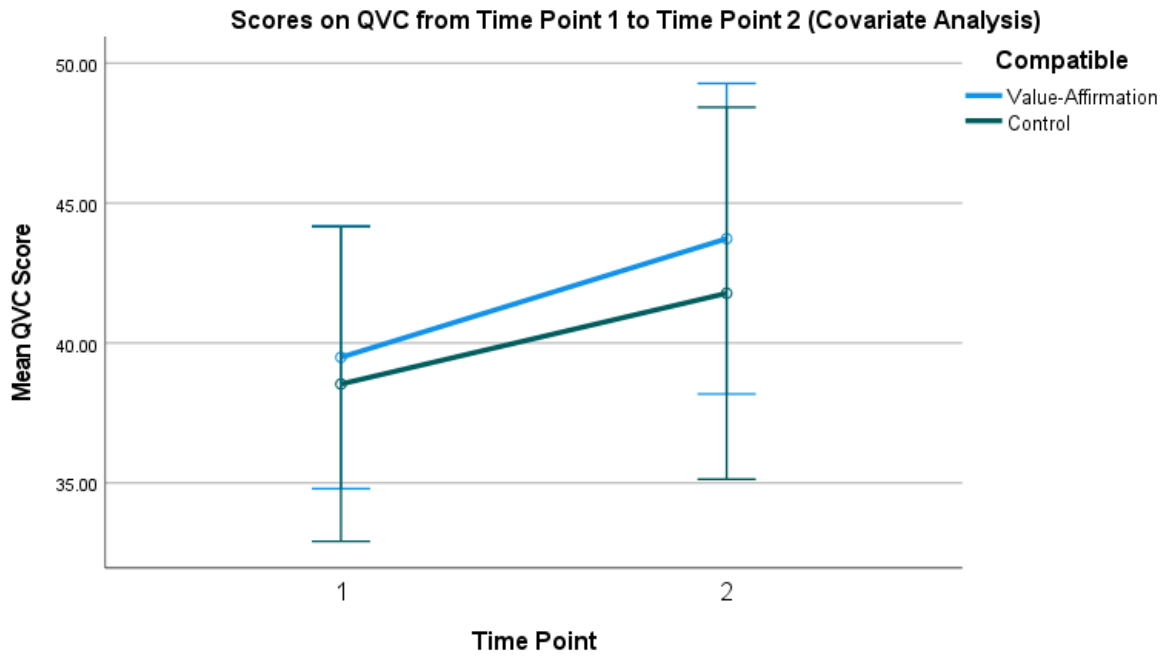
Note. Covariates appearing in the model are evaluated at the following values: intoxication =

.31; whether participants completed the writing portion after 5 minutes = .50. Error bars are set

at 95% confidence intervals.

Appendix G

Figure 4

Scores on QVC from Time Point 1 to Time Point 2 (Covariate Analysis)

Note. Covariates appearing in the model are evaluated at the following values: intoxication = .30; whether participants completed the writing portion after 5 minutes = .49. Error bars are set at 95% confidence intervals.