An Initial Investigation of Tanning-Related Cues and the Effect

On Demand and Craving for Ultra-Violet Indoor Tanning

By

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Abstract

Melanoma and other skin cancers have become the most commonly diagnosed cancers in the United States. Despite the well-established link between skin cancer and ultra-violet indoor tanning (UVIT), approximately 30 million Americans report engaging in UVIT each year, and the majority of these users are white females aged 16 to 29 years. Although some studies have suggested that exposure to UV radiation may produce reinforcing effects in frequent tanners paralleling the signs and symptoms of substance use disorders, no previous study has explored the impact of tanning-related cues on demand for tanning. The aim of the present study was to examine the effects of tanning-related cues on participants' behavioral economic demand and craving for UVIT. Participants were 23 undergraduate students (22 females, 1 male) recruited from introductory courses in Applied Behavioral Science at the University of Kansas. Each participant underwent a cue-exposure procedure consisting of experiencing neutral- and tanning-related cues. Results suggest that, at the aggregate level and predominantly at the level of the individual, behavioral economic demand and self-reported craving were relatively greater in the condition with the tanning cues. Behavioral interpretations of demand and craving are suggested and implications for public policy level interventions (e.g., excise taxes and imposed constraints on tanning advertisements) are further discussed.

Keywords: UVIT, behavioral economics, craving, tanning, cues

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An Initial Investigation of Tanning-Related Cues and the Effect On the Demand and Craving for Ultra-Violet Indoor Tanning

A new "Bronze Age" has dawned across America and much of the modernized world. Each year, approximately 7.8 million women and 1.9 million men in the United States engage in ultra-violet indoor tanning (UVIT; Guy, Berkowitz, Holman, & Hartman, 2015). Of those tanners, nearly one-third are non-Hispanic white women aged 16-25 years (U.S. Department of Health and Human Services, 2014; Guy, Berkowitz, Watson, Holman, & Richardson, 2013). The widespread use of UVIT has become a public health concern especially given its association with skin cancer (U.S. Department of Health and Human Services, 2014). Perhaps most alarming, for individuals under the age of 35, it is estimated that their melanoma risk will increase by 75% with their first UVIT use (Boniol, Autier, Boyle, & Gandini, 2012); for users under the age of 25 – more than 50% of all UVIT users (Wehner et al., 2014) – the risk will increase by up to 102% (Wehner et al., 2012). Each additional UVIT use will increase the risk of melanoma by nearly 2% (Boniol et al., 2012). It is further estimated that the number of melanoma diagnoses attributable to UVIT – the third most common and most lethal form of skin cancer (Fisher & James, 2010; Levine, Sorace, Spencer, & Siegel, 2005) – now outweighs the number of lung cancer attributable to smoking (Wehner et al., 2014). Some researchers (Heckman & Manne, 2012) are colloquially referring to the extreme cases of this addiction as *tanorexia*.

Despite the well documented risks associated with UVIT, the tanning industry remains a lucrative multi-billion-dollar industry and is continuing to grow (Bizzozero, 2008); public health experts surmise that much of the popularity can be attributed to advertising techniques mirroring those of the tobacco industry (Holman et al., 2013; Sinclair & Makin, 2013). Indeed, Greenman and Jones (2010) compared the advertising techniques of the indoor tanning and tobacco

industries and concluded that both industries have relied on similar strategies. Consider that advertisements from these industries commonly feature medical professionals for mitigating health concerns. For example, early advertisements for cigarettes featured individuals in medical garb and captions stating how their particular cigarette brand diminished throat irritation or other minor effects. Similarly, some advertisements from the tanning industry feature images of medical professionals and captions that highlight the benefits of obtaining vitamin D from UVIT. Other advertisement campaigns attempt to appeal to a sense of social acceptance. Both industries commonly present images of young, healthy, smiling models. Other advertisement campaigns are aimed at emphasizing psychotropic effects of their products. These advertisements aim to portray the products as sources of pleasure and happiness. Finally, both industries target specific populations, primarily young adults.

The similarities between the tobacco and tanning industries do not end with advertisements. According to Sinclair and Makin (2013), both industries (a) support third-party advocacy groups and lobbyists that advance the industry's interests, (b) offer products or services that lead to potentially negative health outcomes, and (c) provide products or services that can be addictive (see U.S. Department of Health and Human Services, 2012 for the addictive properties of tobacco products and Kourosh, Harrington, & Adinoff, 2010 and U.S. Department of Health and Human Services, 2014 for the addictive properties of tanning services). Although research suggesting tobacco use is addictive is well-established (U.S. Department of Health and Human Services, 2012), recent studies on UVIT are suggesting that "many frequent tanners show signs and symptoms of addiction similar to those used as criteria for substance abuse or dependence" (Sinclair & Makin, 2013, p E28).

In 2004, Feldman and colleagues investigated whether UV exposure produced a physiologic reinforcing effect. In their study, a total of 14 participants who used tanning beds regularly (defined as between 8 and 15 times per month) were exposed to standard UV-emitting tanning beds as well as tanning beds equipped with UV-filters. In their study, each participant was randomly exposed to one of the two tanning beds twice a week for six weeks. The two tanning beds were identical with the exception that one contained acrylic filters preventing the emission of UV radiation. The filters were unnoticeable and the transparency provided the same heat distribution to the participants as the standard bed. The primary dependent measure was the percentage of opportunities participants chose the UV tanning bed over the non-UV tanning bed. After exposure to UV and non-UV blinded conditions, results suggest that frequent tanners selected the standard tanning bed without the UV-blocking filters, which suggests that frequent tanners are able to distinguish between the two tanning beds. Participants reported relaxation associated with the tanning bed that produced UV exposure, suggesting that UV radiation is detectable and yields a positive effect on mood that might reinforce tanning behavior.

In a similar study, Kaur et al. (2006) examined whether naltrexone, an opioid antagonist, blocked the reinforcing effects of UV exposure in eight frequent tanners and eight infrequent tanners. The researchers hypothesized that naltrexone would block the effect of UV exposure if cutaneous endorphins are indeed involved. The participants underwent a similar procedure to the one used by Feldman et al. (2004), except that this study also examined the effects of an escalating dose of naltrexone in conjunction with a placebo-controlled administration. Interestingly, the study was stopped when 4 out of the 8 frequent tanners exhibited withdrawal symptoms including nausea and jitteriness after being administered naltrexone. Their study

provides further evidence that the reinforcing effects of UV exposure are, in certain ways, similar to those effects reported in studies with pharmacologically addictive substances.

A survey study conducted in 2005 by Warthan and colleagues reported that 26% of 145 beachgoers met criteria for UVIT addiction, and 53% of respondents met several criteria for a substance use disorder (SUD) diagnosis on the *Diagnostic and Statistical Manual of Mental Disorders* (*Fourth Edition, Text Revision; DSM-IV-TR*). Interestingly, other studies suggest UVIT users have greater tendencies to engage in various risk behaviors such as alcohol and marijuana use (Mosher & Danoff-Burg, 2010), use of tobacco, binge drinking, steroid use, and report greater tendency of having multiple sexual partners (Guy et al., 2014).

Given the similarities between UVIT and commodities with the potential of being abused (Mosher & Danoff-Burg, 2010; Sinclair & Makin, 2013), the question remains: Do frequent tanners *crave* UVIT? According to a recent review by Sofis, Jarmolowicz, and Martin (2014), drug craving is typically described from the classical conditioning framework. Cue-reactivity paradigms are used to evaluate drug craving via physiological responses and subjective craving scales, which are typically assessed before and after cue exposure. Although assessments of subjective craving provide information regarding the moment-to-moment fluctuations in motivation, Sofis et al. argue that an over-reliance on the classical conditioning framework emphasizing the close temporal proximity of responses and cues leaves "no explanation for events that occur outside the small temporal window" (p. 88). They propose a different approach to cue-reactivity research; specifically, one that integrates behavioral and neuroeconomic methods and utilizes single-subject methodology.

The cue-reactivity paradigm has been popular in addiction research for nearly 25 years (Reynolds & Monti, 2013). Cue-reactivity research typically consists of exposing drug users to

neutral stimuli and drug-related stimuli. Reactivity to cues is commonly assessed using subjective measures (e.g., self-reported craving), physiological measures (e.g., heart rate, skin conductance, salivation), and, to a lesser extent, behavioral measures (e.g., latency of engaging in drug use, number of responses emitted to gain access to drug use and subsequent amount consumed; Reynolds & Monti, 2013). More recently, advances in neuroimaging methods and technology allow for the study of reactivity in brain regions following cue exposure. Generally, cue reactivity studies demonstrate changes in autonomic and physiological functioning and increases in self-reported craving and consumption in the presence of drug-related cues (Carter & Tiffany, 1999; Reynolds & Monti, 2013). Specifically, in their meta-analysis on cue-reactivity, Carter and Tiffany (1999) report larger effects in self-reported craving relative to physiological responses, suggesting that physiological responding is less influenced by cue exposure. Thus, according to Reynolds & Monti (2013), cue-reactivity research may be useful for promoting basic phenomenology related to addiction, evaluating treatment efficacy, and prescribing specific interventions to meet individual's needs.

In spite of the promising utility of cue-reactivity research, several issues related to cue-reactivity research ought to be addressed. First, Conklin and Tiffany (2002) report that some findings across studies have been inconsistent. A possible explanation for inconsistencies lies in the variability of cue-reactivity methods, specifically regarding the modality of cue presentation (e.g., *in vivo*, audio, video, pictorial, virtual reality), qualitative differences in cues, differences in reactivity measurements, differences in individuals' substance use factors (e.g., polydrug use, deprivation), and even the presentation order of the cues (see Reynolds & Monti, 2013). To address the last concern, Reynolds and Monti proffer, "The recommended approach in cue reactivity research is to use both drug-related and neutral control stimuli… rather than solely

comparing drug cue responses to a pre-stimulus baseline" (p. 387). Sayette, Griffin, and Sayers (2010) report that researchers commonly counterbalance the order of cue presentation, but the limitation of this strategy is the possibility of carryover effects. Monti et al. (1987) reported initial evidence of carryover effects when drug-related cues (alcohol cues) were presented before the neutral-cues. That is, cravings and urges do not always dissipate after cue exposure. As a result, Monti et al. (1987) advise the presentation of neutral-cues prior to drug-related cues (see Sayette, Griffin, & Sayers, 2010 for a discussion and suggestions for the presentation order of cues in the cue-reactivity paradigm).

The aforementioned studies on the reinforcing properties of UV exposure, along with the greater tendency of engaging in multiple risk behaviors, warrant further examination within the lens of a behavioral economic framework – namely, the reinforcement pathology model of addiction. The reinforcement pathology model (Bickel, Jarmolowicz, Mueller, & Gatchalian, 2011; Bickel, Johnson, Koffarnus, MacKillop, & Murphy, 2014) states that, relative to control populations, people with commodity-specific dependence tend to (a) overvalue the commodity and (b) excessively value the immediate access to the commodity despite the possibility of delayed outcomes. For example, a chronic drinker exhibits a relatively high value, or demand, for alcohol. Within a behavioral economic framework this means that the drinker defends their consumption of alcohol even when facing increasing constraints (e.g., increasing price of alcohol). Additionally, a chronic drinker is likely to prefer immediate access to alcohol at the expense of obtaining larger yet delayed rewards.

Behavioral economics integrates behavioral psychology and microeconomic theory in the study of risky health behavior and substance use disorders (Bickel, Jarmolowicz, Mueller, & Gatchalian, 2011; Bickel, Johnson, Koffarnus, MacKillop, & Murphy, 2014; Bickel &

Vuchinich, 2000; Jarmolowicz, Reed, DiGennaro Reed, & Bickel, 2016; MacKillop, 2016). The behavioral economic approach of quantifying demand is of particular interest in this paper. According to the law of demand, relative consumption of a commodity will decrease when forms of constraint are introduced (Samuelson & Nordhaus, 1985). Demand for a commodity, or reinforcer, is typically assessed by measuring consumption of a reinforcer as a function of increasing constraints, or price of the reinforcer (e.g., lever presses, monetary prices; Hursh & Roma, 2013; Hursh & Silberberg, 2008; Reed, Kaplan, & Becirevic, 2015). Thus,

> The term *demand* may be defined as the extent to which an organism defends consumption of a reinforcer in the face of the aforementioned constraints….Reinforcer demand is a multifaceted variable that entails the collective analysis of myriad components and analyses/parameters, each telling one part of the story. As such, demand may be conceptualized as a molar measure of reinforcer efficacy. (Reed et al., 2015, p. 280).

If the goal is to study behavior within the context of the environment, then traditional operant methods will likely suffice. However, if the goal is to extensively study the reinforcer and its role within the context of consumer demand, then the behavioral economic framework and demand curve analyses become invaluable tools. The demand curve analysis entails a parametric approach to evaluating consumption of a reinforcer (the dependent variable). The manipulations of the reinforcer cost serve as the independent variables within a parametric design, a form of within-subject design (Johnston & Pennypacker, 2009) that is particularly useful in evaluating the reinforcing efficacy of a commodity as a function of changes in the independent variable. According to the law of demand, consumption of the commodity when it is freely available describes the maximum demand for the reinforcer, and behavioral economists describe this portion of the demand curve as *inelastic* demand. *Elastic* demand, on the other hand, is defined as proportionally greater decreases in consumption relative to increases in constraints (Hursh &

Silberberg, 2008; Reed et al., 2015) as indicated by a prototypic demand curve in Figure 1. The Hursh and Silberberg (2008) exponential demand model and the different parameters of the demand curve are further discussed below.

Although demand curve assessments are useful for identifying relative reinforcer efficacy, traditional assessments of demand carry several limitations. For example, (a) it may require several repeated sessions over a long period of time to assess demand; (b) the demand assessment for illicit or controlled substances (e.g., heroin, alcohol) can pose a danger to the participant – especially if consumed in large quantities at low unit prices (e.g., FR 1); (c) the demand assessment may be impractical or even impossible, "as is the case in studies of public policy interventions where repeated administration is infeasible, costly, or likely to produce social unrest" (Reed et al., 2015). Thus, behavioral economists have turned to the *hypothetical purchase task* (HPT).

The HPT was first used by Jacobs and Bickel (1999) to assess the demand for hypothetical cigarettes and heroin as a function of increasing prices in opioid dependent users. In their study, researchers asked participants to imagine they were not receiving any drug abstinence treatment, that they had no other means of acquiring cigarettes or heroin, and that any cigarettes or heroin purchased had to be used by them alone within 24 hours. The HPT questionnaire presented a total of 15 prices ranging from $0.01 to $1,120, and participants were asked to report the number of cigarettes and bags of heroin that they would hypothetically purchase. Although interesting, this self-report nature of the HPT should be interpreted with caution. In their seminal article, Baer, Wolf, and Risley (1968) state: "A subject's verbal description of his own non-verbal behavior usually would not be accepted as a measure of his actual behavior unless it were independently substantiated" (p. 93). Fortunately, several studies

thereafter (MacKillop & Murphy, 2007; MacKillop et al., 2008; MacKillop et al., 2010; Madden & Kalman, 2010) have demonstrated the importance and utility of data obtained from HPTs. In short, these studies have demonstrated the predictive nature of HPTs, as well as the concurrent and convergent validities between demand obtained from HPTs and experiential tasks. Thus, reporting consumption in an HPT *is* a behavior in and of itself, or as Odum (2011) described, "The choice is not hypothetical, only the rewards" (p. 430).

As promising as the HPT is for assessing the reinforcing efficacy of a commodity, only a few studies have used HPTs within a cue-induced craving paradigm. MacKillop, Menges, McGeary, and Lisman (2007) investigated the effects of craving induction and the DRD4 VNTR genotype of 35 heavy drinkers' relative value for alcohol. Participants were randomly assigned to experience either personally relevant alcohol cues or neutral cues. Participants in both conditions completed a relative value of alcohol task immediately following cue exposure. The relative value of alcohol task consisted of 9 dichotomous choices between a 1.5 oz. sip of the participant's favorite beer and a monetary amount. The monetary amounts ranged between $0.01 and $5.00. All participants began the task by making a choice between a 1.5 oz. sip of their favorite beer and $1.00. The amount of money in all subsequent choice conditions adjusted based on the participant's previous choice. Relative value of alcohol was defined as the crossover point at which the participant's change in preference switched from alcohol to money and vice versa. Participants were provided with the total amount of actual alcohol and/or money based on their choices on the relative value of alcohol task. Results indicate that craving induction yields a significant increase in subjective craving assessed via a single item, 100-point Likert-type scale reflecting the urge to drink. Cue induction, however, was not associated with greater relative value of alcohol. It is possible that the null effect of craving induction on the relative value of

alcohol is attributed to several methodological considerations. For example, the relative value of alcohol task was designed to be short (duration of about 90 s) and provided a maximum of one standard alcoholic beverage which likely had relatively limited psychoactive effects.

In a systematic replication on cue induced craving, MacKillop et al. (2010) recruited 92 heavy drinkers and investigated cue-induced craving using a one-way within-subject design where each participant underwent exposures to neutral cues consisting of water and alcohol cues, in that order. An alcohol purchase task (APT) was used to assess alcohol demand across a set of 19 prices ranging from $0 (free) to $1120 per standard drink. Standard drinks consisted of 12 oz. beers, 5. oz. wine, and 1.5 oz. shots of hard liquor or mixed drinks containing one shot of liquor. The procedure was similar to that of MacKillop et al. (2007) except that the participants did not receive any actual drinks for consumption. Results suggest relatively greater self-reported craving following exposure to alcohol cues, but the findings were mixed for the indices of alcohol demand. Despite that not all of the behavioral economic demand indices changed as a result of alcohol cue exposure, participants reported they would (a) drink more when the beverages were free (Q_0), (b) spend more money on alcohol (O_{max}), and (c) persist in purchasing alcohol even at high prices (breakpoint). Additionally, alcohol cue exposure resulted in an increase in the normalized price (normalized P_{max}; the price at which the elasticity of consumption decreases at a higher rate than the rate at which prices increase).

In 2012, Amlung and colleagues investigated the correspondence between choices on an APT and choices for actual drinking behavior. A collateral goal of their study was to examine the effects of alcohol cues on APT performance. Forty-one heavy-drinking adults completed APTs for hypothetical and actual alcohol and money, and participated in an alcohol cue-reactivity paradigm. The cue exposure experiments typically proceed as follows: the participant (1)

provides baseline levels of heart rate/blood pressure and completes a demographics questionnaire along with other motivation assessments including craving questionnaires; (2) is then exposed to neutral cues (e.g., water in place of alcohol); (3) completes a HPT in the neutral condition; (4) is then exposed to the drug cues (e.g., participant's typically consumed alcoholic beverage, bar environment containing alcohol related decorations, dimmed lights); (5) and finally completes the HPT in the cue condition. In their study, Amlung and colleagues provided each participant the opportunity to consume beverages (i.e., randomized outcome from APT was actually presented such that the participant was given actual money and consumed their actual, preferred alcoholic beverage). It is important to note that each participant experienced the conditions in the same sequence, because previous studies have consistently demonstrated carryover effects such that the effects from the drug-cue condition carryover into the neutral-cue condition (MacKillop & Lisman, 2005, 2008; Monti et al., 1987). Amlung and colleagues report that, compared to neutral cues, alcohol cues produced a trend level increase in intensity (Q_0; consumption when the commodity is free), but found no significant increases in the other behavioral economic indices (e.g., $P_{max,}$ O_{max}, breakpoint). Interestingly, alcohol cues also significantly increased subjective craving, as measured using the validated Alcohol Urge Questionnaire (AUQ; Bohn, Krahn, & Staehler, 1995).

Amlung et al. (2015) recently proposed another approach for assessing alcohol craving and demand where they compared the behavioral economic demand indices obtained from the standard APT assessment to that of a brief version of the APT. The brief version, referred to as alcohol demand single item assessment, consists of items relating to demand intensity (Q_0), breakpoint, and maximum expenditure (O_{max}). For example, the brief version of the APT assesses demand intensity with, "If drinks were free, how many drinks would you have right

now?"; assesses breakpoint with, "What is the maximum amount that you would pay for a single drink right now?"; and maximum expenditure with, "What is the maximum total amount that you would spend on drinking right now?" Subjective craving was assessed on a 100-point visual analog scale asking, "How much do you want a drink right now?" (p. 3). The experimental design entailed a double-blind, between-subjects study where participants experienced either an alcohol, a placebo, or a control condition. Although participants in the alcohol and placebo groups anticipated consuming alcohol, only those in the alcohol group actually consumed alcohol (190-proof grain alcohol mixed with orange juice) while those in the placebo group only consumed orange juice. The control group did not anticipate alcohol and consumed only orange juice. All participants in each of the three groups completed a subjective craving questionnaire and the alcohol demand single item assessment during five points in the study: (a) baseline, (b) immediately following consumption, (c) ascending breath alcohol concentration (BrAC), (d) peak BrAC, and (e) descending BrAC. Results suggest that moderate doses of alcohol significantly increased participants' reported number of drinks when drinks were free (Q_0), and the maximum amount that participants would pay for a single drink (breakpoint). Subjective craving and maximum expenditure (O_{max}) also increased in the group receiving alcohol, albeit to a lesser extent. The three indices (Q_0, breakpoint, and O_{max}) obtained from the alcohol demand single item assessment were significantly associated with those from the APT, thus demonstrating the utility of a new, relatively quick assessment.

To date, only a couple studies have examined the effects of cues between real and hypothetical purchases of tobacco. First, MacKillop, Brown, Stojek, Murphy, Sweet, and Niaura (2012) examined the effects of acute nicotine withdrawal and cigarette cues on craving and cigarette demand in a sample of 33 non-treatment seeking smokers. Participants were first

exposed to neutral cues (e.g., removing a small golf pencil from a box of pencils, manipulating it, holding it, and writing with the pencil on a pad of paper), followed by tobacco cues (e.g., opening an unopened pack of cigarettes, removing one cigarette, placing it in their mouth, lighting the cigarette with a lighter, holding cigarette), and then completed a battery of assessments related to affect, psychophysiological arousal, subjective craving, and behavioral economic demand for cigarettes. The cigarette purchase task (CPT) consisted of 22 prices ranging from $0 to $10 and, to ensure honest responding on the CPT, participants were told that they "had a $10 'tab' that they could either keep as cash or allocate toward up to 10 cigarettes during the self-administration period" (MacKillop et al., 2012, p. 3) where the actual amount of money and cigarettes was determined randomly. Results suggest that nicotine withdrawal induced a significant increase in P_{max} and breakpoint while cigarette cues elicited greater demand for cigarettes (i.e., lower elasticity). Second, Acker and MacKillop (2013) replicated the effect of cigarette cues on behavioral economic demand (i.e., elasticity) with 47 participants using an immersive virtual reality (VR) cue-reactivity paradigm. Participants viewed neutral cues consisting of 3 min clips of two narrated on a flat-screen TV and then viewed cigarette cues (e.g., ashtrays, preferred brand of cigarettes, burning cigarettes, lighters) presented via a head-mounted display (i.e., Z800 3D Visor, eMagin Corporation), a pair of headphones that simulated environmental sounds, and a smell machine (Scent Palette, Headhunter 2000) that generated scents to stimulate olfactory sensation. Subjective craving, affect, and demand were assessed immediately after the cue exposure. Demand was assessed using a CPT with 18 prices ranging from $0 to $5 per cigarette and each price was accompanied by corresponding pack prices. Although Acker and MacKillop's finding that tobacco-related cues increase demand (i.e., lower elasticity) directly replicates MacKillop et al. (2012), Acker and Mackillop also report increases

in O_{max} and breakpoint, suggesting that the procedure in MacKillop et al. (2012) may have masked some cue effects.

Despite the promising research using the cue-reactivity paradigm and behavioral economic framework with alcohol and tobacco, no studies to my knowledge have examined the cue-induced effects on craving and demand for UVIT. The goal of the present study is to identify the cues typically found in a tanning salon and to examine the extent to which UVIT users demonstrate a relatively higher demand for tanning in the presence of tanning-related cues than neutral cues. Specifically, the first part of this study entailed a focus group consisting of people who reported tanning previously. Speaking with individuals who have previously tanned would help identify some of the specific tanning-related cues for the second part of the study. In the second part of the study I sought to investigate demand for tanning using a tanning-specific HPT (Tanning Purchase Task [TPT]) within the tanning cue-reactivity paradigm adapted from the Amlung et al. procedure (2012). I hypothesized exposure to tanning cues would result in an increase in demand for tanning, as indicated by the various indices of demand (explained below). Put simply, I expected that demand for tanning would be relatively inelastic (i.e., participants persist in purchasing hypothetical tanning sessions over the course of 30 days despite increases in price) when tanning cues were present rather than when tanning cues are absent. In sum, the overall aims of this study were to explore the reinforcer efficacy of tanning and to investigate the sensitivity of craving within the context of tanning cues.

Preliminary Focus Group Study

Participants, Setting, and Materials

Eight Caucasian females participated in an informal focus group that lasted about 1 hour. The individuals who participated in the focus group did not participate in the cue-reactivity

portion of the study. The focus group was designed so that individuals who are familiar with UVIT could inform the researchers about tanning salons, tanning-related stimuli, and tanning behaviors. I recruited focus group participants from the Introduction to Applied Behavioral Science course at the University of Kansas; these participants received 0.5% of extra credit toward their overall grade. Although no demographic information was collected from the eight participants (except for the name for the purpose of granting extra credit), all participants were considered to be about the average age of the typical undergraduate students in the introductory course. The questionnaire for the focus group was also approved by the University of Kansas Human Subjects Committee (HSCL #00001355; Appendix A).

The setting of the focus group was in a conference room in the Dole Human Development Center at the University of Kansas. The conference room contained a large table with several chairs. The participants and three experimenters (including the primary investigator) were seated around the table. The participants were informed to not disclose their personal experiences regarding tanning, but to respond as if describing the experiences of an "average" person engaging in UVIT. Participants were encouraged to converse freely with the other people in the room (including the three experimenters). The experimenters asked many (but not all) of the open-ended questions shown in Appendix B due to time constraints. The experimenters recorded notes on notepads and a laptop as the participants freely talked about the "average" persons' experience with UVIT.

Cue-Reactivity Study

Methods

Participants. I recruited participants from courses in the Department of Applied Behavioral Science at the University of Kansas. I used inclusion criteria to identify participants whom: (1) were 18+ years of age, (2) reported use of an indoor tanning device at least twice in the previous year[1], and (3) reported no history of an allergic reaction to tanning lotion or bronzer. Twenty-two females and one male (M_{age} = 20.1, *SD* = 1.8) participated in the study. Participants were compensated with 0.5% extra credit toward the course from which they were recruited. I informed participants that participation was voluntary and that the information they provided was completely confidential. The University of Kansas Human Subjects Committee approved all procedures (HSCL #00001355; Appendix A).

Materials. I administered all survey tasks were presented using *Qualtrics Online Survey Software* (http://www.qualtrics.com/) on Dell® OptiPlex computers and monitors (50.8 cm diagonal). The study began with an informed consent page and an agreement form where the participant acknowledged that he or she was at least 18 years of age or older, has used indoor tanning devices at least two times in the previous year, has no history of allergic reactions to tanning lotions, and is aware of the possibility of experiencing some minor skin irritation during the study (see Appendices A and C, respectively).

All questionnaires described below were identical in both conditions (i.e., neutral- and tanning-cue conditions) except the neutral-cue condition also included a math problem task at the very end of the survey (see Appendix D). The purpose of the math problem task was to increase

[1] Although Feldman et al. (2004) and Kaur et al. (2006) reported recruiting participants that have tanned 8-15 times a month (frequent tanners) or having used tanning beds no more than 12 times in a year (infrequent tanners), the inclusionary criteria was much less restrictive in the current study due to its exploratory nature and the goals of investigating changes in demand and craving for tanning.

the period of time between the two conditions, thus decreasing the likelihood of the participant responding identically in both conditions. I did not program consequences for answering correctly or incorrectly on the math problem task. All statistical tests were conducted using GraphPad Prism® 7.00 for Microsoft® and IBM® SPSS® Statistics Version 23.0.0.0 for Windows.

Demographics Questionnaire and Tanning Demographic Questionnaire. The demographics questionnaire consisted of general demographic-related questions (e.g., gender, race, age, annual household income; see Appendix E), and the remainder of the questions were related to UVIT. The questions related to tanning included the Fitzpatrick Skin Type assessment (i.e., a standard measure with good psychometric properties on skin type based on questions about the skin's likelihood of burning and tanning; Fitzpatrick, 1988), the 4-item tanning-specific CAGE scale used to assess problematic tanning and/or tanning dependence (mCAGE; see Ashrafioun & Bonar, 2014), and other questions related to tanning behavior based on the modified *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (m*DSM-IV-TR*; see Appendix E). Participants were classified as "At Risk" for tanning dependence if they scored positive on either the mCAGE (at least two affirmative responses) or on the m*DSM-IV-TR* where they scored affirmative on two subparts: (1) response was scored affirmative for answering "yes" to both "*Do you think you need to spend more time using the tanning device to maintain your perfect tan?*" and "*Do you think your tan will fade if you spend the same amount of time using the tanning device each time?*"; (2) a response was scored affirmative for any response other than 0 for the following question: "*How many days a week do you visit tanning salons*?" (see Ashrafioun & Bonar, 2014; Mosher & Danoff-Burg, 2010; Warthan, Uchida, & Wagner, 2005).

Tanning Purchase Task (TPT). The hypothetical purchase task (HPT) assesses the hypothetical consumption of a commodity across a range of prices (Jacobs & Bickel, 1999). The survey instructions presented the following statement at the onset of the tanning purchase task (TPT):

> Imagine you live in an area with only one indoor tanning salon and no other way to artificially tan. The following questions ask how many times you would pay to use an indoor tanning bed in the next 30 days (1 month from today). Imagine: (1) Your income/savings is equal to what you have in reality, right now; (2) The tanning bed you can access is the same model and level of bed that you typically use; (3) You can tan for a maximum of 20 minutes each day; (4) You can use a tanning bed once per day, 30 days per month; (5) Payments for use of the tanning bed must come from you, and you alone. There are no "right" or "wrong" responses. Please answer all questions honestly, thoughtfully, and to the best of your understanding, as if you were actually in this situation.

Immediately following the instructions, the survey presented the following question: "How many times would you pay to use an indoor tanning bed per month if each use cost…? (Please use numeric responses between 0 and 30)."[2] The TPT assessed the frequency of purchasing a 20-minute UVIT session as the cost of the tanning sessions increased across 18 prices (in U.S. dollars): $0 (free), $1, $2, $5, $10, $15, $20, $30, $40, $50, $60, $70, $80, $90, $100, $150, $300, and $600; participants made decisions for each of the 18 discrete prices. Appendices F and G depict the assumptions of the TPTs exactly as they appeared to the participants in the neutral- and tanning-cue conditions, respectively.

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[2] The upper boundary was set to 30 to reflect the maximum number of tanning sessions in a 30-day period as per the U.S. Food and Drug Administration's regulation that prohibits individuals from engaging in UVIT more than once in a 24-hr period (http://www.fda.gov/radiation-emittingproducts/radiationemittingproductsandprocedures/tanning/default.htm).

Neutral-Cue Condition. The neutral-cue condition consisted of a 2.2 m by 2.0 m room that was adjoined to an observation booth of the same dimensions by a panel of mirrored glass. The neutral-cue room contained a chair and table, three samples of unscented hypoallergenic body lotion (i.e., *Aveeno, Vaseline,* blend of the two lotions), a small box of facial tissues, hand sanitizer, a Dell® computer monitor (50.8 cm diagonal), a standard keyboard, a computer mouse, a set of two speakers placed on each side of the monitor, two *Science* magazines placed on a small stand in the corner of the room, two large posters (one depicting the world map and the other depicting a map of the United States), and a small white-noise machine that was unobtrusively placed under the table (see Figure 2, panel A).

Tanning-Cue Condition. The tanning-cue condition was set in a room identical in size to the room of the neutral-cue condition. In lieu of neutral cues, this room contained stimuli similar to those found in a tanning salon and informed by the focus group in the preliminary study. Specifically, as identified during the focus group, the tanning-related stimuli for the tanning-cue condition ultimately included a sample of three scented tanning lotions, a box of facial tissues, hand sanitizer, a beach-scene displayed across two walls (opposite side of the room from the one-way mirror), two posters promoting tanning (e.g., popular tanning lotion company posters depicting tan women in bikinis), two fitness magazines placed on a small stool in the corner of the room, a small shelf with neatly folded orange towels, a tanning pillow, tanning goggles, a clear bowl with an assortment of tanning stickers (e.g., palm trees, playboy bunny logo), blue-LED lights mounted on the upper and bottom portions of the Dell® computer monitor (50.8 cm diagonal), a blue-halogen lamp placed in the upper corner of the room (adjacent to the door), a keyboard, a computer mouse, computer speakers on each side of the

monitor, and a space heater placed unobtrusively underneath the table at which the participant was seated (see Figure 2, panel B).

Subjective Craving Questionnaires

Modified-Craving to Tan Questionnaire (mCTQ). The Craving to Tan Questionnaire (CTQ; Ashrafioun & Bonar, 2015) consists of five items that assess individuals' frequency, intensity, and duration of tanning urges during the last week. According to Ashrafioun and Bonar (2015), the CTQ has excellent internal consistency, convergent validity, and construct validity. The directions for the CTQ state: "*The questions in this form apply to the last week that you engaged in any tanning. Please indicate the answer that best fits how you felt during that time.*" Each of the five items contain seven possible choices, and the choices differ depending on the specific item. For example, the item that asks: "*At its most severe point, how strong was your craving to tan during this period*?" consists of options ranging from "*None at all*" to "*Strong urge and would have tanned if possible.*"

For the purpose of the current study, I modified the CTQ (*m*CTQ) to entail only three questions. Specifically, I omitted items 1 and 3 ("*How often have you thought about tanning or how good tanning would make you feel during this period?*" and "*How much time did you spend thinking about tanning?*") because the options for these items included durations that were outside of the scope of this study (e.g., "*Nearly all of the time, that is, more than 40 times during this period or more than 6 times a day*"). The *m*CTQ designed for the purpose of the current study consisted of the remaining three items: (1) "*At its most severe point, how strong was your craving to tan during the last five minutes today?*", (2) "*How difficult would it have been to resist tanning during this period of time if you had the chance to do so?*", and (3) "*Keeping in mind your responses to the previous questions on this page, please rate your overall average craving*

to tan in the last five minutes today." The phrase "*last five minutes today*" was used for items 1 and 3 because the degree of cue exposure was presumably most salient during this period (e.g., the participant was instructed to apply lotion to their hands).

Modified-Questionnaire on Tanning Urges (mQTU). The modified-Questionnaire on Tanning Urges (*m*QTU) was exclusively used for this study and adapted from the Questionnaire on Smoking Urges-Brief (QSU-Brief; Cox, Tiffany, & Christen, 2001) – a widely used scale for assessing cigarette smokers' urges to smoke. The scale consisted of items such as, "*I have a desire for tanning right now*", "*Nothing would be better than tanning right now*", and "*If it were possible I would probably tan right now*". Each of the items was scored on a 7-point Likert scale ranging from *strongly disagree* to *strongly agree*.

Modified-Mood and Physical Symptoms Scale (mMPSS). Craving was also assessed using the modified-Mood and Physical Symptoms Scale (*m*MPSS). The original MPSS assesses cigarette craving and consists of two items: "*How much of the time have you felt the urge to smoke today?*" and "*How strong have the urges been today?*" (West & Ussher, 2010). Both items consist of a 6-point Likert scale ranging from "*not at all*" to "*all the time*" and "*no urges*" to "*extremely strong*", respectively. A composite score for the MPSS is obtained by averaging the two items. According to West and Ussher (2010), the MPSS and the Shiffman Scale (SS; described below) were the only scales to show somewhat lower sensitivity to cigarette abstinence. For the purpose of the present study, I modified the scale to include: "*How much of the time have you felt the urge to tan today?*" and "*How strong have the urges been today?*"

Modified-Tanning Withdrawal Scale (mTWS). Akin to the scales described above, the modified-Tanning Withdrawal Scale (*m*TWS) was exclusively designed and used for the present study. I adapted the scale from the Wisconsin Smoking Withdrawal Scale (WSWS; described in

West & Ussher, 2010). The *m*TWS consisted of four questions, scored on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*. The four-item scale included the following four statements: (1) "*I have frequent urges to tan*"; (2) "*I have been bothered by the desire to tan*"; (3) "*I have thought about tanning a lot*"; and (4) "*I have trouble getting tanning off my mind*."

Modified-Tanning Withdrawal Scale #2 (mTWS2). The modified-Tanning Withdrawal Scale #2 (*m*TWS2) was adapted from the Cigarette Withdrawal Scale (CWS; as described in West & Ussher, 2010). Etter and Hughes (2006) report high test-retest reliability after a 14-day follow-up survey, and conclude that there is strong content validity and internal consistency with the CWS. Unlike the *m*TWS described above, the responses on the *m*TWS2 ranged on a 5-point Likert scale ranging from *totally disagree* to *totally agree*. Items included: (1) "*The only thing I can think about is tanning*"; (2) "*I miss tanning terribly*"; and (3) "*I feel an irresistible need to tan*."

Modified-Tanning Withdrawal Scale #3 (mTWS3). The modified-Tanning Withdrawal Scale #3 (*m*TWS3) was a one-item scale adapted from the Minnesota Nicotine Withdrawal Scale (MNWS, see West & Ussher, 2010). The original scale assesses "*Desire or craving to smoke*" on a 5-point Likert scale ranging from *none* to *severe*. The psychometric properties of the MNWS were tested with 4,644 treatment-seeking smokers and results indicate high test-retest reliability following a 14-day period (Etter & Hughes, 2006). I modified the scale in the present study to include the word "*tan*" instead of the word "*smoke*." The *m*TWS3 contained no other modifications from the MNWS.

Modified-Shiffman Scale (mSS). The original Shiffman Scale (Shiffman, Khayrallah, & Nowak, 2000) assesses individuals' urges, needs, and cravings for smoking cigarettes. It includes four items, each ranked between 1 and 10 (i.e., *low* to *high*). The modified-Shiffman Scale (*m*SS) was identical to the original, with the exception of presenting tanning-related words or phrases in lieu of smoking-related words or phrases. For example, instead of asking the participant to indicate their "*Urge to smoke*" where "1" indicates a low urge and "10" indicates a high urge (any number between 1 and 10 is permissible; the response signifies the degree of the urge), the *m*SS presented "*Urge to tan*". Specifically, the *m*SS instructed participants to indicate the degree related to the (1) "*Urge to tan*"; (2) "*Need to tan*"; (3) "*Crave to tan*"; and (4) "*Need a tanning bed*."

Modified-Craving Rating (mCR). I adapted the modified-Craving Rating (*m*CR) scale from the Craving Rating (CR) scale described in West and Ussher (2010). While the original CR consists of a single question, "*How much have you craved cigarettes today?*", the *m*CR entails, "*How much have you craved tanning today?*" The participant responded on a 6-point Likert scale ranging from "*not at all"* to "*a great deal*."

Visual Analog Scale for Tanning (VAST). The Visual Analog Scale for Tanning (VAST) was developed for the present study and consisted of a single item (i.e., "*How much would you like to go tanning right now?*"). The VAST differs from the scales described above because it consists of a 100 mm horizontal line with descriptive anchors on each end: "*not at all*" and "*A great deal*." Participants were asked to click and move a slider across the horizontal line to indicate the degree of how much they would like to go tanning right now (Appendix H).

Procedure. Each participant underwent the same single-subject design procedure in the following order: demographics questionnaire, neutral-cue condition, and tanning-cue condition. The sequence of the two cue conditions was not counterbalanced due to previous cue-reactivity studies demonstrating carryover effects when participants are exposed to the substance-related cues *before* the neutral-cues (MacKillop & Lisman, 2005; MacKillop & Lisman, 2008; Monti et al., 1987). The entire session lasted approximately 25 minutes for each participant. A visual depiction of the approximate timeline of the procedure is presented in Appendix I. Each participant started the study in an empty conference room (e.g., undecorated walls, containing only a computer, desk, and chair) where they read the information statement, provided consent (Appendices A and B), and completed a computerized demographic questionnaire and the tanning demographics questionnaire (Appendix D). All participants were exposed to an audio recording in the neutral- and tanning-cue conditions, modeled after Amlung et al., (2012; see Appendix J). The audio recording was identical in both conditions and presented verbal instructions (i.e., smelling the lotion [neutral = unscented body lotion; tanning-related = UVIT lotion], rubbing a small amount into the hands). The goal of using the audio was to maximize the participant's experience of the visual, olfactory, and tactile cues.

Following the completion of the demographic questionnaire, a research assistant escorted the participants to the neutral-cue condition. Upon arrival to the neutral-cue condition, the research assistant instructed the participant to sit in a chair at the table. Next, the research assistant instructed the participant to smell three different samples of unscented lotions. After the participant selected their preferred lotion, the research assistant removed two non-preferred samples of lotion. After the participant indicated he or she had no further questions, the research assistant informed the participant that an audio recording would begin to play after the research

assistant left the room. The participant was instructed to listen closely and to comply with the instructions presented. As soon as the research assistant stepped out of the room, the experimenter – positioned in the other room – turned on the white noise machine. The audio recording ended with instructions to turn on the computer monitor and to complete the questionnaires.

After the participants completed the questionnaires in the neutral-cue condition, the research assistant entered the room and escorted the participant to the tanning-cue condition. Immediately after being seated at the table, the research assistant asked the participant to smell the three tanning lotions and to select his or her most preferred tanning lotion. The research assistant then removed the other two tanning lotions. As soon as the research assistant turned off the lights and left the room, the experimenter simultaneously activated the blue-LED lights, the space heater, and the audio recording from the adjacent room. After listening to and following the instructions of the audio recording, the participant turned on the computer monitor and completed an identical questionnaire as in the neutral-cue condition. At the end of the session each participant was debriefed about the procedure and was given an information pamphlet obtained from the American Cancer Society® about the risks of melanoma, "*Why You Should Know About Melanoma*" (Appendix K).

Procedural Integrity. The computerized nature of data collection rendered interobserver agreement unnecessary. Procedural integrity was maintained throughout the study by having the research assistants undergo training sessions that consisted of role-play and feedback. Additionally, during every session, research assistants followed a detailed step-by-step task analysis on how to implement the procedure (Appendix L). The primary investigator was present, albeit unobtrusively, during all of the sessions and was responsible for activating the

cues (e.g., audio recording, lights, heater/white noise machine) when the research assistant left the participant in the neutral- and tanning-cue conditions. The primary investigator discretely (from the observation room) recorded procedural integrity data using a step-by-step task analysis and a checklist (see Appendices L and M) during each session; procedural integrity was 100% across all sessions.

Demand Curve Analysis. Each participant's reported consumption across the range of prices presented in the TPT was fitted using the Hursh and Silberberg (2008) exponential model of demand equation:

$$\log Q = \log Q_0 + k(e^{-\alpha(Q0C)} - 1) \qquad \text{Equation (1)}$$

where α (alpha) represents the change in elasticity, or the change in rate of decline in consumption (log *Q*) with increases in cost (*C*; α thereby quantifies sensitivity of consumption of the reinforcer due to increasing cost constraints). The intensity of demand (Q_0) is the level of consumption at zero cost. Therefore, Q_0 represents the maximum level of consumption of the demand curve. The scaling constant, *k*, is the range of consumption in logarithmic units and allows for quantitatively comparing essential value (*EV*) between commodities and across participants. The range of consumption, *k*, was determined to be 2.71 after allowing the two aggregate demand curves (i.e., neutral- and tanning-cue demand) to share a *k* value less than 5 during aggregate curve fitting. The primary parameter obtained from a demand curve is the essential value (*EV*; Hursh & Roma, 2013; Hursh & Silberberg, 2008; Reed, Kaplan, & Becirevic, 2015). Essential value is calculated using Hursh's (2014) equation:

$$EV = 1/(100 * \alpha * k^{1.5}) \qquad \text{Equation (2)}$$

Relatively large essential values indicate little change in consumption across increases in price. Therefore, a relatively large essential value is indicative of the participant defending their

maximum consumption (i.e., consumption at Q_0) despite the increasing costs of the UVIT sessions. Essential value was the primary higher-order dependent variable in this study.

Breakpoint was another observed metric. Breakpoint refers to the price at which consumption of the reinforcer is completely suppressed. That is, the first price at which zero purchasing of UVIT sessions is reported. The P_{max} is the price at which demand changes from inelastic to elastic (see Figure 1; slope of the curve is -1.00). The P_{max} is mathematically derived from the following equation presented in Hursh (2014):

$$P_{max} = 1/(Q_0 * \alpha * k^{1.5})*m; \text{ where } m = 0.083k + 0.65 \qquad \text{Equation (3)}$$

Therefore, the rate of consumption to the left of the P_{max} is relatively inelastic (i.e., slope is less negative than -1.00). That is, the proportional decrease in consumption is *less* than the proportional increase in price. Elastic demand is thereby represented to the right of the P_{max}. Simply put, the proportional decrease in consumption to the right of P_{max} is *greater* than the proportional increase in price (i.e., slope is more negative than -1.00). This calculated P_{max} is a useful metric for identifying the exact price at which demand changes from inelastic to elastic. This metric alone has proven useful in informing policy makers about setting taxes on cigarettes, for example, to decrease the demand for cigarettes (MacKillop et al., 2012).

Finally, demand curves are typically presented alongside expenditure curves, also known as work functions. Consumption at P_{max} (on demand curve), when multiplied by the price at that point, yields the maximum expenditure (O_{max}; the maximum output on the work function). This output, within nonhuman studies for example, can be the maximum number of lever presses that the animal emits to obtain the reinforcer. For the present study, this translates to the maximum amount spent (in U.S. dollars) for purchasing tanning sessions. Essential value, P_{max}, and O_{max} were calculated using the automated calculator developed by Kaplan and Reed (2014).

Results

Demographic Data. Participants' demographic data are summarized in Table 1. The sample contained 22 females and 1 male (mean age = 20.1 years, *SD* = 1.8 years); 91.3% identified as "White/Caucasian," and 8.7% identified as "Native American." Of the 23 participants, 12 met the mCAGE and 2 met the *DSM-IV-TR* classifications for "At Risk" for tanning dependence. The two participants who scored affirmative on the *DSM-IV-TR* also scored affirmative on the mCAGE.

Demand Curve Data.

Figure 3 depicts the group's demand and expenditure curves for the neutral-cue and tanning-cue conditions. The top panel depicts the demand curves where consumption, measured in number of tanning sessions purchased in a month, varies as a function of increasing prices of tanning sessions. The demand curve in the neutral-cue condition and the tanning-cue condition depicts a systematic decrease in consumption as a function of price. The exponential demand model yielded good fits for the neutral-cue (R^2=.81) and tanning-cue conditions (R^2=.89).

The D'Agostino and Pearson normality test was conducted for all six of the behavioral economic indices to determine if the values approximated the normal distribution, and because the data were not normally distributed, the Wilcoxon matched-pairs signed rank test was used to compare matched (within-subject) rate of change in demand elasticity (α) and other behavioral economic demand indices (*EV*, P_{max}, O_{max}, Q_0, and breakpoint) between neutral- and tanning-cue conditions. Given that the Wilcoxon matched-pairs signed rank test is not greatly influenced by extremely low or extremely high values due to its comparison of the medians between conditions, all 23 individuals' data were retained in the analyses. Results showed a significant

effect in α, $Z = 2.764$, $W = 159$, $p < .01$, as well as EV ($Z = 2.763$, $W = 159$, $p < .01$). Significant effects also were observed for P_{max} ($Z = 2.207$; $W = 127$, $p < .05$), O_{max} ($Z = 2.763$, $W = 159$, $p < .01$), and breakpoint ($Z = 2.248$, $W = 61$, $p < .05$), but not Q_0 ($Z = 0.943$, $W = 9$, $p = .4375$).[3] Figure 4 depicts individuals' behavioral economic demand indices in the neutral-cue and tanning-cue conditions. Table 2 shows the spearman's rho correlations for the behavioral economic indices.

Craving Data. The Wilcoxon matched-pairs signed rank test was used to investigate differences in subjective craving scores between neutral- and tanning-cue conditions. Significant effects were observed across eight out of the nine craving scales: QTU ($Z = 3.171$, $W = 195$, $p < .001$), *m*MPSS ($Z = 2.977$, $W = 84$, $p < .01$), *m*TWS2 ($Z = 3.095$, $W = 119$, $p < .001$), *m*TWS3 ($Z = 2.324$, $W = 54$, $p < .05$), *m*CTQ ($Z = 3.741$, $W = 199$, $p < .0001$), *m*SS ($Z = 3.628$, $W = 180$, $p < .0001$), *m*CR ($Z = 2.546$, $W = 69$, $p < .05$), and the VAST ($Z = 3.573$, $W = 220$, $p < .0001$). No significant effect was observed with the *m*TWS ($Z = 1.303$, $W = 41$, $p = .2174$). Figure 5 shows the composite scores for each of the nine craving scales. Table 3 depicts spearman's rho correlation coefficients for composite scores of the subjective craving scales. Strong, positive correlations were observed across each of the sales (r_s ranged between .42 and .90 in the neutral-cue condition; between .45 and .91 in the tanning-cue condition).

Discussion

The primary goal of this study was to examine the effects of tanning-related cues on demand for tanning. The findings of the current study suggest that both behavioral economic

[3] Wilcoxon *Z* and *W* values were obtained from the Wilcoxon matched-pairs rank test in *SPSS*® and GraphPad Prism®, respectively.

demand and craving for tanning are contextually dynamic; that is, demand and craving are influenced by proximal environmental stimuli, specifically the presence of the tanning-related stimuli. Although considering that cue-reactivity research within behavioral economics is still in its infancy (Amlung et al., 2012), and the fact that this is currently the only study examining tanning demand and craving using a cue-reactivity paradigm, further research is necessary, especially if the goal is to guide public policy decisions about UVIT. Therefore, many of the points described below about public policy implications should be interpreted with caution.

Although the demand curve analysis yields valuable metrics for assessing motivation (Hursh & Silberberg, 2008; Hursh, 2014), it can be argued that demand curves also offer a novel interpretation of craving. First and foremost, a distinction between cue-induced and withdrawal-induced craving needs to be made. Whereas the latter is predominantly studied and explained from a neuroscience and physiological perspective (Lowenstein, 1996; MacKillop, Menges, McGeary, & Lisman, 2007), the former is most often interpreted from a classical conditioning perspective. At best, cue-induced craving explained from solely a classical conditioning perspective offers a lackluster account for the operant behaviors related to tanning. A motivating operations (MOs) framework (Laraway, Snycerski, Michael, & Poling, 2003; Michael, 1982, 1993, 2000; Miguel, 2013), on the other hand, offers an interpretation that is conceptually systematic with operant conditioning. Therefore, the present study offers an interpretation for craving within the framework of operant conditioning, specifically using the principles of motivating operations.

Rather than interpreting cues as stimuli that *elicit* craving, it may be more accurate to interpret cues as stimuli that *evoke* a craving *response*. That is, similar to the framework of motivating operations, cues have two main effects (Laraway et al., 2003): (1) a value-altering

effect where the essential value of a reinforcer increases, and (2) a behavior-altering effect that is characterized by an increased likelihood of responses that have resulted in accessing the reinforcer in the past. Therefore, it is possible that cues that evoke a craving response function as motivating operations. It is also possible, however, that some cues may function as discriminative stimuli, because, in the past, the actions that followed contacted reinforcement. For example, a glowing neon sign located on the entrance of a tanning salon that advertises "Tanning," functions as a discriminative stimulus for entering the establishment, making a purchase, and tanning in a tanning bed.

The process of classical conditioning may help explain the spatio-temporal conjunction (e.g., the pairing) between the initially neutral proximal stimulus (e.g., tanning lotion) and the unconditioned or conditioned stimulus (e.g., exposure to ultra-violet radiation from a UVIT device). As dermatological studies have demonstrated (Feldman et al., 2004; Kauer et al., 2006), UV-radiation may have automatically reinforcing properties, particularly when UV induces endorphin and opioid secretion (Gambichler et al., 2002; Kauer et al., 2006, Kourosh, Harrington, & Adinoff, 2010). Initially, various neutral stimuli such as tanning lotions and posters of scantily clad bronzed models do not evoke any craving response for tanning – that is, tanning lotions and posters do not initially alter the value of UV exposure nor do they evoke a chain of responses that ultimately results in the access of UV-radiation. Only after repeated exposure with the UV radiation may the proximal cues begin to evoke craving responses. Premackian conditioning (described below) may serve as a relevant framework that offers a more comprehensive account of behavior. Of course, this behavioral account is merely one interpretation – albeit, a conceptually systematic account premised by conditioning research –

but it offers a more complete account of craving than that of simple classical conditioning, which explains craving in terms of one-to-one correspondence akin to the stimulus eliciting a response.

Premackian conditioning, according to Killeen (2014), occurs when one class of actions (i.e., behavior) leads to another class of actions, which ultimately allows the organism to engage in responses that yield biologically potent reinforcers or events (i.e., unconditioned responses or consummatory behavior). As discussed earlier, there is some evidence that UV radiation has reinforcing properties (e.g., Feldman et al., 2004; Kaur et al., 2006; Sinclair & Makin, 2013). The class of actions described above are termed excitatory because they lead to more positive actions; the class of actions would be described as inhibitory if they lead to less positive (or negative) responses. Central to the notion of Premackian conditioning is that signals of the transition from one class of actions to the next can either be innate or learned. To put it succinctly, "The key idea of Premackian conditioning is that actions, and the opportunity to make them, reinforce other actions" (Killeen, 2014, p. 545). According to that view, behavior is dynamic and the stream of operant responses transitions from actions lower on the chain of action-sequences to actions higher on that chain of action-sequences. Responses in a particular module on the action-sequence hierarchy are either elicited by unconditioned stimuli or conditioned stimuli or selected by the reinforcer (e.g., UV radiation penetrating the skin), and, therefore, a particular response can be viewed as competing with other responses. According to this framework, it is possible that proximal cues and distal cues elicit physiological responses in frequent tanners, increase demand for tanning, and evoke a sequence of responses that may ultimately lead to the access of UV exposure. As the current study suggests: When it comes to demand and craving for UVIT, cues should not be overlooked.

The UVIT industry, estimated to be a multi-billion-dollar industry (Bizzozero, 2008), seems to value the role of cues in UVIT demand, given that the industry is notorious for using marketing strategies and advertisements aimed at consumers (Greenman & Jones, 2010). According to Reed (2014), "advertisements promoting UVIT rely heavily on visually appealing graphics and models. The allure of tanning also extends into the salon, where lotions feature unique scents" (p. 250). A study of 54 tanning facilities in San Diego found that 24% of the facilities offered the "high-pressure 'Ultrabronz,' 'Super bed,' or 'Orbit bed,' which were advertised as containing 100% UVA rays and no 'harmful burning UVB rays'"(Culley et al., 2001, p. 56). Furthermore, Culley et al. (2001) examined levels of compliance by indoor tanning salons with federal and state regulations and recommendations and found that no salon complied with all 13 of the regulations/recommendations. Interestingly, many of the tanning salon operators who were interviewed downplayed the risks associated with UVIT (see Culley et al., 2001). In a more recent study on tanning facilities in California, Grewal, Haas, Pletcher, and Resneck (2013) reported that 61% of the tanning facilities they telephoned denied any dangers from UVIT. These findings suggest that misinformation about the dangers of tanning is prevalent, suggesting a need for enforcement of state and federal laws.

Given the prominent presence of tanning lotion and other tanning-related paraphernalia in the tanning salon, it is possible that the consumer's decision at the point-of-purchase can be influenced by various stimuli as well as special discounts and package deals. This assumption must be interpreted with caution, however, due to the disadvantage of making inferences about generality across settings solely based off of data collected in a simulated tanning salon. Given the major finding of the current study – demand and craving for tanning increases in the presence of tanning-cues – a tanning salon patron with a history of using tanning services may experience

heightened cravings and increased demand in the presence of the cues at the point-of-purchase. At best, the patron during the point-of-purchase might be more inclined to spend more money on tanning services, and at worst, might even purchase an unlimited monthly (or annual) tanning package. It is reasonable to expect that a commitment response such as purchasing an unlimited package of tanning would likely entail a greater frequency of tanning.

An additional contribution of this study is an extrapolation of the demand analysis to identify the unit-elasticity point (P_{max}) along the demand curve to inform tax policy. The Patient Protection and Affordable Care Act of 2010 mandates a 10% excise tax on all UVIT package purchases. The P_{max} metric obtained from the demand curve analysis offers a price associated with elasticity in participants' demand curves. That is, if public policy makers wish to decrease demand for tanning, while simultaneously generating tax revenue, then the empirically derived P_{max} might be used to suggest an excise tax on tanning services. This metric has been used in research on cigarette consumption and the effects of empirically derived taxation (MacKillop et al., 2012). Although an interesting finding in the present study, caution should be practiced considering my small sample size. Government regulations in the form of excise taxes affect all consumers. A recent study explored the effects of empirically derived taxes on individuals who exhibit low, moderate, and high levels of demand for UVIT (Reed, Kaplan, Becirevic, Roma, & Hursh, 2016), and concluded that infrequent tanners may tolerate an excise tax of approximately $15 on a $30 unlimited tanning package while frequent tanners may tolerate up to a $25 tax on a $30 package (constituting an 83% tax increase that far exceeds the current 10% tax). In the present study, the difference between the median P_{max} exhibited by the participants in the neutral-cue ($12.26) and tanning-cue conditions ($14.06) was substantial. Therefore, it is presumed that an increase in price (via excise taxation) may serve to decrease consumption of

UVIT, presumably deterring those who have never tanned from tanning in the first place. This may be a worthwhile endeavor considering that about one out of every three young white women between the ages of 16 and 25 engages in UVIT (Guy, Berkowitz, Watson, Holman, & Richardson, 2013).

The current study has several limitations. First, the behavioral economic demand curve assessment is a *proxy* to tanning-related behavior. Although HPTs are becoming increasingly popular in behavioral economic research regarding behavioral addictions and substance use disorders (Bickel, Jarmolowicz, Mueller, & Gatchalian, 2011; Bickel, Johnson, Koffarnus, MacKillop, & Murphy, 2014; Jarmolowicz, Reed, DiGennaro Reed, & Bickel, 2015) and behavioral health in general (Hursh & Roma, 2013), as of yet only one study (Reed et al., 2016) has validated the TPT. Given the growing number of validation studies in the substance use literature (e.g., alcohol and tobacco; Amlung et al., 2012; Amlung & MacKillop, 2014; Amlung et al., 2015; MacKillop & Murphy, 2007; MacKillop et al., 2008; MacKillop et al., 2010; Madden & Kalman, 2010), future research may attempt to validate the TPT with tanning specific addiction tools such as the Structured Interview for Tanning Abuse and Dependence (Heckman et al., 2008; Hillhouse et al., 2012) and the Tanning Pathology Scale (Heckman et al., 2014; Hillhouse, Turrisi, Stapleton, & Robinson, 2010). A similar recommendation is in order for the subjective craving scales. The majority of the craving scales in this study were slightly modified or adapted from tobacco and alcohol scales to suit the purpose of the study. Only the VAST (Appendix H) was originally designed for the sake of this study. The validity of these craving scales remains in question despite the strong correlations obtained across the various scales.

A second limitation is the time of year in which the study took place (Spring semester of 2015; specifically, February 12 to March 13). Some research using *Google Trends* (e.g., a free

online resource that quantifies the percentage of Google searches using a target term or phrase; see Reed, Yanagita, Becirevic, & Kaplan [2014]) suggests that tanning-related key words (i.e., "tanning salon") peak in the months of spring (March, April, and May in the northern hemisphere and September and October in the southern hemisphere; Cidre Serrano et al., 2016; Dunstone, Makin, & Conway, 2013; Reed, 2015). It is possible that participants' demand and craving in the present study would have been affected differently if the study was conducted at a different time of year (e.g., Fall semester). Furthermore, one study (Hillhouse, Turrisi, & Shields, 2007) identified at least four subtypes of tanners: event tanners, spontaneous or mood tanners, mixed tanners, and regular year-round tanners. Hillhouse and colleagues emphasize that a "one size fits all" intervention will likely not work when it comes to UVIT. Despite my inability to classify the participants in the present study due to the nature of the questionnaires we chose and the small sample size, it may be worthwhile to investigate how demand and craving is modulated by tanning-related cues in different categories of tanners.

Lastly, additional limitations result from the sequence of events used in the present study. Given that all participants experienced the two cue conditions in the same sequence, an order effect cannot be ruled out. The primary reason for selecting the sequence described above was to assess whether or not any effect in the direction of elevated demand and craving would be observed with a relatively small sample size. A future study could investigate demand and craving where participants experience the neutral cues *following* the tanning-cue exposure. Additionally, considering that all participants experienced the neutral-cue and tanning-cue conditions within minutes of each other, it is possible that a fleeting effect in behavioral economic demand curve indices and craving was observed. Therefore, the results should be interpreted with caution. Future studies may benefit from examining demand and craving over an

extended period of time (e.g., 1 week, 2 weeks, etc.). A ceiling effect in demand intensity (Q_0) is also concerning given that the upper boundary on the TPT was 30 days and majority of the sample (74%) showed no difference in Q_0 between neutral- and tanning-cue conditions. Although this finding can be interpreted as cues having no effect on UVIT behavior when tanning sessions are freely available in the next 30 days, the questions remain: (a) to what degree might tanning-related cues affect Q_0 of different categories of tanners, including those who have never tanned?; and (b) to what degree might the behavioral economic indices change as a result of cues if the timeframe on the TPT was different from the one used in the present study (e.g., 1 week, 2 months, 6 months, 1 year)?

In conclusion, this is the first study, to my knowledge, to systematically quantify the relations between behavioral economic demand and self-reported craving for UVIT within a cue-reactivity paradigm. The main finding is that tanning cues can potentially increase demand and craving for tanning. Despite cue exposure research still being in its infancy, it may be fruitful to continue exploring tanning demand and craving, as well as the mechanisms of these effects (e.g., classical conditioning, operant conditioning). Empirical validation of behavioral economic assessments may contribute to preventative health campaigns aimed at decreasing rates of skin cancer. This study is timely because the Surgeon General of the United States issued a Call to Action to Prevent Skin Cancer in 2014 (U.S. Department of Health and Human Services, 2014) emphasizing the need for more behavioral studies that would strengthen research, surveillance, and monitoring of tanning-related behaviors. Specifically, some of the Surgeon General's specific aims are to "increase understanding of indoor tanning behaviors, including when, where, and how people tan," as well as to increase the "understanding of motivations to tan or not to tan" (U.S. Department of Health and Human Services, 2014, p. 63). Further studies are necessary

to answer the call to action and to increase our understanding about the decision-making processes when it comes to UVIT.

Figures

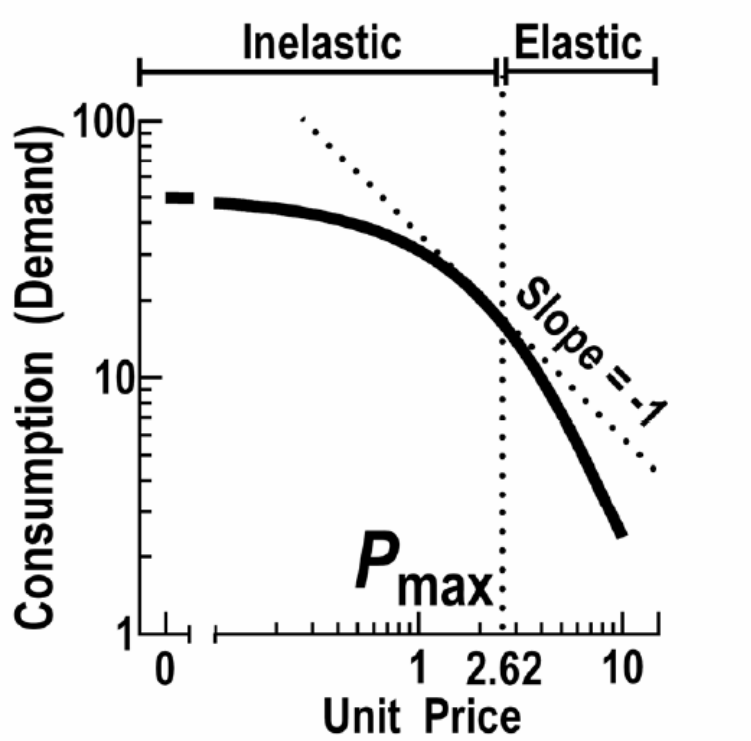

Figure 1. Prototypical demand curve depicting P_{max}, showing the shift from inelastic to elastic demand. Used with permission from Reed, Kaplan, and Becirevic (2015).

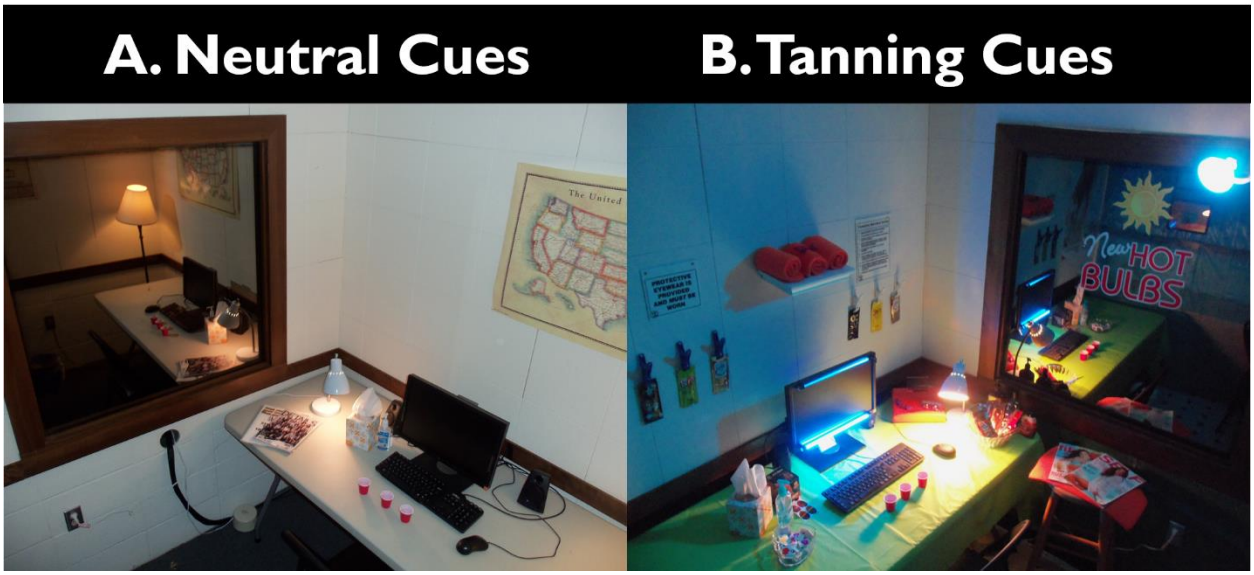

Figure 2. Neutral- and tanning-cue conditions are depicted in panels A and B, respectively.

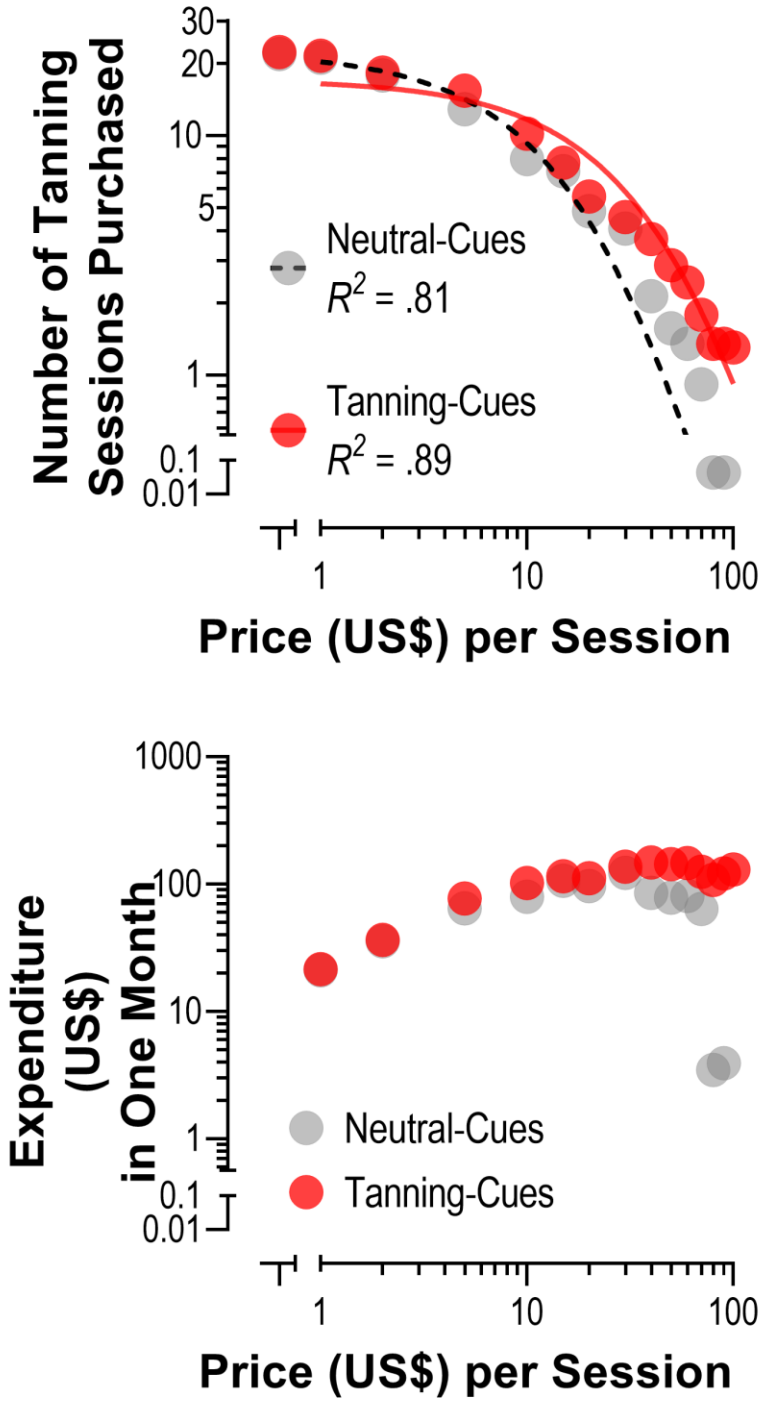

Figure 3. Demand curves (top panel) and expenditure curves (bottom panel). Top panel displays Equation 1 fit to the mean data of the participants in the neutral- and tanning-cue conditions.

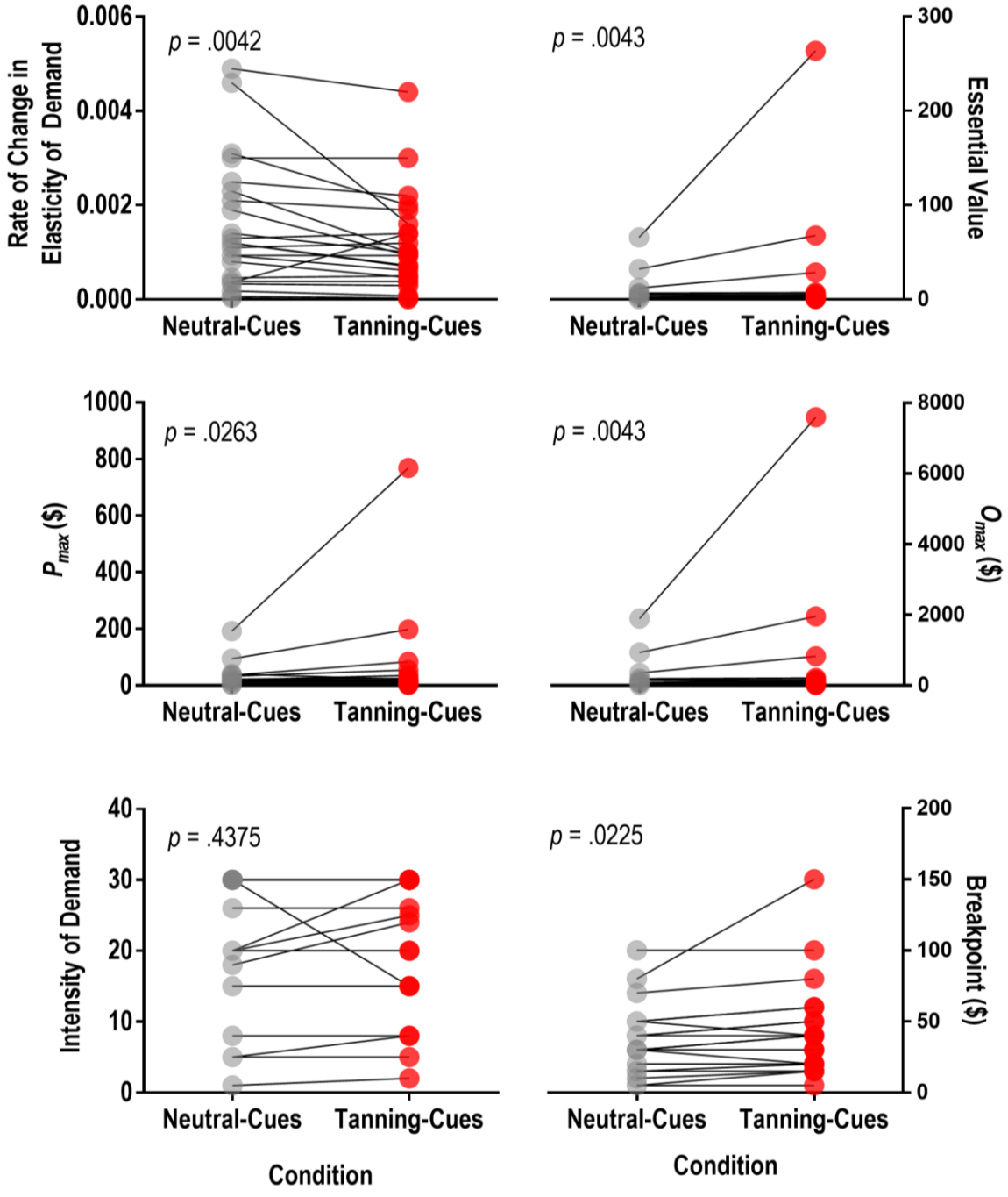

Figure 4. Comparisons between the behavioral economic indices for each individual going from the neutral- to tanning-cue conditions.

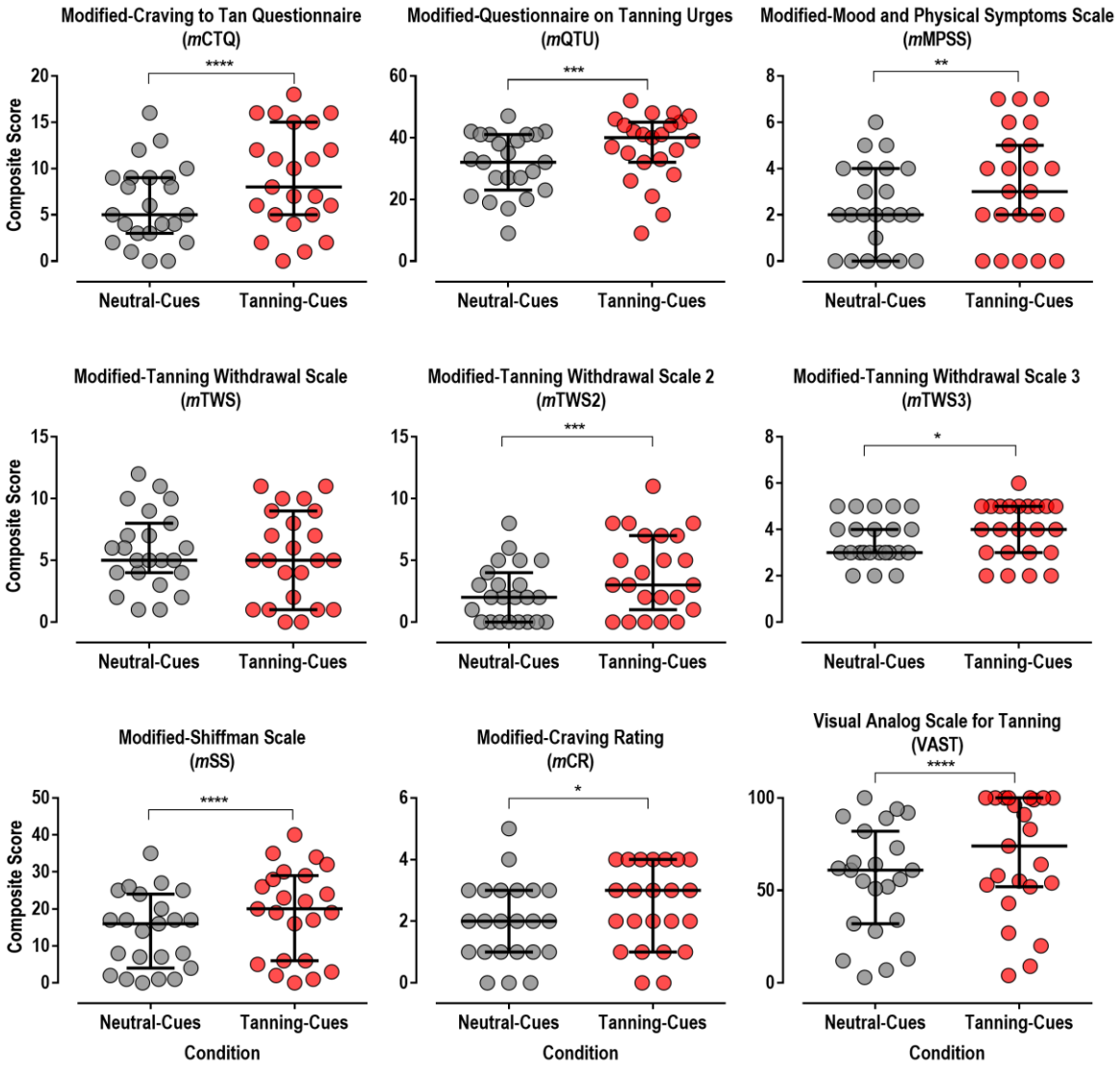

Figure 5. Comparison of median composite scores for each of the nine self-reported craving scales across the neutral- and tanning-cue conditions. Error bars depict inter-quartile range. *$p < .05$. **$p < .01$. ****$p < .0001$

Tables

Table 1

Demographic Characteristic of Study Participants

Characteristic	No. of Participants
Gender	
Male	1
Female	22
Ethnicity	
White/Caucasian	20
Native American	3
Skin Type	
Always burn, never tan	0
Always burn, rarely tan	1
Sometimes burn, often tan	11
Rarely burn, always tan	10
Never burn, always tan	1
Free Access to Tanning?	
Yes	4
No	19
Pay for Tanning?	
Yes	22
No	1
"At Risk" for Tanning Dependence?	
Yes	12
No	11

Note. Participants were classified as At Risk for Tanning Dependence if they scored positive on at least the mCAGE or m*DSM-IV-TR.*

Table 2

Spearman's Rho Correlation Coefficients for Behavioral Economic Indices

	1	2	3	4	5	6
1. *EV*	---	-1.0***	.28	.76***	1.0***	.84***
2. Elasticity	-1.0***	---	-.28	-.76***	-1.0***	-.84***
3. Q_0	.50*	-.50*	---	-.23	.28	.12
4. P_{max}	.64***	-.64***	-.14	---	.76***	.66***
5. O_{max}	1.0***	-1.0***	.50*	.64***	---	.84***
6. BP	.79***	-.79***	.07	.65***	.79***	---

Note. Bottom left represents neutral-cue condition; top right represents tanning-cue condition.

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

Table 3

Spearman's Rho Correlation Coefficients for Composite Scores of Subjective Craving Scales

	1	2	3	4	5	6	7	8	9
1. *mCTQ*	---	.66**	.80**	.77***	.79***	.86***	.91***	.91***	.84***
2. QTU	.62**	---	.52*	.64**	.71***	.45*	.66***	.60**	.65***
3. *m*MPSS	.72***	.51*	---	.67***	.73***	.73***	.84***	.84***	.62**
4. *m*TWS	.74***	.71***	.55**	---	.80***	.71***	.78***	.72***	.51*
5. *m*TWS2	.51*	.66**	.58**	.76***	---	.75***	.81***	.75***	.67***
6. *m*TWS3	.86***	.64**	.61**	.74***	.62**	---	.82***	.75***	.67***
7. *m*SS	.90***	.66**	.74***	.67***	.59**	.82***	---	.82***	.82***
8. *m*CR	.89***	.53**	.67***	.52*	.42*	.73***	.84***	---	.72***
9. VAST	.83***	.74***	.63**	.64***	.54***	.82***	.86***	.72***	---

Note. Bottom left represents neutral-cue condition; top right represents tanning-cue condition.

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

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Appendices

Appendix A: Information Statement

Indoor Tanning Study

The Department of Applied Behavioral Science at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You may refuse to sign this form and not participate in this study. You should be aware that even if you agree to participate, you are free to withdraw at any time. If you do withdraw from this study, it will not affect your relationship with this unit, the services it may provide to you, or the University of Kansas.

PURPOSE OF THE STUDY

The purpose of this proposed investigation is to evaluate college student's decision making regarding hypothetical purchases of indoor tanning packages.

PROCEDURES

Participating in this study will entail completing some brief questionnaires about indoor tanning use in the presence or absence of environmental stimuli. The duration of the procedure is approximately 30 – 60 minutes.

RISKS

You may be asked to apply indoor tanning lotion to your hands. There is a possibility of a minor skin irritation caused by these lotions. If you have a history of an allergic reaction due to tanning lotion or bronzer, then you are advised against participating.

This study poses no risk of UV-A or UV-B exposure.

BENEFITS

Your participation in this study will indirectly benefit society by providing our scientific field with information about indoor tanning behavior.

PAYMENT TO PARTICIPANTS

You will be compensated with 1/2 of 1% point of extra credit. This extra credit will be applied to the undergraduate ABSC course from which you are recruited.

PARTICIPANT CONFIDENTIALITY

Although you will be required to provide your name, rest assured that your name will not be associated in any publication or presentation with the information collected about you or with the research findings from this study. Instead, the researcher will use a study number or a pseudonym rather than your name. Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission.

Rev 7/13

WITHDRAWAL

You may withdraw from this study at any time.

QUESTIONS ABOUT PARTICIPATION

Questions about procedures should be directed to the researcher listed at the end of this consent form.

PARTICIPANT CERTIFICATION:

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study. I understand that if I have any additional questions about my rights as a research participant, I may call (785) 864-7429 or (785) 864-7385, write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7568, or email irb@ku.edu.

_____ _____

Type/Print Participant's Name Date

_____

Participant's Signature

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Appendix B: Indoor Tanning Questionnaire for Focus Group

1. How old do you think most people are when they first start to go indoor tanning?
    a. Younger than 13
    b. 13-14
    c. 15-16
    d. 17-18
    e. Older than 18

2. *Describe what people may find in typical indoor tanning salon?

3. How many mirrors are in the average room in a tanning salon?

4. *What color is the typical tanning bed?

5. *What color is the typical tanning lamp?

6. *What are some sounds people hear in a tanning salon?

7. *What are some sounds people hear in the tanning bed?

8. *What are some smells people notice in the tanning salon?

9. Do you think that people know about the dangers of tanning?

10. Do you think that people have been burned from indoor tanning?

11. Did you think that people know the dangers of tanning before the start tanning?

12. Do you think that the average tanner is familiar with the different strengths of tanning beds?

13. Is there a UV strength that people have a preference for? If so, which strength?

14. Does the average tanner think that tanning salon workers are knowledgeable about the risks of tanning?

15. Do you think that people have ever fallen asleep in a tanning bed?

16. *What is the difference between a tanning bed and a tanning booth?

17. Do you think that people have used tanning booths?

18. Which do you think the average tanner prefers more: tanning beds or tanning booths?

19. *Has the average tanner ever tried spray tanning?

20. *Do you think that the average tanner uses protective goggles when using tanning devices?

21. Do you think the average tanner uses a towel to cover any areas predisposed to tanning damage (like moles)?

22. Do you think the average tanner uses any lotion with any spf ingredient before tanning?

23. What are the time restrictions on tanning devices?

24. What do you think is the longest duration for which the average tanner has tanned in a single session?

25. Do you think tanners ever use tanning devices without wearing protective goggles?

26. Do you think the tanning beds are sanitized between each user in a tanning salon?

27. How important is to the average tanner to have a sanitized tanning bed before laying down?

28. Are other services offered at indoor tanning salons that tanners typically visit? If so, what are the services? (i.e. manicures, pedicures, massages)

29. *Describe what you think the typical tanner might feel when they are inside a tanning bed?

30. *Does the average tanner get warm or hot in a tanning bed?

31. Is being warm important to the average tanner?

32. Do you think tanners ever experience claustrophobia when using tanning devices?

33. What type of tanning lotion does the average tanner use?

34. Where do you think the average tanner purchases the tanning lotion from?

35. What is the highest quality brand of tanning bed that the average tanner uses?

36. How much money do you think the average tanner spends on indoor tanning services?

37. How long many sessions does it take for the average tanner to achieve their ideal results?

38. *Once the average tanner's ideal results are met, how many sessions per day/week/month/year are required to maintain the result?

39. **Do you think the average indoor tanner chooses natural tanning over indoor tanning when weather permits?

40. How often do you think the average tanner goes tanning? Per week? Per month? Per year?

41. *What do you think the average tanner would say about a state ban on indoor tanning for minors (under 18 years)?

*Questions presented during focus group.

Appendix C: Agreement Form

I agree to the following:

- I am 18 years of age or older
- I have used an indoor tanning device at least twice in the past year
- I am not allergic to tanning lotions
- I am aware that I may experience some minor skin irritation from the lotion

_____ _____

Type/Print Participant's Name Date

_____

Participant's Signature

Appendix D: Math Task in Neutral-Cue Condition

Please complete the following math problems by typing in a numerical response.

44 + 8 =	
51 x 2 =	
65 + 15 =	
8 x 6 =	
51 + 10 =	
24 + 25 =	
43 x 2 =	
42 + 24 =	
19 + 31 =	
60 x 3 =	

Appendix E: Demographics Questionnaire

I am a:
- ❍ Male
- ❍ Female

What is your race?
- ❍ White/Caucasian
- ❍ African American
- ❍ Hispanic
- ❍ Asian
- ❍ Native American
- ❍ Pacific Islander
- ❍ Other

My current age (in years) is:

What is your combined annual household income?
- ❍ Less than 30,000
- ❍ 30,000 – 39,999
- ❍ 40,000 – 49,999
- ❍ 50,000 – 59,999
- ❍ 60,000 – 69,999
- ❍ 70,000 – 79,999
- ❍ 80,000 – 89,999
- ❍ 90,000 – 99,999
- ❍ 100,000 or more

If you could, how many days a week would you use an indoor tanning bed?
- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7

Fitzpatrick Skin Type (select the one that best describes how you react to the sun):

- ❍ Always burn, never tan
- ❍ Always burn, rarely tan
- ❍ Sometimes burn, often tan
- ❍ Rarely burn, always tan
- ❍ Never burn, always tan

Do you try to cut down on the time you spend tanning, but find yourself still using indoor tanning devices?

- ❍ Yes
- ❍ No

Do you ever get annoyed when people tell you not to use tanning devices?

- ❍ Yes
- ❍ No

Do you ever feel guilty that you use tanning devices too much?

- ❍ Yes
- ❍ No

When you wake up in the morning do you want to use tanning devices?

- ❍ Yes
- ❍ No

Do you think you need to spend more and more time using the tanning device to maintain your perfect tan?

- ❍ Yes
- ❍ No

Do you think your tan will fade if you spend the same amount of time using the tanning device each time?

- ❍ Yes
- ❍ No

Do you continue tanning so your tan will not fade?

- ❍ Yes
- ❍ No

When you go tanning do you usually spend more time using the tanning device than you had planned?

- ❍ Yes
- ❍ No

Do you try other non-tanning related activities, but find you really still like spending time using tanning devices best of all?

- ❍ Yes
- ❍ No

How many days a week do you visit tanning salons?

Do you tan year round?

- ❍ Yes
- ❍ No

Have you ever missed work, a social engagement, or school because of a sunburn?

- ❍ Yes
- ❍ No

How old were you when you first used a tanning bed?

Which level tanning bed do you typically use?

- ❍ Level 1
- ❍ Level 2
- ❍ Level 3
- ❍ Level 4 or higher
- ❍ I spray tan, I don't typically use tanning beds
- ❍ I don't use any tanning devices

Do you have free access to a tanning device? (i.e., free tanning at an apartment complex)

- ❍ Yes
- ❍ No

Do you pay for your tanning?

- ❍ Yes
- ❍ No

Appendix F: Neutral-Cue TPT Assumptions

Imagine you live in an area with only one indoor tanning salon and no other way to artificially tan. The following questions ask how many times you would pay to use an indoor tanning bed in the next 30 days (1 month from today).

Imagine:

- Your income/savings is equal to what you have in reality, right now.
- The tanning bed you can access is the same model and level of bed that you typically use.
- You can tan for a maximum of 20 minutes each day.
- You can use a tanning bed once per day, 30 days per month.
- Payments for use of the tanning bed must come from you, and you alone.

There are no "right" or "wrong" responses. Please answer all questions honestly, thoughtfully, and to the best of your understanding, as if you were actually in this situation.

How many times would you pay to use an indoor tanning bed per month if each use cost...? (Please use numeric responses between 0 and 30).

Appendix G: Tanning-Cue TPT Assumptions

Imagine you live in an area with only one indoor tanning salon and no other way to artificially tan. The following questions ask how many times you would pay to use an indoor tanning bed in the next 30 days (1 month from today).

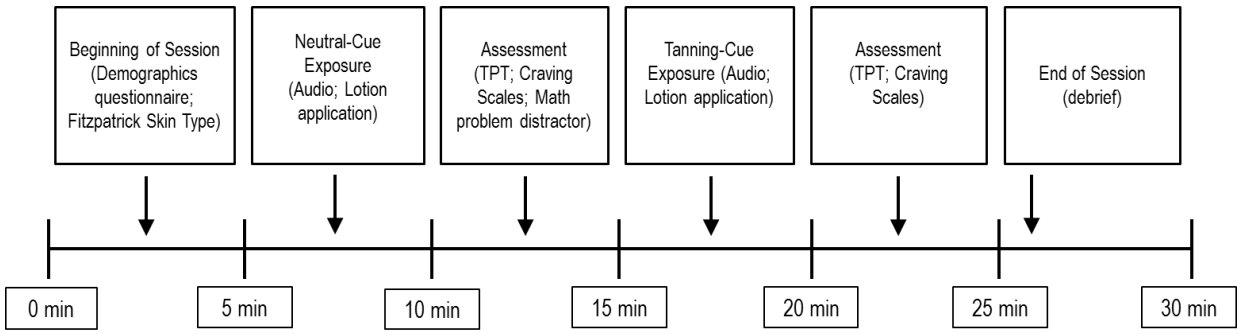
Imagine:

- Your income/savings is equal to what you have in reality, right now.
- The tanning bed you can access is the same model and level of bed that you typically use.
- You can tan for a maximum of 20 minutes each day.
- You can use a tanning bed once per day, 30 days per month.
- Payments for use of the tanning bed must come from you, and you alone.

There are no "right" or "wrong" responses. Please answer all questions honestly, thoughtfully, and to the best of your understanding, as if you were actually in this situation.

Appendix H: Visual Analog Scale for Tanning (VAST)

Appendix I: Approximate Timeline of the Procedure



Appendix J: Script for Cue Exposure

Tanning Cue-Exposure Script (modified from Amlung et al., 2012).
Long pause = 5s; short pause = 3s.

We will now begin. Please listen carefully and please follow the directions. (long pause).

Please take a few moments to look around the room. Look at the items on each wall. (long pause). Notice the two large posters. (short pause). Notice the two magazines. (long pause).

In a moment I'm going to ask you to smell the lotion in front of you. When you are asked, please take five deep breaths inhaling the smell of the lotion. (long pause). Please pick up the cup of lotion and take five deep breaths inhaling the smell of the lotion with each breath. Keep the lotion up to your nose. Take deep breaths and inhale the smell of the lotion. After you have taken five deep breaths, put the lotion back down. (long pause).

Please pick up the cup of lotion and take five deep breaths. Take your time and take deep breaths. Pay attention to the smell of the lotion. Once you have taken five deep breaths, put the cup back down. (long pause).

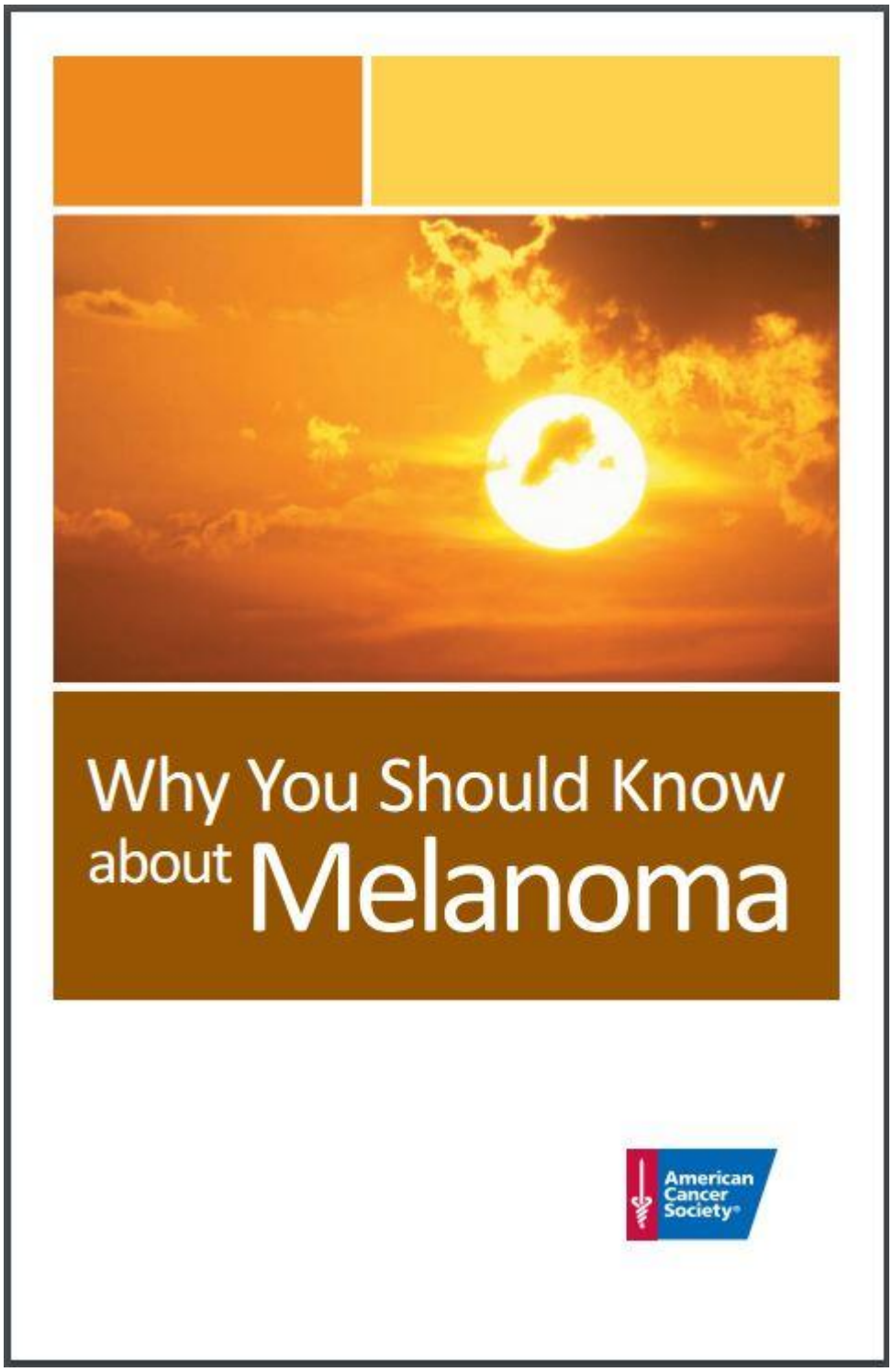
Please pick up the cup of lotion and take five deep breaths inhaling the smell of the lotion with each breath. Keep the lotion up to your nose. Take deep breaths and inhale the smell of the lotion. After you have taken five deep breaths, put the lotion back down. (long pause).

Next, I'm going to ask you to apply some lotion to your hands. When you are asked, please pick up the lotion and apply it to your hands. (long pause). Please pick up the cup of lotion. Using your index finger, scoop and place a dime-sized amount of lotion onto your hand, and place the cup of lotion back down. Use both hands to apply the lotion to the front and back of your hands. (long pause). Notice how the lotion feels on your hands. (long pause). After you have applied the lotion to your hands, take a few moments to rub the lotion thoroughly into the skin of your hands. Notice how the lotion feels on your hands.

Please pick up the cup of lotion and take five deep breaths. Take your time and take deep breaths. Pay attention to the smell of the lotion. Once you have taken five deep breaths, put the lotion back down. (long pause).

Next, I'm going to ask you to turn *on* the computer monitor and to turn *off* the light on the desk lamp (long pause). At this time, please turn *on* the computer monitor by pressing the orange button on the lower right side of the monitor. Please turn *off* the lamp on the desk by twisting the top button. (long pause). Please read the instructions on the screen thoroughly, think about your responses for each question, and please respond honestly. You may now use the mouse to complete the surveys.

Appendix K: Melanoma Information Pamphlet



Appendix L: Task Analysis of Procedure

Participant Number:_____

Part One (Demographics):

- ○ When the participant arrives, greet him/her in the first floor lobby of Dole.

Good morning/afternoon/evening! How are you today?

- ○ Walk with the participant to room 1102

Let's get started. Please join me in this room (move to room 1102).

Feel free to place your belongings here (gesture toward the table). We will move to a different room at some point, but we will return here at the end of the study. Please have a seat.

- ○ Turn on the computer monitor.

Before we begin the study, I need to obtain consent from you for participation. Please take a couple of minutes to read this consent form and click the arrow at the bottom to continue. On the next page please type your name and date if you're willing to provide consent. If you do, please also complete the demographic information form. I will be nearby if you have any questions.

- ○ Participant completes demographics survey.

Great! Thank you for completing that. Please follow me to the next room.

- ○ Walk to the Control room.

Part Two (Control):

Please have a seat. Take a moment to look around the room. (Wait about 5-seconds). For this next part, you will select a sample of lotion. Please take a few moments to examine the options. Please choose the one that smells best to you, the one you most prefer.

- ○ After participant selects a lotion, RA places the other two cups of lotion on the small stand in the corner.

This next part will include an audio recording. Once the audio begins playing please listen to it carefully and follow the directions. During this time, I will be waiting outside of the room and, after this part of the study is finished, I will knock before coming back in.

Do you have any questions at this time? (If yes – answer them, but do not be specific).

I will now step out of the room. Please listen to the audio and follow the instructions. I will knock on the door when you have finished the survey.

- ○ RA steps out of the room, closing the door.
- ○ Amel: play Audio Track.
- ○ Amel: Immediately press the ON button on the power strip (white noise machine).
- ○ Participant turns on the monitor and continues working on the survey.
- ○ RA knocks on the door before entering.

Excellent! Thank you for completing this part of the study. Now we will step out and continue to the next and final part of the study. Please follow me.

- ○ Escort the participant to the Tanning Salon.

Part Three (Tanning Salon):

Please have a seat. Take a moment to look around the room. (Wait about 5-seconds). Again, you will select a sample of lotion. Please take a few moments to examine the options. Point to the one that smells best to you, the one you most prefer.

- ○ After participant selects a lotion, RA places the other two cups of lotion on the small stand in the corner.

This next part will also include an audio recording. Please listen to it carefully and follow the directions. I will wait outside of the room again until the audio recording and the survey portion is complete.

Do you have any questions at this time? (If yes – answer them, but do not be specific).

- ○ RA steps out of the room, closing the door.
- ○ Amel: Immediately press the ON button on the power strip.
- ○ Amel: play Audio Track.
- ○ Participant turns on the monitor and continues working on the survey.
- ○ After the participant completes the survey, RA will knock on the door before entering and turning on the lights.

Excellent! Thank you for participating in our study!

- ○ Escort them back to room 1102.

Please follow me back to the first room to pick up your items.

- ○ Make sure the participant collects his/her belongings.
- ○ Hand them the melanoma brochure.

You may now take your belongings and you can have this booklet about melanoma (hand the booklet to the participant). Do you have any questions for me? (Wait for them to respond; answer any questions that they may have). Thank you again for participating. Have a great day!

Appendix M: Procedural Fidelity Checklist

Name of RA: _____

Date and Time: _____

Introduction		**Notes**
	Promptness	
	Professional Appearance	
	Introduced Themselves	
	Other	

Demographics		**Notes**
	Follows Task Analysis	
	Other	

Neutral-Cue Exposure		**Notes**
	Follows Task Analysis	
	Provided lotion	
	Other	

Tanning-Cue Exposure		**Notes**
	Follows Task Analysis	
	Provided lotion	
	Other	

End of Study		**Notes**
	Follows Task Analysis	
	Provided Brochure	
	Other	

Other Notes: