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A comparison of the efficacy of an appearance-focused skin cancer intervention within indoor tanner subgroups identified by latent profile analysis

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Abstract The reduction of intentional exposure to ultraviolet (UV) radiation is an important area of skin cancer prevention. Hillhouse et al. (Cancer 113:3257–3266, 2008) have developed an appearance-focused intervention with evidence of efficacy in lowering indoor tanning UV exposure in young women. In the current study, a subgroup approach was used to determine moderators of intervention efficacy. Undergraduate females in two regions of the United States ($n = 362$) were randomized into an intervention or control condition. Latent profile analysis was used to identify subgroups of indoor tanners based on patterns of indoor tanning motives. Intervention efficacy was examined within each subgroup. We found evidence for 4 subgroups of tanners: knowledgeable-appearance tanners, low-knowledge tanners, low-knowledge, relaxation tanners, and knowledgeable, low-appearance and low-relaxation tanners. The intervention significantly reduced indoor tanning for the low-knowledge subgroup (34% of the sample). The utility of the subgroup approach in developing targeted behavioral skin cancer interventions is discussed.

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The growing incidence of skin cancer has highlighted the need for prevention efforts designed to reduce skin cancer risk behavior. Nearly half of all new cancers are skin cancers (American Cancer Society 2009) and incidence rates of melanoma, the deadliest form of the disease, have increased yearly since 1981 (Clegg et al. 2002). Treatment of skin cancer costs the United States 1 billion dollars annually, making it one of the most expensive diseases to treat (Housman, et al., 2003). Skin cancer risk factors are primarily behavioral and laboratory, case-controlled, and prospective studies suggest a link between the use of artificial ultraviolet (UV) indoor tanning beds/salons and skin cancer (International Agency for Research on Cancer 2007). Despite the risks, the 5 billion United States dollar a year indoor tanning industry continues to grow and 30–50% of young adult women report indoor tanning (Brooks et al. 2006; Knight et al. 2002; Robinson et al. 2008). A recent and dramatic rise in melanoma rates in young women parallels these high indoor tanning rates (Purdue et al. 2008).

Etiological studies have identified psychosocial motives related to the decision to indoor tan. The primary motivation for many tanners is the belief that indoor tanning enhances appearance. Indoor tanning is socially reinforced as young people generally perceive tanned individuals as more attractive than their pale counterparts (Broadstock et al. 1992). Indoor tanning is related to increased confidence in appearance and feelings of attractiveness (Cafri et al. 2009; Hillhouse et al. 1999; Knight et al. 2002). Normative beliefs are also important as individuals who perceive high indoor tanning usage within their friends

(Hillhouse et al. 2000; Jackson and Aiken 2006), the media (Cafri et al. 2006; Jackson and Aiken 2006), or their social group (Stapleton et al. 2008) are more likely to indoor tan. Finally, some tanners are motivated by feelings of relaxation experienced both during and after a session (Knight et al. 2002; Zeller et al. 2006). A reduction in artificial UV preference following opiate blockage (Kaur et al. 2006) provides a possible biological mechanism for this perceived benefit. While much has been written about these variables, little is known about how these different motivations combine within individuals to influence the decision to indoor tanning.

Many indoor tanning interventions are designed to emphasize the appearance-damaging effects of UV exposure under the assumption that most young women are tanning primarily to enhance appearance. These appearance-focused interventions highlight premature skin wrinkling, skin aging, and other forms of skin damage that can be caused or made worse by UV exposure. These interventions have demonstrated reductions in indoor tanning with varying methods of delivery including a booklet (Hillhouse and Turrisi 2002; Hillhouse et al. 2008), an individually-delivered intervention (Turrisi et al. 2008), and UV photographs of participants' UV-induced skin damage (Gibbons et al. 2005).

The appearance-focused booklet intervention (Hillhouse et al. 2002, 2008) represents a promising approach. This intervention (available upon request from the authors) has been designed with principles of decision-theoretical frameworks (Ajzen 1985; Rosenstock 1974) and Jaccard's Behavioral Alternative Model (Jaccard 1981). In addition to providing information about UV-induced appearance and health damage, healthy alternatives to indoor tanning are suggested. The intervention has evidence of efficacy in lowering indoor tanning in two trials (Hillhouse et al. 2002, 2008). The appeal of a booklet includes the potential for widespread distribution and the relatively low cost of intervention dissemination compared to other more resource-intensive interventions.

While this intervention appears to be efficacious, little is known about moderator effects of the current intervention and appearance-focused interventions in general. Moderator analyses are often used to identify pre-intervention characteristics of participants that may influence intervention efficacy. In the current study, indoor tanning motives related to the decision to indoor tan (appearance-enhancement beliefs, normative beliefs, relaxation beliefs), as well as knowledge of both the appearance-damaging and health-damaging effects of UV exposure were examined as moderators of intervention efficacy. These analyses are an integral part of a targeted behavioral medicine approach in which matching interventions to participants is desirable. Inherent in the targeted approach is the assumption that few interventions function as a "one-size fits all" and the identification of distinct types of participants for whom the intervention is efficacious is critical to effective and efficient intervention dissemination (King et al. 2008).

Traditional intervention moderator analyses have entailed using whole samples to test for and interpret interaction effects found between a single variable of interest and the intervention condition. For example, a model could test whether a participant's pre-intervention indoor tanning appearance-enhancement beliefs influence intervention efficacy. While these analyses are informative, examination of decision-making variables in isolation is limiting. Unfortunately, simultaneously modeling multiple moderators with this approach can be complicated given the need for large sample sizes and the difficulty in interpreting higher-order interactions (Pastor et al. 2007). In addition, these analyses are variable-centered approaches that model averaged relationships across participants. This averaging can mask important and distinct intrapersonal decision-making variable patterns that may uniquely influence how a participant responds to an intervention.

In the current study, we used a novel subgroup moderator approach that allows for the simultaneous examination of multiple variables. Latent profile analysis (LPA), a person-centered, model-driven approach, was used to produce distinct subgroups of tanners. Individuals share similar patterns of pre-intervention tanning motives with others in their subgroup and have distinctly different patterns compared to those in other subgroups (Muthén 2002). Intervention efficacy for each LPA-derived subgroup was determined by comparing follow-up indoor tanning behaviors of control and intervention participants within each subgroup.

In addition to providing information about intervention moderator effects, the identification of subgroups of indoor tanners may yield useful conclusions about intervention dissemination strategies. Pagoto and Hillhouse (2008) have discussed the need for pre-intervention screening strategies for placing tanners into appropriate interventions. The identification of distinct subgroups of tanners based on tanning motives may be a first step in establishing intervention screening procedures. If the current intervention is found to be efficacious for tanners with a wide variety of indoor tanning decision-making profiles, the intervention could be widely recommended. However, it is likely the intervention will work best for certain subgroups of tanners. Tanners could be screened prior to intervention administration and the intervention could be recommended for those tanners who are likely to benefit based upon their pattern of tanning motives. Finally, the identification of tanner types for whom the intervention is not efficacious can provide insight into ways to tailor intervention messages to better reach these tanner subgroups.

Methods

Sample

Participants were 362 female undergraduate students (mean age = 18.69, SD = 0.98) drawn from both a Northeastern and a Southeastern United States university. Both universities have primarily Caucasian student populations (>80%). Participants who received the intervention ($n = 169$) were compared to non-intervention control participants ($n = 193$) on baseline demographic variables (Table 1). No significant differences were found.

Recruitment

Study invitation emails were sent to a random selection of 1,690 freshman and sophomore female undergraduates in two cohorts. Inclusion criteria were indoor tanning at least once in the previous year or an intention to indoor tan in the next year. Participants must have been between the ages of 18 and 21 years old as the intervention was written for this audience. Of the 1,690 invited students, 853 participated in the baseline screening assessment. Approximately half of those participants (n = 475) met eligibility requirements and most of those eligible agreed to participate (n = 455). Participants were randomized to condition upon agreement to participate. Data from 53 participants, those recruited in the first cohort, were not used because some measures were not included in the data collection. Of the remaining 402 cohort two participants, we excluded 13 participants who did not receive the mailed intervention and 11 participants who did not meet eligibility requirements but were mistakenly invited into the study. Sixteen participants dropped out after baseline (the small number did not permit a statistical analysis of incompletes vs. completions), yielding a final sample size of 362.

Procedure

The baseline assessment was administered in October 2006 and the booklet was mailed upon completion. The follow-up survey was administered approximately 6 months later

Table 1 Demographic variables by group ($N = 362$ female indoor tanners)

Variables	Control $n = 193$	Intervention $n = 169$
Fitzpatrick skin type ($\chi^2(4, N = 361) = 3.91, p = .42$)		
I	8.3%	7.1%
II	19.2	26.0
III	42.0	42.6
IV	26.9	22.5
V	3.6	1.7
Family socioeconomic status ($\chi^2(3, N = 361) = 0.76, p = .86$)		
Much lower than most families	0.0%	0.0%
Moderately lower	10.4	11.2
About average	53.9	56.8
Moderately higher	31.6	27.0
Much higher than most families	4.1	3.0
Year in school ($\chi^2(3, N = 361) = 5.51, p = .24$)		
Freshman	58.0%	62.7%
Sophomore	31.6	32.0
Junior	9.8	4.7
Senior	0.5	0.5
Mean age (SD)	18.78	18.59
($t(360) = 1.86, p = .06$)	(1.04)	(.89)
Mean age began indoor tanning (SD)	15.72	15.84
($t(347) = -0.71, p = .48$)	(1.63)	(1.44)
Estimated number of tanning sessions in past 12 months (SD)	27.01	28.83
($t(348) = -0.64, p = .52$)	(26.40)	(26.22)
Estimated number of tanning sessions in past 3 months (SD)	3.79	4.62
($t(348) = -1.20, p = .23$)	(6.28)	(6.61)

in April 2007. Participants were offered monetary compensation ($20) for completing each assessment. Assessments were administered online, all participants gave informed consent, and procedures were approved by the Institutional Review Boards at each site.

Intervention description

The intervention is a 24-page booklet written at an 8th grade reading level. The booklet is divided into six sections that address various aspects of the indoor tanning experience. Sections one and two contain information about the history of tanning as well as current tanning norms. Sections three and four provide information about the appearance- and health-damaging effects of UV exposure. Section five provides indoor tanning guidelines that emphasize tanning cessation as well as harm-reduction recommendations. The final section provides information about alternative appearance-enhancement behaviors.

Participants provided feedback about the booklet by writing short summaries and completing rating scales of each section. Ratings of booklet interest, readability, comprehension, and usefulness were highly positive. Additional information about intervention content and fidelity can be found in our previous work (Hillhouse et al. 2002, 2008).

Measures

All measures were derived from previous literature and have demonstrated good reliability (Hillhouse et al. 1999, 2000; Turrisi et al. 1998).

Indoor tanning frequency

Previous 3 and 12 month indoor tanning were measured at baseline. These opened-ended items asked about the number of indoor tanning sessions within the time frame. The follow-up outcome measure was a 3 month indoor tanning frequency item designed to measure behavior during the peak months of indoor tanning (i.e., January through March). These measures have been shown to be highly correlated with bi-weekly diary measures of behavior within the same time frame (r's = 0.87, $P < .001$) (Hillhouse et al. 2008). Extreme outliers (less than 4% of responses) were re-coded to a number of tanning sessions greater than the largest non-outlying value (e.g., two standard deviations above the mean) to achieve acceptable levels of skewness and kurtosis (e.g., <2 and 4, respectively) (Tabachnick and Fidell 2001).

Appearance-enhancement beliefs

These beliefs were measured with 5 items (e.g., "I am satisfied with how much tanning improves my attractiveness", "When I am tan, I am sexually appealing"). The response metric was a 5-point Likert-type scale anchored with 1 (*strongly disagree*) and 5 (*strongly agree*). The items were averaged to create a single index ($\alpha = .88$).

Normative beliefs

Normative beliefs about friends' and peer indoor tanning usage were assessed with 2 items ("My closest friends indoor UV tan" and "Most typical college women indoor UV tan"). Items were measured on 5-point Likert-type scales anchored with 1 (*strongly disagree*) and 5 (*strongly agree*) and were averaged to create a single index ($\alpha = .66$).

Tanning relaxation beliefs

Indoor tanning relaxation beliefs were assessed with 6 averaged items measured on 5-point scales (e.g., "Indoor tanning is a stress-free way to relax", "I love the warm feeling of indoor UV tanning") ($\alpha = .93$).

Appearance-damage knowledge

Appearance-damage knowledge of UV exposure was assessed with 2 averaged items ("I believe that indoor UV tanning can lead to premature skin wrinkling and aging" and "Indoor UV tanning is hard on the long-term appearance of skin") on 5-point Likert-type scales ($\alpha = .70$).

Health-damage knowledge

Health-damage knowledge was assessed with 4 averaged items (e.g., "I think that indoor UV tanning would significantly increase my risk for developing skin cancer", "Indoor UV tanning can harm my health") measured on 5-point scales ($\alpha = .87$).

Statistical analyses

We used LPA to identify categorical latent indoor tanner profiles, or subgroups, based on mean patterns of the five continuous indoor tanning motive indexes. LPA estimates the proportion of participants who fit each subgroup, the pattern of psychosocial indicator variable means within each subgroup, and the posterior probability of each individual belonging to each subgroup. Scores on these indicator variables were standardized to aid in interpretation of

the tanner subgroups. The LPA model used also assumes equal indicator-item variances across latent subgroups.

Model testing was based on the recommendations of Lanza et al. (2007). The first step in determining the best-fitting LPA model is to test a model restricted to a one-profile solution to the data. Additional classes are added iteratively and fit indices are evaluated at each step to test for model fit improvement. The appropriate fit indices for LPA models are the Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC). A decrease in size of these indices is indicative of better model fit (Muthén and Shedden 1999). Also critical to determining model fit is the extent to which a given model converges and the practical interpretability of the resulting profiles. LPA analyses were conducted with M plus version 4.4 (Muthén and Muthén 2006).

We tested for intervention effects on mean levels of indoor tanning at follow-up within each subgroup using a series of independent *t*-tests. We chose to use multiple comparisons over alternative approaches (e.g., ANOVA) because the subgroups found in an LPA often have unequal numbers of individuals and disproportionate variances between subgroups which can lead to unpredictable changes in type 1 error rates with ANOVA (Glass et al. 1972). In addition, the ANOVA assumption that membership in one subgroup does not influence whether a participant can be a member of another is violated (Clark and Muthén 2009).

Results

Latent profile analysis

The first step in the latent profile analysis was to fit a comparison baseline model that restricted the data to a one-profile solution (Table 2). This baseline model was compared to less restricted models (e.g., models freed to fit additional profiles) until the best fitting model was found. The second model tested allowed a two-profile solution to the data. The AIC and BIC fit indices decreased for the second model, which was indicative of better model fit for the two-profile solution. Three- and four-profile models were subsequently tested with the four-profile solution exhibiting the best model fit. The four-profile solution was retained as the final model when the five-profile solution did not converge, which is often indicative of poor model fit due to the over extraction of profiles. For each model, estimation terminated normally using 250 random start values and the best loglikelihood value replicated. The entropy value for the four profile solution was 0.89. An entropy value above 0.80 suggests well separated and distinct latent profiles as well as good predictive value of the tanner profiles by the indoor tanning motive indicator variables (Celeux and Soromenho 1996).

Table 2 Fit indices for latent profile analysis models

	AIC	BIC
One-profile solution	4571.09	4610.01
Two-profile solution	4414.82	4477.08
Three-profile solution	4278.43	4364.05
Four-profile solution	4192.28	4301.25

Note: The five-profile solution did not converge

AIC Akaike Information Criteria, *BIC* Bayesian Information Criteria

The four profiles/subgroups are presented in Table 3. The numbers below each subgroup heading represent the mean values of the five moderator variables for individuals in each subgroup. These numbers have been standardized (z-scores) to aid in interpretation of the means. Examination of Table 3 shows that approximately 47% of the sample ($n = 179$) was represented by profile one. When compared to other subgroups, individuals in this subgroup reported higher than average appearance-enhancement beliefs (0.22), approximately average scores on normative beliefs (0.01), average levels of relaxation beliefs (0.16), and above average appearance-damage (0.60) and health-damage knowledge (0.41). Their knowledge of both types of risks was significantly higher on average than individuals in subgroups 2 and 3 (represented by different Table 3 subscripts). Based upon this pattern of motive means, this subgroup was labeled knowledgeable-appearance tanners.

Individuals described by the second tanner subgroup ($n = 117$; 34% of the sample) reported approximately mean levels of appearance-enhancement beliefs (0.09), normative beliefs (0.08), and relaxation beliefs (0.15) while reporting significantly below average appearance- (−.50) and health-damage knowledge (−0.45). These tanners seemed to be relatively unaware of the negative effects of indoor UV exposure and were labeled low-knowledge tanners.

The third subgroup (8% of the sample; $n = 30$) reported approximately average levels of appearance (0.04) and normative (−0.14) beliefs, above average levels of relaxation beliefs (0.34), and significantly below average levels of both appearance- (−2.09) and health-damage (−1.03) knowledge. Individuals in this subgroup reported significantly lower knowledge compared to the other subgroups and were unique in reporting significantly above average relaxation motivation. As such, this subgroup was labeled low-knowledge, relaxation tanners.

The final subgroup (11%; $n = 36$) was characterized by significantly below average scores on appearance enhancement (−1.28), below average scores on normative beliefs (−0.21), significantly below average relaxation beliefs (−1.45), and significantly above average appearance- (0.56) and health-damage knowledge (0.45). These

Table 3 Standardized means (and variances) of the indoor tanning motives within each subgroup

	Subgroup 1: knowledgeable-appearance tanners ($n = 179$; 47%)	Subgroup 2: low-knowledge tanners ($n = 117$; 34%)	Subgroup 3: low-knowledge, relaxation tanners ($n = 30$; 8%)	Subgroup 4: knowledgeable, low-appearance and low-relaxation tanners ($n = 36$; 11%)
Appearance-enhancement beliefs ($\sigma^2 = .46$)	$.22^{4}$	$.09^{4}$	$.04^{4}$	$-1.28^{1,2,3}$
Normative beliefs ($\sigma^2 = .74$)	.01	.08	−.14	−.21
Relaxation beliefs ($\sigma^2 = .48$)	$.16^{4}$	$.15^{4}$	$.34^{4}$	$-1.45^{1,2,3}$
Appearance-damage knowledge ($\sigma^2 = .11$)	$.60^{2,3}$	$-.50^{1,3,4}$	$-2.09^{1,2,4}$	$.56^{2,3}$
Health-damage knowledge ($\sigma^2 = .46$)	$.41^{2,3}$	$-.45^{1,3,4}$	$-1.03^{1,2,4}$	$.45^{2,3}$

Note: All variables have been standardized (z-scores) to aid in interpretation

Superscripts (e.g.,[1]) indicate a significant mean difference with the numbered subgroup, $P < .05$

individuals were knowledgeable of negative tanning effects but report significantly lower appearance-enhancement and relaxation beliefs compared to the other subgroups. This subgroup was labeled knowledgeable, low-appearance and low-relaxation tanners.

Comparing intervention and control participants within subgroups

As the average posterior probability of membership within each class was greater than or equal to .88 (i.e., .91, .96, .99, .88), individuals were assigned to their most likely profile in order to perform the subgroup moderator analyses (Clark and Muthén 2009). Comparisons between treatment and control participants on the 3 month indoor tanning outcome were made within each subgroup using 4 independent *t*-tests. Twelve of the 362 participants assigned to subgroups were missing outcome data and were excluded from the follow-up analysis. Baseline equivalence was tested by comparing participants in each subgroup on past 12 month indoor tanning at baseline. There were no significant intervention and control differences in previous year indoor tanning within the 4 subgroups (all P's $> .10$). Thus, differences in follow-up behavior within the subgroups are likely due to the intervention.

The tests showed a significant difference between treatment and control participants in the low-knowledge tanner subgroup, $t\ (112) = 2.48$, $P < .05$, such that, on average, control participants engaged in 4.12 more tanning sessions compared to treatment participants during the 3 month post-intervention follow-up period (Table 4). Non-significant follow-up behavior differences were observed between intervention and control participants in each of the 3 other subgroups (all t's < 1.96, all P's $> .05$). The *t*-test normality assumption was met for all subgroups except for the low knowledge tanner subgroup and, as a result, the corrected *t*-test significance value was used. The difference in the *t*-values was minimal (uncorrected $t = 2.36$ vs. corrected $t = 2.49$).

We also provide Cohen's *d* (Table 4) to estimate intervention effects sizes. Medium intervention effect sizes were observed for the low-knowledge tanner subgroup (.46). Effect sizes were small for the knowledgeable-appearance tanners (.20), low-knowledge, relaxation tanners (.30), and the knowledgeable, low-appearance and low-relaxation tanners (.27).

Table 4 Mean (SD) indoor tanning sessions at 3 month follow-up by subgroup and intervention condition with 95% confidence intervals and effect sizes

Tanner subgroup	Intervention condition		*t*-value	95% *LCI* of mean difference	95% *HCI* of mean difference	Cohen's *d*
	Treatment	Control				
Knowledgeable-appearance tanners	9.68 (*10.85*) $n = 87$	7.61 (*10.01*) $n = 88$	1.31	−1.056	5.19	.20
Low-knowledge tanners	9.71 (*10.06*) $n = 68$	5.59 (*7.59*) $n = 46$	2.48*	0.838	7.40	.46
Low-knowledge, relaxation tanners	10.46 (*12.28*) $n = 13$	7.15 (*9.17*) $n = 13$	0.78	−5.503	12.13	.30
Knowledgeable, low-appearance and low-relaxation tanners	1.04 (*2.62*) $n = 23$	2.25 (*5.79*) $n = 12$	−0.69	−4.99	2.58	.27

Numbers in italics represent standard deviation

* Indicates a significant difference between intervention conditions within subgroup, $P < .05$

Discussion

Young adult females are an important population for skin cancer prevention efforts as indoor tanning rates are high in this population. We identified indoor tanner subgroups and tested the efficacy of an appearance-focused handbook intervention within each subgroup.

The LPA solution found support for four latent profiles/subgroups of indoor tanners. Individuals described by the largest subgroup (47% of the sample) reported strongly positive appearance-enhancement beliefs and knowledge of the appearance- and health-damaging effects of indoor tanning. These knowledgeable-appearance tanners seem to be similar to tanners described by others (Knight et al. 2002; Robinson et al. 2008) who continue to indoor tan for appearance enhancement despite being knowledgeable of the negative appearance effects. Researchers have hypothesized that the immediate benefits of indoor tanning, in the form of increased feeling of physical attractiveness, override concerns about harmful effects that are unlikely to occur in the near future. Routledge et al. (2004) have suggested that tanning is beneficial for these individuals on an unconscious level through buffering psychological health-related anxiety by facilitating feelings of self-esteem.

The low-knowledge tanner subgroup (34% of sample) represented tanners who reported low levels of knowledge of the appearance- and health-damaging effects of indoor tanning. While media coverage of the dangers of tanning has increased in the previous two decades, evidenced by increases in knowledge in young people over that time (Robinson et al. 2008), this finding suggests there may be a sizable portion of tanners who have either not received the UV-harm message from media sources and health care professionals or have not attended to it. Robinson et al. (2008) reported 34% of respondents did not know that limiting tanning could prevent future skin cancer, a finding similar to the current study.

The low-knowledge, relaxation subgroup represented the smallest portion of the sample. Researchers have begun to document the physiological effects of indoor tanning (Kaur et al. 2006; Poorsattar and Hornung 2007; Zeller et al. 2006) and our findings suggests a small portion of participants may be indoor tanning primarily for affective reasons. Knowledge of UV-induced appearance and health damage was very low for this subgroup. The strong relaxation motives for these tanners may lessen their interest in knowledge of appearance-related aspects of indoor tanning or may lead them to disregard information about the negative implications of tanning.

The last subgroup (11% of the sample) described tanners who were knowledgeable of UV-related risk and reported the lowest appearance and relaxation beliefs. Given that the motives of these tanners are not obvious in the current study, they may not be well described by the measures. The mean levels of tanning in this subgroup suggest these individuals are tanning at very low rates compared to those in other tanner profiles. Hillhouse et al. (2007) described a tanning behavioral profile labeled event tanners. Event tanners typically tan at low rates and only before specific events such a spring formals, weddings, etc. However, in this study, event tanners represented the largest group of tanners (>50%). It is possible these knowledgeable, low-appearance and low-relaxation tanners represents a portion of event tanners who are simply accompanying other more motivated tanners to tanning session or tanning occasionally, and thus demonstrate weaker appearance motivations. These conjectures point to the need to better characterize these tanners in future research.

In order to assess intervention moderator effects, we compared intervention and control participants within each subgroup on follow-up indoor tanning behavior. A significant, medium-sized intervention effect was found for those assigned to the low-knowledge tanner subgroup. In this subgroup, those who received the intervention reported tanning approximately half as often as those in the control condition. Given that nearly 1 in 3 of the sample are likely to be described by this tanner type, the current intervention has the potential for reducing indoor tanning rates among a sizable portion of the indoor tanning population. These findings suggest that by using a targeted intervention approach, through screening indoor tanners on tanning motives, those identified as low-knowledge tanners may reduce harmful indoor tanning behaviors through the administration of the booklet. For these tanners, the current intervention represents an easily disseminated and economically viable option with the potential of impacting future skin cancer incidence rates.

Intervention effects were non-significant for those participants described by the knowledgeable-appearance tanner profile. This finding suggests the appearance-focused intervention was not successful for tanners who reported the highest appearance motives.

This lack of efficacy may be due to the finding that knowledgeable-appearance tanners are aware of the appearance-damaging effects of indoor tanning prior to intervention administration. These young women may have already considered the negative-appearance implications of indoor tanning and decided the risk of future damage was worth the immediate appearance-enhancement gains. The intervention may be "old news" to these indoor tanners and alternative intervention strategies seem necessary.

One strategy would be to alter the booklet message to one that is less focused on increasing knowledge of appearance damage and more focused on behavioral alternatives, like sunless tanning, that provide indoor tan-

ners with the appearance benefits they get from tanning. Mahler et al. (2005) found increased intervention efficacy when sunless tanning product samples were included with the intervention. In addition, interventions that make the appearance-damage message more personally salient, such as UV-photograph interventions that show existing UV-damage on the faces of indoor tanners (Gibbons et al. 2005; Mahler et al. 2005), may be more effective for these tanners. Finally, researchers have suggested that interventions designed to challenge young women's views of media-driven cultural standards of attractiveness and increase body satisfaction may reduce indoor tanning (Cafri et al. 2006; Jackson and Aiken 2006; Stapleton et al. 2009). This message has been used with efficacy in other women's health areas such as disordered eating, which, like indoor tanning, can be viewed as an appearance-control behavior (Stice and Shaw 2004). More work is needed to determine the potential of this type of intervention.

Non-significant intervention effects were found for the low-knowledge, relaxation subgroup. The failure to detect differences could be due to low power given the small sample sizes (e.g., 13 participants in each condition). While the appearance-focused aspects of the intervention may be important for this subgroup given the low levels of UV-damage knowledge, these findings suggest that supplemental information may be needed to reach these tanners who are tanning for affective reasons. Intervention efficacy may be increased by providing information on alternative ways to experience the relaxation gained from indoor tanning (Danoff-Burg and Mosher 2006). Relaxation alternatives that have the added advantage of contributing to appearance enhancement, like exercising and yoga, may be particularly attractive for this group. Future work should make these alternatives a focal point of interventions. For the final subgroup, the knowledgeable, low-appearance and low-relaxation tanners, the difference between treatment conditions was also small and non-significant. There is likely a floor effect with this group in that their tanning behaviors were so low that it was difficult to produce a significant reduction. However, better understanding of their motivations may allow future interventions to eliminate indoor tanning entirely.

There are some limitations in the current research. All outcome measures were self-report and some recall bias may have occurred. However, Turrisi et al. (2006) have found self-reported UV-risk behavioral measures to be satisfactory. The intervention sample was primarily limited to freshman and sophomore college students in the Eastern United States who reported, on average, medium to moderately high socioeconomic status. More work is needed to test intervention efficacy with older college students, non-college attending women, and women from more diverse geographical locations. The small sample size for some profiles led to a lack of statistical power for treatment control comparisons and necessitated the use of statistical techniques that did not allow for adjustment of covariates. However, the randomization procedures and lack of evidence of pre-intervention sample biases between conditions increases confidence in the findings. The medium effect size of the intervention for the low-knowledge tanners is particularly encouraging as an effect of this size is difficult to find in behavioral intervention studies. Finally, the normative belief index did not differentiate between subgroups. This finding does not necessarily indicate that norms are non-influential to intervention efficacy. A ceiling effect may have occurred as norms were uniformly high in the sample of heavy tanners. Future work should consider whether alternative measures of sociocultural influence further delineate the tanner types.

In sum, the booklet shows promise in reducing indoor tanning tendencies among low-knowledge tanners and could be recommended for tanners with similar patterns of tanning motives. Future research should focus on tailoring intervention content toward knowledgeable-appearance tanners and low-knowledge, relaxation tanners. While the current subgroup LPA solution exhibited good statistical properties and was consistent with the etiological literature on tanning motives, LPA is, by design, exploratory in nature. Future work is needed to replicate the findings in other samples to determine the construct validity of the observed tanner subgroups. In addition, future studies should examine whether screening participants and placing them into pre-determined interventions based upon screening results can lead to increased intervention efficacy. If the booklet was tailored toward a subgroup with a certain pattern of tanning motives, it would be expected that tanners identified as having this pattern by pre-intervention screening would benefit more from the tailored intervention compared to the current handbook. We believe the current research demonstrates the utility of identifying subgroups of intervention participants as a step toward a targeted behavioral skin cancer intervention approach.

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