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A Mediator Model of Sunscreen Use: A Longitudinal Analysis of Social-Cognitive Predictors and Mediators

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Abstract
Background Sun safety behaviors to prevent skin cancer, such as sunscreen use, are difficult to adopt and maintain.
Purpose Most social-cognitive theories assume that the intention to change a behavior is the best predictor of actual change. But unforeseen barriers emerge, or people give in to temptations, such as getting a tan despite their initial good intentions. The Health Action Process Approach proposed by Schwarzer (Appl Psychol 57:1–29, 1) is used to explore the self-regulatory mechanisms of sunscreen use.
Method An international longitudinal survey was conducted with 524 individuals. Intentions, positive outcome expectancies, distal self-efficacy, and risk perception were assessed at time 1, whereas intention, planning, and proximal self-efficacy were measured 2 weeks later at time 2. Sunscreen use was reported at 3-month follow-up (time 3).
Results A structural equation model fit the data well. Positive outcome expectancies, risk perception, and self-efficacy predicted the behavioral intention. Self-efficacy and planning predicted sunscreen use, and planning mediated the relation between intended and performed sunscreen use.
Conclusion The findings contribute to the understanding of psychological mechanisms in health behavior change. They also point to the particular role of mediator variables in the context of sun protection behaviors, which may have implications for designing skin cancer preventive interventions.

Keywords Sunscreen use · Self-efficacy · Planning · Intention · Skin cancer · Sun safety

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Introduction

Skin cancer has become one of the most prevalent forms of cancer around the world among Caucasian populations [2]. Being caused by health-compromising behaviors such as unprotected sun exposure [3], it can be prevented by taking simple protection measures that have been proven to be effective, such as using sunscreen [4, 5]. The skin cancer prevention literature reflects a debate on the most appropriate level of sun protection factor (SPF). Recent medical information on skin cancer protection recommends a SPF of 30 and above [4], although the Healthy People 2010 skin prevention goals and the World Health Organization [6] recommend a SPF of 15 and above [5]. This latter level has been used in most previous psychological studies on sunscreen use [7], and it will also be used in this study.

Although individuals have, in principle, control over their conduct, many fail at successfully controlling their risk behaviors. Such problems can be overcome by self-regulatory efforts, and preventive measures can be adopted, such as using sunscreen, wearing protective clothing, or seeking shade. However, only around 29–50% of individuals adhere to recommended sun protection guidelines [8], and around 70% of young people have been shown not to

use sunscreen regularly [9], highlighting the need to identify the factors that make people adopt more sun protection behaviors.

Health behavior change refers to motivational as well as volitional processes, such as adopting and maintaining health-enhancing behaviors. It also encompasses a variety of social, emotional, and cognitive factors that sometimes are assumed to operate in concert. Therefore, researchers have aimed at identifying the optimal set of factors that allow for the best prediction or explanation of health behavior change. Factors and their interplay are modeled in social-cognitive theories (for a discussion and comparison of models, see Lippke and Ziegelmann [10]).

The Health Action Process Approach

Intention to change behavior stands at the core of most health behavior models and was found to be one of the best proximal predictors of behavior [1]. However, although people sometimes have the best intentions to quit bad habits and adopt healthy alternatives, they may not manage to translate their intentions into action. Intentions have been shown to account for 20–25% of behavior variance [11]. Thus, the majority of behavior variance is left unexplained by intention. This might be best explained by intenders failing to act upon their good intentions [12]. Hence, we focus on postintentional processes in the present study. In studies with long time spans between the assessment of intentions and behavior as well as in intervention studies, intentions have been shown to have limited predictive value [13]. Following this line of thought, it is important to tackle the postintentional factors that help people act upon their intentions.

A model that explicitly includes postintentional mediators to overcome the intention-behavior gap is the Health Action Process Approach (HAPA) [1]. This approach suggests a distinction between (a) pre-intentional motivation processes that lead to a behavioral intention and (b) postintentional volition processes that lead to the actual health behavior. Within the two phases, different patterns of social-cognitive predictors may emerge. In the initial motivation phase, a person develops an intention to act. Within this first phase, risk perception is seen as a distal antecedent (e.g., "I am at risk for developing skin cancer"). Risk perception alone is insufficient to form an intention. Rather, it may set the stage for further elaboration of thoughts about consequences and competence. Similarly, positive outcome expectancies (e.g., "If I use sunscreen, I will reduce my risk for skin cancer") are seen as being important in the motivation phase, when a person balances the pros and cons of certain behavioral outcomes. Further, one needs to believe in one's capability to perform the goal behavior (perceived self-efficacy, e.g., "I am capable of using sunscreen even if it feels sticky"). Perceived self-efficacy operates in concert with positive outcome expectancies, both of which contribute substantially to forming an intention.

After a person develops a motivation toward adopting a particular health behavior, the "good intention" has to be transformed into detailed instructions on how to perform the desired action. Moreover, once an action has been initiated, it needs to be maintained. This is not achieved through a single act of will but involves self-regulatory skills and strategies. Thus, the postintentional phase should be further broken down into more proximal factors represented by volitional constructs, such as self-efficacy and planning.

Good intentions are more likely to be translated into action when people plan the concrete goal attainment and how to overcome barriers. Planning mediates between intention and behavior [14]. Meta-analyses have summarized the findings on the effects of planning (or "implementation intentions") on health behaviors (for an overview, see Gollwitzer and Sheeran [15]). Planning is an alterable variable. It can be easily communicated to individuals with self-regulatory deficits. Randomized controlled trials have documented the evidence in favor of such planning interventions to improve the adoption and maintenance of health behaviors [16–18].

The HAPA allows for a prediction of behavior as well as an understanding of the causal mechanisms involved in behavior change. Thus, a great deal of empirical evidence has been accumulated to support the assumptions of the model for diverse behaviors, such as a healthy diet, performing physical exercise, dental flossing, breast cancer screening, smoking, or seat belt use [1, 19–22]. However, no studies so far have explored the applicability of the HAPA model within the context of sunscreen use.

Predictors of Sunscreen Use

Previous research in the domain of sun protection has tried to identify the best predictors of protective behavior adoption. Perceived threat of developing skin cancer, costs and benefits of adopting a sun protection method, social norms, tanning attitudes, and knowledge about skin cancer were found among the most frequent predictors of sun protection [8, 23, 24]. Risk perception concerning perceived susceptibility to skin cancer and premature aging due to unprotected sun exposure has been shown to predict intention and sunscreen use [25, 26]. Self-efficacy, defined as the belief that one can adopt a certain behavior despite existing barriers, was identified as one of the best predictors of both sun protection intention and behavior [27, 28]. Several barriers for using sunscreen were described, such as beliefs that sunscreen was greasy and sticky, the fact that

sunscreen has to be applied repeatedly, and for men the belief that using sunscreen is "not very manly" [29]. While positive and negative expectancies associated with tanning were thoroughly explored as predictors of sun protection [30], the role of positive outcome expectancies regarding the results of using sunscreen has been not explored in previous studies.

Regarding postintentional factors, planning has been shown to mediate and moderate between intention and sunscreen use [31, 32]. However, these studies did not explore planning as part of a behavior change model but investigated its role as a component added to other models of sun protection.

Earlier studies have tested the effectiveness of the Health Belief Model in predicting sun protection practice in different age groups [33], the effectiveness of Protection Motivation Theory [34, 35], the Theory of Planned Behavior [28], and the Transtheoretical Model [36] in predicting sun protection. However, there is a scarcity of theory-based studies investigating the applicability of both pre-intentional factors, such as positive outcome expectancies, risk perception, and self-efficacy, and postintentional factors, such as planning to change sunscreen use.

Aims of the Present Study

Much evidence has emerged that underscores the theoretical contribution of the HAPA in the context of various health behaviors. The present research represents an application of this model to sunscreen use. So far, no study was found testing the application of the HAPA to sun safety behavior. Moreover, little attention has been given to pre-intentional factors, such as positive outcome expectancies or postintentional mediators of sunscreen use, such as planning. The question is whether the HAPA can be replicated in the context of sunscreen use.

Method

Participants and Procedure

Participants were recruited by announcements placed on university websites and discussion forums from June to September 2009. The online questionnaire was available in four languages: English, German, Portuguese, and Romanian. The study was performed in accordance with both the Helsinki Declaration and the Proposals for Safeguarding Good Scientific Practice by the German Research Foundation. It was also approved by the review board of participating universities. At time 1 (T1), persons (N=524) who were interested in the study gave informed consent for participation and filled in their e-mail address, at which they received the follow-up questionnaires 2 weeks later (time 2, T2) and again 3 months later (time 3, T3). The T1 and T2 questionnaires were completed by 515 participants, whereas the questions at T3 were answered by 154 respondents, 11 (7.1%) of whom were men and 143 (92.9%) were women, with a mean age of 21.46 years (SD=4.47), ranging from 18 to 48 years.

A multivariate analysis of variance revealed differences between dropouts and individuals remaining in the study, Pillai's trace=0.133, $F(7, 495)=10.84$, $p<0.05$. Post hoc analyses of variance showed differences in intentions to use sunscreen ($F(1, 501)=3.57$, $p<0.05$), age ($F(1, 50)=52.77$, $p<0.01$), risk perception ($F(1, 501)=34.24$, $p<0.01$), and gender (Cramer's $V=12$, $p<0.01$). Those who were available for T3 measurements were more likely to be women (92.9% women, 7.1% men), were significantly younger ($t=6.19$, $p<0.01$), perceived less risk ($t=0.46$, $p<0.01$), and had lower intentions to use sunscreen ($t=0.15$, $p<0.05$).

Measures

Risk perception, positive outcome expectancies, self-efficacy, and intention were measured at T1, intention, self-efficacy, and planning at T2, and sunscreen use at T3 [1]. *Intention to use sunscreen* was measured at T1 and T2 with one item asking participants about their intentions during the next months: "I intend to use sunscreen with a SPF 15+ when I am in the sun." Responses ranged from *strongly disagree* (1) to *strongly agree* (4). The correlation between intention T1 and T2 was 0.67 ($p<0.01$).

Planning to use sunscreen was measured at T2 with four items that asked participants to state to which extent they had made a concrete plan on when, where, and how they would use sunscreen. Responses were made on four-point scales ranging from *not at all true* (1) to *exactly true* (4). Cronbach's α was 0.86 for the planning items.

Risk perception was assessed at T1 by four items that targeted perceived vulnerability to develop premature wrinkles and skin spots due to unprotected sun exposure and perceived vulnerability to develop skin cancer. For two of the items, respondents had to estimate their risk for developing cancer and for premature skin aging by choosing an answer from *very unlikely* (1) to *very likely* (5). The other two items asked people to compare their chances of developing premature wrinkles and skin cancer to an average person of their own sex and age. Chances were rated from *much below average* (1) to *much above average* (5). Cronbach's α was 0.88 for the risk perception items.

Self-efficacy was measured at T1 (distal) and T2 (proximal) with four items that asked about people's confidence that they can apply sunscreen even if they face various barriers, such as desiring a tan or forgetting the

sunscreen. Responses ranged from *not at all true* (1) to *exactly true* (4). For distal self-efficacy, Cronbach's α was 0.82, whereas for proximal self-efficacy α was 0.84.

Positive outcome expectancies were assessed at T1 with four items that asked people to respond to what extent they consider several positive outcomes to be true in the case of applying sunscreen, such as having healthy skin or preventing wrinkles. Response options were from *not at all true* (1) to *exactly true* (4). Cronbach's α was 0.83 for these four items.

Sunscreen use was measured at T3 by asking people whether they applied sunscreen with a sun protection factor (SPF) 15+ on sunny days when they were outside. Responses ranged from *strongly disagree* (1) to *strongly agree* (4). Table 1 displays the item examples for all measures used in the study, means, standard deviations, reliability coefficients, and factor loadings obtained in structural equation analyses.

Data Analysis

Structural equation modeling with AMOS 18 was used to examine the longitudinal model. Multiple indicators were specified for each construct except for intention and behavior. Self-efficacy was measured repeatedly at T1 and T2 with four items each. In terms of their distance to the final outcome, we labeled them distal self-efficacy and proximal self-efficacy. Autocorrelated residuals among these two constructs were set free to covary. Positive outcome expectancies as well as risk perception were measured at T1 with four items each. Intention was a single-item measure at T1 and T2. To define the temporal distance between antecedents (self-efficacy, outcome expectancies, and risk perception) and outcomes (planning and sunscreen use), we specified intention in between as a stable construct indicated by these two items. Planning at T2 was measured with four items. For the final behavioral outcome at T3, only one item on sunscreen use was available. Missing data were imputed using full information maximum likelihood, as recommended by Graham [37].

Results

A correlation matrix was inspected to identify the suitability of the data for path analytic procedures (Table 2). Sun protection was mainly related to intention (r=0.46), proximal self-efficacy (r=0.41), and planning (r=0.50), which confirms the contribution of volitional variables to behavior.

A longitudinal structural equation model with multiple indicators was examined. The model fit the data well, χ^2=660, df=217, p<0.01, χ^2/df=3.0, comparative fit index=0.93, Tucker–Lewis index=0.91, root mean square error of approximation=0.06. The standardized solution is depicted in Fig. 1.

Alternative models were specified to examine whether a different one would come up with a superior fit to the data, but this was not the case. Testing the direct effect from intentions to behavior did not make any improvement.

The factor loadings (lambdas) were very high, indicating a good measurement model (see Table 1). The retest reliability of self-efficacy was high (0.82), reflecting the stability of this construct over time. The latent correlation between distal self-efficacy and outcome expectancies was 0.35, between outcome expectancies and risk perception was 0.09, and between self-efficacy and risk perception 0.17. Most conspicuous are the paths from distal self-efficacy to intention (0.63), from intention to planning (0.64), and from planning to behavior (0.44). Moreover, one has to consider the indirect and total effects. Via this pathway and the one via proximal self-efficacy, distal self-efficacy exerts a total effect of 0.39 on sunscreen use and a total effect on planning of 0.41. In comparison, the total effects of outcome expectancies (0.06) and risk perception (0.03) on behavior are negligible. The model explains 35% of behavior variance, 41% of the variance in planning was explained by intention, and 57% of the intention variance by the social-cognitive predictors.

Discussion

The present data attest to the applicability of the HAPA in the context of sunscreen use, adding to the evidence on its usefulness as documented for other behaviors, such as healthy diet, performing physical exercise, dental flossing, breast cancer screening, smoking, and seat belt use [1, 19–22]. Nevertheless, some of the present results require further discussion, for example, the role of health risk awareness adopting the use of sunscreen. In some of the previous studies on sun protection predictors, risk perception was shown to forecast sunscreen use [25, 26, 34]. But previous research shows that risk perception may be less important than outcome expectancies and self-efficacy in predicting intentions [1]. The present study adds to this evidence base by showing that risk perception makes only a minor contribution within the intention formation process, especially in comparison to positive outcome expectancies and self-efficacy toward sunscreen use. One possible explanation might be that other factors, such as valuing a tan [23] might come into play and weaken the effect of risk perception on intention. Future studies should explore the importance of adding appearance norms in the motivational and volitional stages of the HAPA in predicting intention and adoption of sun protection measures.

Table 1 Overview of variables and psychometric data

Construct	Items	Response scale	*M*	SD	Factor loadings
Risk perception	How likely is it that you will develop…: …wrinkles and skin spots due to unprotected sun exposure?	1 (very unlikely)–5 (very likely)	2.47	0.84	0.63
	…skin cancer due to unprotected sun exposure?				0.75
	Compared to an average person of your sex and age, your chances for premature aging are	1 (much below average)–5 (much above average)			0.79
	Compared to an average person of your sex and age, your chances of developing skin cancer are				0.86
Positive outcome expectancies	If I use sunscreen with SPF 15+ I avoid getting sunburned.	1–4	3.07	0.60	0.68
	If I use sunscreen with SPF 15+ I avoid getting wrinkles and age spots.				0.84
	If I use sunscreen with SPF 15+ I reduce my chances of developing skin cancer.				0.71
	If I apply sunscreen when I am in the sun I keep my skin looking young and healthy.				0.74
Distal self-efficacy	I believe I can use sunscreen even if I think I will not get a tan.	1–4	3.13	0.59	0.63
	I believe I can use sunscreen even if my friends do not apply sunscreen when they are in the sun.				0.77
	I believe I can use sunscreen even if I have to invest time and money to buy it.				0.80
	I believe I can use sunscreen even if I have to remember to carry it with me and apply it regularly.				0.74
Intention 1	I intend to use sunscreen with a SPF 15+ when I am in the sun (T1).	1–4	3.18	0.85	0.82
Intention 2	I intend to use sunscreen with a SPF 15+ when I am in the sun (T2).	1–4	3.21	0.78	0.82
Proximal self-efficacy	I believe I can use sunscreen even if I think I will not get a tan.	1–4	3.13	0.57	0.66
	I believe I can use sunscreen even if my friends do not apply sunscreen when they are in the sun.				0.73
	I believe I can use sunscreen even if I have to invest time and money to buy it.				0.83
	I believe I can use sunscreen even if I have to remember to carry it with me and apply it regularly.				0.82
Planning	I have already made concrete plans on how, when and where to use sunscreen.	1–4	2.32	0.79	0.86
	I have already made concrete plans about what to do if I don't have sunscreen with me.				0.83
	I have already made concrete plans about what to do if I feel awkward when applying sunscreen.				0.64
	I have already made concrete plans about what to do if I forget to apply sunscreen.				0.86
Behavior	I applied sunscreen with a sun protection factor (SPF) of at least 15+ when I was in the sun.	1–4	2.31	0.91	–

SD standard deviations

Table 2 Correlation matrix of the major study variables based on composite scores

	1	2	3	4	5	6
1. Risk perception	–					
2. Distal self-efficacy	0.14*	–				
3. Outcome expectancies	0.07	0.31*	–			
4. Intention	0.21*	0.57*	0.35*	–		
5. Proximal self-efficacy	0.17*	0.67*	0.29*	0.62*	–	
6. Planning	0.05	0.39*	0.29*	0.52*	0.42*	–
7. Sunscreen use	−0.04	0.29*	0.23*	0.46*	0.41*	0.50*

*$p<0.01$

The present findings also attest to the important role played by positive outcome expectancies in conjunction with self-efficacy in developing a motivation to use sunscreen. This has implications for interventions that suggest to focus on both factors when trying to change intentions to use sunscreen.

The main addition of the HAPA in comparison to previous social-cognitive models is its inclusion of volitional factors, such as proximal self-efficacy (e.g., coping self-efficacy, recovery self-efficacy) and strategic planning that come into play after people have formed an intention to change their health-compromising behaviors. Strategic planning mediates between intention and behavior, showing that an increase in intentions makes it more likely to plan and then to translate plans into behavior. The present results add to the evidence that emphasize the need to regard postintentional variables in sun protection interventions [31, 32]. Earlier interventions based on the Transtheoretical Model have proven to be effective in promoting sun protection intention and behavior. Although tailored to behavior change stages, these do not explicitly address planning and do not respect the principle of parsimony in designing theory-based interventions [38, 39], or the transition from preparing to act and maintenance is not clearly stated [39].

In a previous analysis with a smaller sample [40], we have found that health-specific optimism in conjunction with high intentions was a prerequisite for planning. Health-specific optimism was based on reverse-coded risk perception at T2. The implication was that people are not motivated by high-risk perception of skin cancer, but rather by low-risk perception after they have already formed an intention, and that one might in the future rather measure the conditional risk perception (e.g., "I am only at risk if I don't take any precautions"). The mechanisms involved need to be further examined.

Some limitations of the present study also need to be addressed. Although self-reports have been shown to be

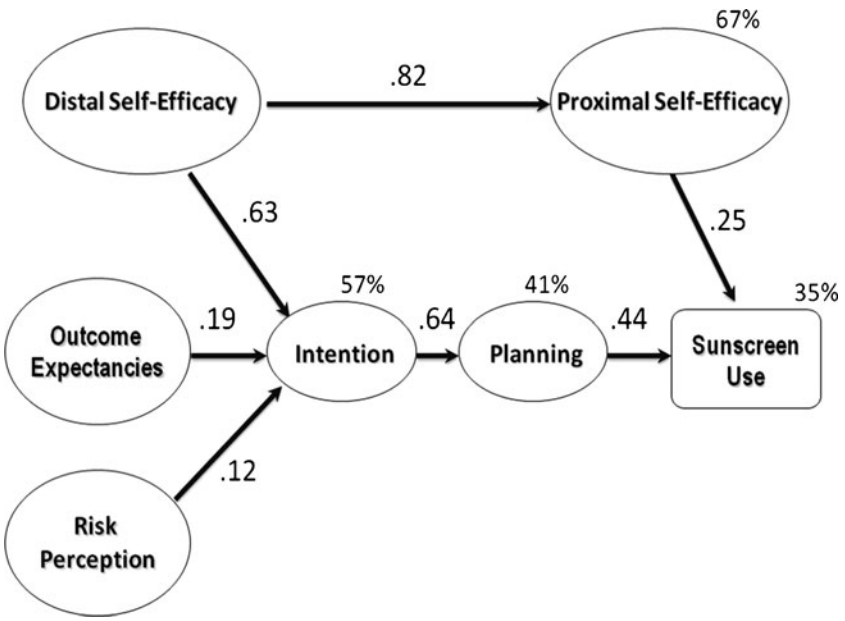

Fig. 1 Longitudinal structural model for social-cognitive determinants of sunscreen use with standardized coefficients (multiple indicators and residuals omitted in the figure for ease of communication). All coefficients $p<0.01$

valid in the context of sunscreen use [41], a general problem remains that for the assessment of behavioral outcomes, self-report measures are often the only ones available. Future research can replicate these results, using frequency of sunscreen use as well as more objective measures.

Another issue is that behavior and intention assessment relied on single-item measures that may be less reliable than multi-item scales. Moreover, in structural equation modeling, by specifying latent variables with only one single manifest item, one assumes perfect measurement, which does not reflect reality. Future studies should apply multiple behavioral measurements, including wearing protective clothing or avoiding sun exposure.

We can also not generalize to the entire population, since the persons who took part in the online study were mainly university students. However, this is a relevant population to target in sun protection interventions because sun exposure during adolescence and young adulthood represents a higher risk for the development of skin cancer later on. This also represents a period when tanning and protection habits are shaped [42]. Moreover, since mostly women have completed the survey at the three measurement points in time and since women are known to use more sun protection [9], further studies should test the HAPA for sunscreen use with a more heterogeneous sample comprising both genders. Another common problem with conducting online surveys is given by the high dropout rate in studies where participation is usually voluntary and without financial compensation. Although the present study also suffers from a high attrition rate, this dropout (of 70% from T1 to T3) is close to the average 40% response rate that was identified in a meta-analysis on internet-based studies [43].

Even though the present findings have added to the evidence attesting to the universality and applicability of the HAPA, they do not necessarily prove that the model chosen is the only one that fits. The question is whether this model appears to be superior to alternative models. To test the validity of a model in comparison to other theories of health behavior change, experimental studies are required. A further question is whether we should judge the quality and usefulness of a model only in terms of explained behavioral variance [10]. Gaining insight into mediating processes upgrades the importance of such mediators as secondary outcomes. The mediators are relevant criteria by themselves. Even if we cannot immediately attain the goal behavior, we might move a crucial step further by changing one of the proximal mediators in the right direction, for instance helping people form more plans to use sunscreen. Thus, elucidating the mechanisms of change is not only of purely scientific interest but also may have significant implications for health promotion by guiding the development of theory-based interventions. In this context, the present results are of interest to both research and practice. The HAPA is a parsimonious model to apply to sunscreen use, it targets both pre- and postintentional factors, and offers solutions for interventions. For example, information on the negative consequences of sun exposure can be used to induce risk perception, decisional balance can be discussed to form positive outcome expectancies, and modeling can be applied to enhance self-efficacy. Finally, for people in the volitional phase, planning strategies can be included to encourage behavior adoption. Thus, when using the model as a template for interventions, one should first identify whether the target persons are in the motivational phase, or whether they have already formed an intention to change and are in the volitional phase. If they are in the latter, a combination of action planning, coping planning, and self-efficacy enhancement have been found to be useful [18]. Future studies should test such interventions using experimental designs to identify the most effective motivational and volitional interventions to promote sunscreen use.

References

1. Schwarzer R. Modeling health behavior change: how to predict and modify the adoption and maintenance of health behaviors. Appl Psychol. 2008;57:1–29.
2. Lens MB, Dawes M. Global perspectives of contemporary epidemiological trends of cutaneous malignant melanoma. Br J Dermatol. 2004;150:179–85.
3. Abdulla FR, Feldman SR, Williford PM, Krowchuck D, Kaur M. Tanning and skin cancer. Ped Dermatol. 2005;22:501–12.
4. Gonzalez S, Fernandez-Lorente M, Gilaberte-Calzada Y. The latest on skin protection. Clin Dermatol. 2008;26:614–26.
5. Green AC, Williams GM. Point: sunscreen use is a safe and effective approach to skin cancer prevention. Cancer Epidemiol Biomark Prev. 2007;16:1921–2.
6. World Health Organization. Sun protection. Simple precautions in the sun. 2010. Retrieved from http://www.who.int/uv/sun_protection/en/.
7. Saraiya M, Glanz K, Briss P, Nichols P, White C, Das D, et al. Interventions to prevent skin cancer by reducing exposure to ultraviolet radiation. A systematic review. Am J Prev Med. 2004;27:422–66.
8. Kasparian NA, McLoone JK, Meiser B. Skin cancer-related prevention and screening behaviors: a review of the literature. J Behav Med. 2009;32:406–28.
9. De Vries H, Willems K, Mesters I, Reubsaet A. Skin cancer prevention behaviors during summer holidays in 14- and 18-year-old Belgian adolescents. Eur J Cancer Prev. 2006;15:431–8.
10. Lippke S, Ziegelmann JP. Theory-based health behavior change: developing, testing and applying theories for evidence-based interventions. Appl Psychol Int Rev. 2008;57:698–716.
11. Abraham C, Sheeran P. Understanding and changing health behavior: from health beliefs to self-regulation. In: Norman P, Abraham C, Conner M, editors. Understanding and changing health behavior. Amsterdam: Harwood; 2000. p. 3–24.
12. Orbell S, Sheeran P. "Inclined abstainers": a problem for predicting health-related behaviour. Br J Soc Psychol. 1998;37:151–65.
13. Luszczynska A, Schwarzer R, Lippke S, Mazurkiewicz M. Self-efficacy as a moderator of the planning–behaviour relationship in

interventions designed to promote physical activity. Psychol Health. 2011;26:151–66.
14. Scholz U, Schüz B, Ziegelmann JP, Lippke S, Schwarzer R. Beyond behavioural intentions: planning mediates between intentions and physical activity. Br J Health Psychol. 2008;13:479–94.
15. Gollwitzer PM, Sheeran P. Implementation intentions and goal achievement: a meta-analysis of effects and processes. Adv Exp Soc Psychol. 2006;38:69–119.
16. Chapman J, Armitage CJ, Norman P. Comparing implementation intention interventions in relation to young adults' intake of fruit and vegetables. Psychol Health. 2009;24:317–32.
17. Luszczynska A. Effects of an implementation intention intervention on physical activity after MI are mediated by cognitive processes, change in forming action plans. Soc Sci Med. 2006;62:900–8.
18. Wiedemann A, Lippke S, Reuter T, Ziegelmann JP, Schüz B. The more the better? The number of plans predicts health behaviour change. App Psychol Health Well Being. 2011;3:87–106. doi:10.1111/j.1758-0854.2010.01042.x.
19. Gutiérrez-Doña B, Lippke S, Renner B, Kwon S, Schwarzer R. How self-efficacy and planning predict dietary behaviors in Costa Rican and South Korean women: a moderated mediation analysis. App Psychol Health Well Being. 2009;1:91–104.
20. Luszczynska A, Cao DS, Mallach N, Pietron K, Mazurkiewicz M, Schwarzer R. Intentions, planning, and self-efficacy predict physical activity in Chinese and Polish adolescents: two moderated mediation analyses. Int J Clin Health Psychol. 2010;10:265–78.
21. Renner B, Kwon S, Yang BH, Paik KC, Kim SH, Roh S, et al. Social-cognitive predictors of dietary behaviors in South Korean men and women. Int J Behav Med. 2008;15:4–13.
22. Ziegelmann JP, Lippke S. Planning and strategy use in health behavior change: a life-span view. Int J Behav Med. 2007;14:30–9.
23. Jackson KM, Aiken LS. A psychological model of sun protection and sunbathing in young women: the impact of health beliefs, attitudes, norms, and self efficacy for sun protection. Health Psychol. 2000;19:469–78.
24. Turrisi R, Hillhouse J, Gebert C, Grimes J. Examination of cognitive variables relevant to sunscreen use. J Beh Med. 1999;22:493–509.
25. Bränström R, Ullen H, Brandberg Y. Attitudes, subjective norms and perception of behavioral control as predictors of sun related behavior in Swedish adults. Prev Med. 2004;39:992–9.
26. De Vries H, Lezwijn J, Hol M, Honing C. Skin cancer prevention: behaviour and motives of Dutch adolescents. Eur J Cancer Prev. 2005;14:39–50.
27. Mahler HIM, Fitzpatrick B, Parker P, Lapin A. The relative effects of a health-based versus an appearance-based intervention designed to increase sunscreen use. Am J Health Promotion. 1997;11:426–9.
28. Myers LB, Horswill MS. Social cognitive predictors of sun protection intention and behavior. Behav Med. 2006;32:57–63.
29. Eid M. Sun exposure and skin cancer prevention. In: Smelser NJ, Baltes PB, editors. International encyclopedia of the social & behavioral sciences. Amsterdam: Elsevier; 2001. p. 15278–81.
30. Paul C, Tzelepis F, Parffit N, Girgis A. How to improve adolescents' sun protection behaviour? Age and gender issues. Am J Health Behav. 2008;32:387–98.
31. Jones F, Abraham C, Harris P, Schulz J, Chrispin C. Modeling the cognitive prerequisites of sunscreen use in Australian and UK samples. Psychol Health. 2001;16:191–206.
32. Van Osch L, Reubsaet A, Lechner L, Candel M, Mercken L, De Vries H. Predicting parental sunscreen use: disentangling the role of action planning in the behavior–intention relationship. Psychol Health. 2007;23:1–19.
33. Carmel S, Shani E, Rosenberg L. The role of age and an expended health belief model in predicting skin cancer protective behaviour. Health Edu Research. 1994;9:433–47.
34. Grunfeld EA. What influences university students intentions to practice safe sun exposure behaviors? J Adolesc Health. 2004;35:486–92.
35. Mcclendon BT, Prentice-Dunn S. Reducing skin cancer risk: an intervention based on protection motivation theory. J Health Psychol. 2001;6:321–8.
36. Kristjansoon S, Bränström R, Ullen H, Helgason AR. Transtheoretical model: the investigation of adolescents' sunbathing behavior. Eur J Cancer Prev. 2003;12:501–8.
37. Graham JW. Missing data analysis: making it work in the real world. Ann Rev Psychol. 2009;60:549–76.
38. Pagoto S, McChargue D, Fuqua RW. Effects of a multicomponent intervention on motivation and sun protection behaviors among Midwestern beachgoers. Health Psychol. 2003;22:429–33.
39. Prentice-Dunn S, McMath BF, Cramer RJ. Protection motivation theory and stages of change in sun protection behavior. J Health Psychol. 2009;14:297–305.
40. Craciun C, Schüz N, Lippke S, Schwarzer R. Risk perception moderates how intentions are translated into sunscreen use. J Behav Med. 2010;33:392–8. doi:10.1007/s10865-010-9269-5.
41. Dwyer T, Blizzard L, Gies PH, Ashbolt R, Roy C. Assessment of habitual sun exposure in adolescents via questionnaire—a comparison with objective measurement using polysulphone badges. Melanoma Res. 1996;6:231–9.
42. Shoveller JA, Lovato CY, Young RA, Moffat B. Exploring the development of sun-tanning behavior: a grounded theory study of adolescents' decision-making experiences with becoming a sun tanner. Int J Behav Med. 2003;10:299–314.
43. Cook C, Heath F, Thompson RL. A meta-analysis of response rates in web- or internet-based surveys. Edu Psychol Measurement. 2000;60:821–36.