A randomised controlled trial of an online theory-based intervention to improve adult Australians' sun-protective behaviours

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Abstract word count: 200

Main text word count: 1417 (excluding abstract, references, and in-text citations)

Abstract

Objective: To evaluate the effectiveness of a single-session online theory of planned behaviour (TPB)-based intervention to improve sun-protective attitudes and behaviour among Australian adults.

Methods: Australian adults (N = 534; 38.7% males; M_{age} = 39.3 years) from major cities (80.9%) and regional (17.6%) and remote areas (1.5%) were recruited and randomly allocated to an intervention (N = 265) and information only group (N = 267). The online intervention focused on fostering positive attitudes, perceptions of normative support, and control perceptions for sun protection. Participants completed questionnaires assessing standard TPB measures (attitude, subjective norm, perceived behavioural control, intention, behaviour) and extended TPB constructs of group norm (friends, family), personal norm, and image norm, pre-intervention (Time 1) and one week (Time 2) and one month post-intervention (Time 3). Repeated Measures Multivariate Analysis of Variance tested intervention effects across time.

Results: Intervention participants reported more positive attitudes toward sun protection and used sun-protective measures more often in the subsequent month than participants receiving information only. The intervention effects on control perceptions and norms were non-significant.

Conclusion: A theory-based online intervention fostering more favorable attitudes towards sun safety can increase sun protection attitudes and self-reported behaviour among Australian adults in the short term.

Trials registry: Australian and New Zealand Trials Registry number ACTRN12613000470796

Keywords: sun safety, intervention, online, theory of planned behaviour; attitudes

Introduction

Australians are at high risk for developing skin cancers, demonstrated by alarmingly high national prevalence rates (Australian Institute of Health and Welfare, 2013; Australian Institute of Health and Welfare and Cancer Australia, 2008). After substantial public campaigning, Australians show awareness of the dangers of sun exposure (Stanton et al., 2005) although this awareness has not translated into sufficient sun-protective practices (Volkov et al., 2013). The development of effective interventions to increase Australians' sun safety targeting key determinants of sun-protective behaviour is, therefore, needed.

The theory of planned behaviour (TPB; Ajzen, 1991) is a well-validated model which can assist the development of health-behaviour interventions. In the TPB, behaviour is determined by intention which is underpinned by attitude (positive/negative evaluation), subjective norm (perceived social pressure), and perceived behavioural control (perceived ability/efficacy; PBC, also influencing behaviour), with these three latter constructs each with an underlying belief base (behavioural, normative, and control beliefs). The TPB has been used successfully to explain people's sun protection intentions and behaviour (e.g., Myers & Horswill, 2006). Support has also been demonstrated for augmented TPB models of sun-protective behaviour. For example, group members' use and approval of sun-protective measures (group norm), internalised values about whether one "should" be sun safe (personal norm), and media image norms of tanned and pale models (image norm) represent important determinants of sun-protective intentions (e.g., Jackson and Aiken, 2000; Parker et al., 1995; White et al., 2008; White et al., in press).

Based on the dearth of theory-based sun safety interventions in Australia and the potential for the economical and accessible delivery of online programs (Cugelman et al., 2011), this brief report describes a randomised controlled trial testing the effectiveness of a single-session online TPB-based intervention. Intervention participants were expected to show significant improvements in their attitude, subjective norm, PBC, group norm (for friends and family), personal norm, image norm, intention, and self-reported behaviour from pre-intervention to follow-up (one week and one month) compared to adults receiving readily available information about sun safety.

Methods

Participants

Adults (N = 532; 38.7% men; 70.8% fair-skinned) aged 18-80 years (M = 39.3 ± 14.41 years) were recruited via media releases, billboards, newsletters, email lists, and snowballing from major cities (80.9%), regional (17.6%) and remote (1.5%) areas of

Australia between March and May 2013. Based on a priori power calculations, 130 participants per condition were needed to detect a medium effect (effect size [f] = 0.25, α = 0.05, power = 95%).

Design and Procedure

The University's Ethics Committee provided ethical approval. Participants (see Figure 1 for a participant flow chart) completed a baseline questionnaire immediately before the experimental session (Time 1) after which they were randomly allocated (via a computer-generated random number sequence) to the intervention (n = 265; M_{age} = 38.94 years; 38% male; 69.8% fair-skinned) or information only (n = 267; M_{age} = 39.64 years; 39.3% male; 71.6% fair-skinned) condition. The intervention comprised an interactive 20-25 minute online session incorporating animated scenarios, problem solving, goal setting, and quizzes, prompting participants to consider their attitudes towards, normative support for, and control over using sun protection (see Cleary et al., 2014). Information only participants viewed an 8-minute DVD and read fact sheets about sun protection, resources currently available on Cancer Council Queensland's website. The control session took about 20 minutes in total. Intervention participants' responses to the various interactive tasks indicated that participants had engaged with the material and control participants were asked specifically to confirm that they had read the fact sheets (see supplementary Tables S1 and S2 for intervention and control group scripts). Participants completed a second questionnaire one week (Time 2) and one month (Time 3) post-intervention re-assessing the baseline measures. Participants received two AUD$20 store vouchers (at Time 1 and 3).

Measures

Consistent with TPB recommendations (Ajzen, 1991), the target behaviour was: "Performing sun-protective behaviours (using SPF 30+ sunscreen, wearing protective clothing such as a hat, long-sleeved shirt and sunglasses, and seeking shade between 10am and 3pm) every time you go in the sun for more than 10 minutes during the next week". Items and item reliabilities for all study variables are presented in Table 1.

[Insert Table 1 about here]

Results

A 2 (intervention, information only) by 3 (pre-intervention, one week and one month post-intervention) Repeated Measures Analysis of Variance was performed with the standard and extended TPB constructs serving as dependent variables. Table 2 shows descriptives for all dependent variables and p values and effect sizes for univariate interactions. Alpha

adjustments were used for follow-up simple effects of Time (p = .01) and pairwise comparisons (p = .001) to control for Type 1 errors.

[Insert Table 2 about here]

Results revealed a significant multivariate Time effect, Pillai's Trace = .38, $F(18, 256) = 8.52$, $p < .001$, $\eta^2 = .38$, with univariate effects found for attitude, $F(1.94, 530.26) = 29.80$, $p < .001$, group norm friends, $F(1.88, 512.24) = 6.63$, $p = .002$, image norm, $F(1.98, 539.15) = 20.77$, $p < .001$, intention, $F(1.80, 490.51) = 11.61$, $p < .001$, and self-reported behaviour, $F(1.96, 533.92) = 15.04$, $p < .001$. Pairwise comparisons revealed that attitude, group norm friends, intention, and self-reported behaviour increased significantly between Time 1 and Time 2 while image norm decreased significantly across these time points.

A significant multivariate Time x Condition effect was also found, Pillai's Trace = .12, $F(18, 256) = 1.94$, p =.01, $\eta^2 = .12$. Univariate Time x Condition effects were observed for attitude, $F(1.94, 530.26) = 4.48$, p = .01, and self-reported behaviour, $F(1.96, 533.92) = 3.46$, p = .03. For intention, the interaction approached significance, $F(1.80, 490.51) = 2.49$, p = .09. Univariate follow-up Analyses of Variance for attitude and self-reported behaviour examined the simple effects of Time within the two conditions. Attitude improved significantly across time in the intervention, $F(2, 289) = 21.54$, $p < .001$. Pairwise comparisons for the simple effects of time within the intervention showed that attitudes significantly improved from Time 1 to Time 2, with the improvement maintained at Time 3. In the information only group, the simple effects of time was significant, $F(2, 289) = 4.88$, p = .008, indicating an improvement across time points but when applying the more stringent alpha level of .001, the pairwise effects were not significant. For self-reported behaviour, a significant Time effect was observed in the intervention, $F(2, 292) = 14.87$, $p < .001$, but not in the information only group, $F(2, 292) = 2.35$, p = .097. Pairwise comparisons showed that sun protection in the intervention increased from Time 1 to Time 2, with this significant increase maintained at Time 3.

A mediation analysis (Hayes, 2013) was conducted to examine whether the effect of the intervention on sun-protective behaviour was mediated by changes in attitudes (see supplementary Figure S1). The indirect effect of the intervention on sun-protective behaviour via attitudes was significant, b = .07, 95% Cl [.01, .20]. However, the direct effect of the intervention on sun-protective behaviour remained significant, b = .37, 95% Cl [.03, .70], suggesting partial mediation.

Discussion

This randomised controlled trial showed that a single-session online TPB-based intervention increased adults' short-term sun protection attitudes and self-reported behaviour. Intervention participants reported more frequent use of sun-safe measures one week post-intervention, with the increase maintained at one-month follow-up, compared to baseline with no corresponding change for information only participants. The changes in self-reported behaviour were partially driven by the parallel increases in positive attitudes, consistent with the important role of attitudes in Australian adults' sun-safe decisions (White et al., in press).

The intervention, however, was unsuccessful in changing perceived behavioural control or norms. The means for perceived behavioural control were already high, suggesting a strong sense of control over performing sun-safe behaviours. The means for the multiple sources of norms were lower, suggesting an opportunity for change. Sun safety norms, however, may be more ingrained and resistant to change within adults given that they are often based on rigid perceptions with norms potentially more malleable prior to adulthood, such as among adolescents (see, for example, White et al., 2010).

Despite strengths, including the strong theory base and the potential for economical and accessible delivery of the program, this study has limitations. The follow-up time period was short and actual behaviour was not assessed. Although self-report measures of solar UV radiation exposure have been shown to be valid against objectively measured exposure (e.g., UV badges; see Glanz et al., 2010), self-report may have inflated behavioural estimation. It is unknown whether sun-protective measures were used effectively (e.g., whether sunscreen was reapplied) and seasonal differences were unaccounted for. It should be noted also that the effect sizes were small. Finally, due to participant self-selection and greater attrition among male participants, the results may not generalise more broadly.

Conclusion

This brief report has provided initial evidence for an economical and accessible approach to encourage adults' sun protection. Despite being unsuccessful in shifting perceptions of control and norms, TPB-based intervention strategies were effective in fostering favorable evaluations of sun protection which, in turn, increased self-reported sun-safe behaviour.

Acknowledgements

This study was funded by the Australian Research Council and the Cancer Council Queensland. The funding sources had no involvement in the study design, the collection and analysis of the data, the writing of the report, or the decision to submit this report for publication.

Conflict of interest statement

The authors declare there is no conflict of interest.

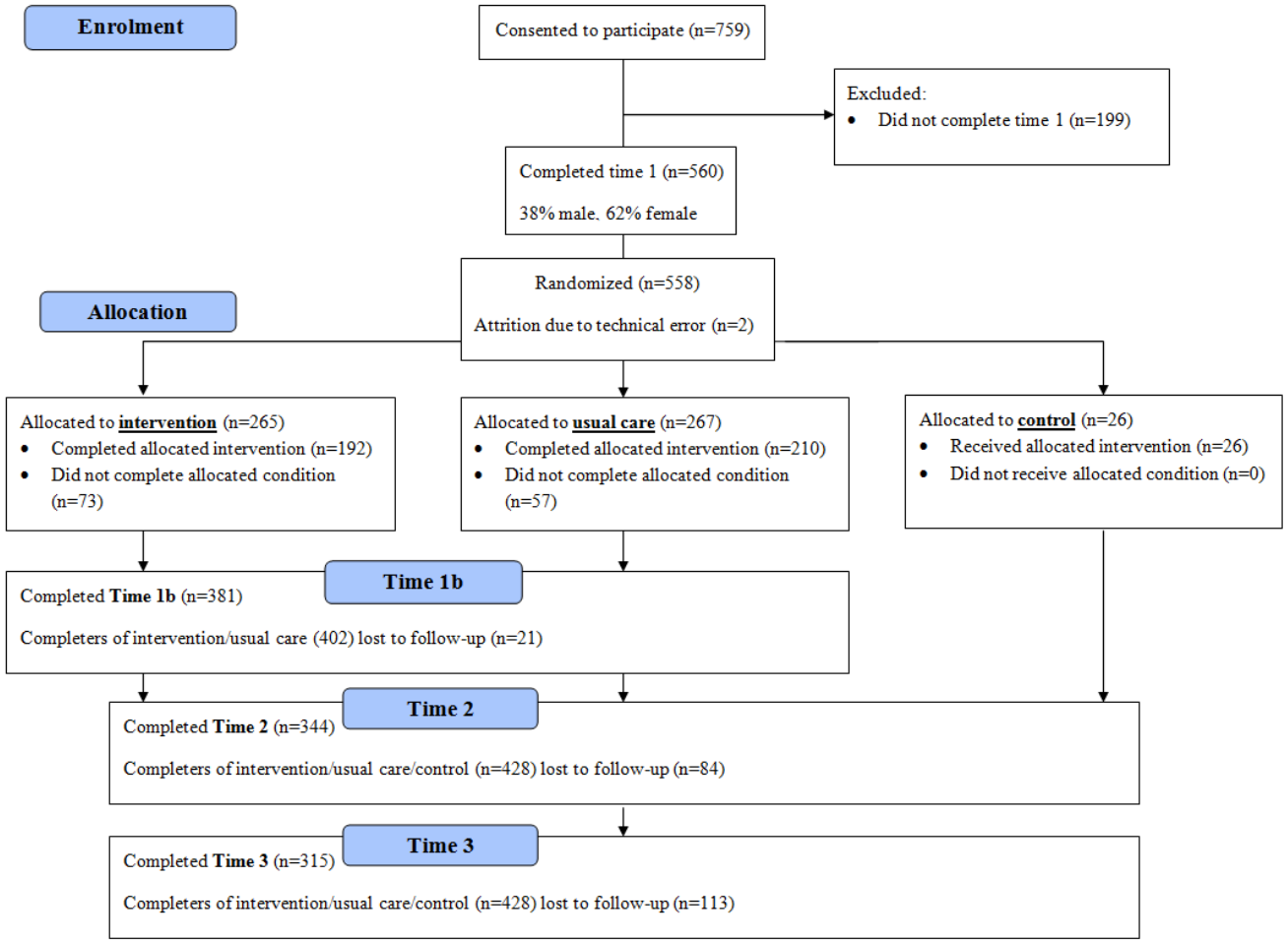

Figure 1. Participant flow chart. Participants completing the intervention and usual care and relevant measures at Time 1, Time 2, and Time 3 were included in the final analysis (N =275). There were no significant differences between participants who completed all time points and those who completed Time 1 only on any of the baseline measures. Attrition was greater among men (50.2%) than women (40.7%) between Time 1 and Time 3, $\chi^2(1) = 4.61$, $p = .03$.

Table 1

Number of Items, Internal Consistency (Cronbach's Alpha/Pearson's r), Response Anchors, and Measures Used for the Standard and Extended TPB Constructs Assessed at Time 1 (T1, pre-intervention), Time 2 (T2, one week post-intervention), and Time 3 (T3, one month post-intervention)

Construct	#items	α/*r*	Response anchors	Measures
Attitude	6	T1=.84 T2=.86 T3=.87	1 (*pleasant*); 7 (*unpleasant*) [a] 1 (*good*); 7 (*bad*) [a] 1 (*wise*); 7 (*unwise*) [a] 1 (*easy*); 7 (*difficult*) [a] 1 (*nice*); 7 (*awful*) [a] 1 (*positive*); 7 (*negative*) [a]	Performing sun-safe behaviours every time I go in the sun for more than 10 minutes during the next week, would be…
Subjective norm	3	T1=.86 T2=.89 T3=.89	1 (*strongly disagree*); 7 (*strongly agree*)	"Those people who are important to me would want me to perform sun-safe behaviours"; "Most people who are important to me would approve of me performing sun-safe behaviours"; "Most people who are important to me would think that I should perform sun-safe behaviours"
Perceived behavioural control	4	T1=.84 T2=.87 T3=.86	1 (*strongly disagree*); 7 (*strongly agree*)	"I have complete control over whether I perform sun-safe behaviours"; "It is mostly up to me whether I perform sun-safe behaviours"; "If I wanted to it would be easy for me to perform sun-safe behaviours"; "I am confident that I could perform sun-safe behaviours"
Group norm friends	4	T1=.83 T2=.83 T3=.84	1 (*strongly disagree*); 7 (*strongly agree*)	"Most of my friends/family members perform sun-safe behaviours"; "My friends/family members think that performing sun-safe behaviours is a good thing to do";
Group norm family	4	T1=.84 T2=.83 T3=.87	1 (*none*); 7 (*all*)	"How many of your friends/family members would think that performing sun-safe behaviours every time they are out in the sun for more than 10 minutes in the next week is a good thing to do?"; "How many of your friends/family members would perform sun-safe behaviours every time they are in the sun for more than 10 minutes during the next week?"
Personal norm	2	T1=.78 T2=.80 T3=.81	1 (*strongly disagree*); 7 (*strongly agree*)	"I think I should perform sun-safe behaviours"; "Sun-safe behaviours is something I should do"

Image norm	5	T1=.67 T2=.66 T3=.69	1 (*strongly disagree*); 7 (*strongly agree*)	"Celebrities and movie stars always seem to have a tan"; "I see more examples of models who do not have a tan on TV and in magazines than I used to" [a] ; "I think that to be a successful movie star or TV star you should have a tan"; "It seems that society wants young people to have a tan"; "I can think of many movie stars and TV stars who do not have a tan [a]"
Intention	3	T1=.95 T2=.97 T3=.95	1 (*strongly disagree*); 7 (*strongly agree*)	"I intend to perform sun-safe behaviours"; "I plan to perform sun-safe behaviours"; "It is likely that I will perform sun-safe behaviours"
Behaviour [b]	2	T1=.67 T2=.71 T3=.78	1 (*never*); 7 (*always*)	"Think about the past week. On average, how often did you perform sun-safe behaviours on Saturday and Sunday?"; "Think about the past week. On average, how often did you perform sun-safe behaviours on a typical week day?"

Note. Each question was specified in terms of a context and a timeframe ("every time I go in the sun for more than 10 minutes during the next week").
[a] Reverse scored item.
[b] Participants also indicated what sun-protective behaviours they had performed to increase recall and the measure's reliability.

Table 2

Means (Standard Deviations) and Significance Levels Examining Time by Condition Interaction Effects for Standard and Extended TPB Constructs at Time 1 (pre-intervention), Time 2 (one week post-intervention), and Time 3 (one month post-intervention) ($n_{intervention} = 126$; $n_{information\ only} = 149$)

Construct	Condition	Time 1 (Pre-Intervention)	CIs	Time 2 (Post-Intervention)	CIs	Time 3 (Post-intervention)	CIs	*p*	η^2
Attitude	Intervention	5.25[a] (1.00)	5.06, 5.43	5.64[b] (.89)	5.47, 5.81	5.68[b] (.93)	5.50, 5.86	.01	.02
	Information only	5.29 (1.07)	5.12, 5.46	5.45 (1.04)	5.29, 5.60	5.49 (1.09)	5.33, 5.66		
Subjective norm	Intervention	5.93 (.98)	5.76, 6.10	6.05 (.88)	5.90, 6.21	6.02 (.93)	5.85, 6.19	.14	.01
	Information only	5.90 (.93)	5.74, 6.05	5.88 (.91)	5.73, 6.02	5.80 (1.01)	5.64, 5.96		
PBC	Intervention	6.16 (.82)	6.01, 6.32	6.07 (.85)	5.92, 6.22	6.11 (.76)	5.97, 6.26	.10	.01
	Information only	6.03 (.94)	5.89, 6.17	6.08 (.88)	5.94, 6.22	6.13 (.92)	6.00, 6.27		
Group norm friends	Intervention	4.68 (1.16)	4.81, 4.88	4.91 (1.05)	4.72, 5.09	4.88 (1.10)	4.68, 5.07	.29	.00
	Information only	4.65 (1.12)	4.47, 4.84	4.76 (1.07)	4.59, 4.93	4.71 (1.12)	4.53, 4.89		
Group norm family	Intervention	5.14 (1.21)	4.93, 5.35	5.19 (1.11)	4.99, 5.39	5.27 (1.21)	5.06, 5.49	.16	.01
	Information only	4.97 (1.20)	4.78, 5.17	5.01 (1.12)	4.83, 5.19	4.93 (1.22)	4.74, 5.13		
Personal norm	Intervention	6.18 (.89)	6.01, 6.34	6.27 (.91)	6.10, 6.44	6.31 (.76)	6.14, 6.47	.13	.01
	Information only	6.17 (.95)	6.03, 6.32	6.17 (1.03)	6.01, 6.33	6.11 (1.06)	5.96, 6.26		
Image norm	Intervention	3.89 (.93)	3.73, 4.06	3.70 (.96)	3.53, 3.87	3.58 (1.01)	3.41, 3.75	.47	.00
	Information only	3.96 (.97)	3.80, 4.11	3.82 (.94)	3.67, 3.98	3.75 (.95)	3.59, 3.90		
Intention	Intervention	5.49[a] (1.21)	5.27, 5.71	5.75[b] (1.11)	5.55, 5.96	5.83[b] (.99)	5.62, 6.04	.09	.01
	Information only	5.55 (1.27)	5.35, 5.75	5.63 (1.22)	5.44, 5.82	5.68 (1.32)	5.49, 5.87		
Behaviour	Intervention	4.29[a] (1.66)	4.00, 4.59	4.81[b] (1.64)	4.52, 5.10	4.95[b] (1.62)	4.66, 5.24	.03	.01
	Information only	4.45 (1.72)	4.18, 4.72	4.62 (1.66)	4.35, 4.88	4.69 (1.68)	4.42, 4.95		

Note. PBC = perceived behavioural control; CIs = confidence intervals; η^2 = Eta-squared. Means with different superscripts are significantly different. Analyses are based on $N = 275$ due to missing data ($n = 21$) and attrition (reasons unknown due to the online completion of the sessions and questionnaires; see supplementary Figure S1 for a full participant flow chart)..

References

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50:179-211. doi:10.1016/0749-5978(91)90020-t

Australian Institute of Health and Welfare, 2013. Cancer survival and prevalence in Australia: Period estimates from 1982 to 2010. Asia Pac. J. Clin. Oncol. 9:29-39. doi:10.1111/ajco.12062

Australian Institute of Health and Welfare, Cancer Australia, 2008. Non-melanoma skin cancer: general practice consultations, hospitalisation and mortality, in: Australian Institute of Health and Welfare (Ed.). Australian Institute of Health and Welfare, Canberra.

Cleary, C.M., White, K.M., Young, R.M., Hawkes, A.L., Leske, S., Starfelt, L.C., Wihardjo, K., 2014. Study protocol: A randomised controlled trial of a theory-based online intervention to improve sun safety among Australian adults. BMC Cancer 14:1-17. doi:10.1186/1471-2407-14-162

Cugelman, B., Thelwall, M., Dawes, P., 2011. Online interventions for social marketing health behavior change campaigns: A meta-analysis of psychological architectures and adherence factors. J. Med. Internet Res. 13:e17-e17. doi:10.2196/jmir.1367

Glanz, K. P., Gies, P., O'Riordan, D. L., Elliott, T., Nehl, E., McCarthy, F., Davis, E., 2010. Validity of self-reported solar UVR exposure compared with objectively measured UVR exposure. Cancer Epidemiol. Biomarkers Prev. 19:3005-12. doi: 10.1158/1055-9965.EPI-10-0709

Hayes, A. F., 2013. Introduction to mediation, moderation and conditional process analysis: A regression-based approach. The Guildford Press, New York.

Jackson, K.M., Aiken, L.S., 2000. A psychosocial model of sun protection and sunbathing in young women: The impact of health beliefs, attitudes, norms, and self-efficacy for sun protection. Health Psychol. 19:469-78. doi:10.1037/0278-6133.19.5.469

Myers, L. B., Horswill, M. S., 2006. Social cognitive predictors of sun protection intention and behavior. Behav. Med. 32:57-63. doi:10.3200/BMED.32.2.57-63

Parker, D., Manstead, A.S.R., Stradling, S.G., 1995. Extending the theory of planned behaviour: The role of personal norm. Br. J. Soc. Psychol. 34:127-37. doi:10.1111/j.2044-8309.1995.tb01053.x

Stanton, W.R., Moffatt, J., Clavarino, A., 2005. Community perceptions of adequate levels and reasons for skin protection. Behav. Med. 31:5-15. doi:10.3200/BMED.31.1.5-17

Volkov, A., Dobbinson, S., Wakefield, M., Slevin, T., 2013. Seven-year trends in sun protection and sunburn among Australian adolescents and adults. Aust. N. Z. J. Public Health 37:63-69. doi:10.1111/1753-6405.12012

White, K.M., Hyde, M.K., O'Connor, E.L., Naumann, L., Hawkes, A.L., 2010. Testing a belief-based intervention encouraging sun-safety among adolescents in a high risk area. Prev. Med. 51:325-28. doi:10.1016/j.ypmed.2010.07.003

White, K.M., Robinson, N.G., Young, R.M., Anderson, P.J., Hyde, M.K., Greenbank, S., Rolfe, T., Keane, J., Vardon, P., et al., 2008. Testing an extended theory of planned behaviour to predict young people's sun safety in a high risk area. Br. J. Health Psychol. 13:435-48. doi:10.1348/135910707X210004

White, K.M., Starfelt, L.C., Young, R.M., Hawkes, A.L., Leske, S., Hamilton, K., in press. Predicting Australian adults' sun-safe behaviour: Examining the role of personal and social norms. Br. J. Health Psychol. doi:10.1111/bjhp.12108