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Personalised electronic messages to improve sun protection in young adults

Sarah Mair[1], H Peter Soyer[2], Philippa Youl[3], Cameron Hurst[1], Alison Marshall[1] and Monika Janda[1]

1School of Public Health, Institute of Health and Biomedical Innovation, Queensland University of Technology, Brisbane, 4000, Australia
2Cancer Council Queensland, Brisbane, 4001, Australia
3Dermatology Research Centre, The University of Queensland, School of Medicine, Princess Alexandra Hospital, Brisbane, 4000, Australia

Correspondence:
Dr Monika Janda,
School of Public Health,
Queensland University of Technology,
Victoria Park Road,
Kelvin Grove,
QLD 4059,
Australia
(Fax: 61731383130; Email: m.janda@qut.edu.au)

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Summary
The incidence of all skin cancers, including melanoma, continues to rise. It is well known that ultraviolet (UV) radiation is the main environmental risk factor for skin cancer, and excessive exposure at a young age increases the risk of developing skin cancer. The aim of this study was to determine the acceptability and feasibility of delivering sun protection messages via electronic media such as short message services (SMS) to people 18-40 years, and explore factors associated with their acceptability. Overall, 80% of participants agreed that they would like to receive some form of sun protection advice; of these, 20% prefer to receive it via SMS and 42% via email. Willingness to receive electronic messages about the UV index was associated with being unsure about whether a suntanned person would look healthy and greater use of sun protection in the past. Careful attention to message framing and timing of message delivery and focus on short-term effects of sun exposure such as sunburn and skin ageing should increase the acceptability of such messages to young people. We conclude that sun protection messages delivered to young adults via electronic media appear feasible and acceptable.

Introduction
Skin cancers account for one third of all cancer diagnoses worldwide.[1] Of the three main types of skin cancer, melanoma has the highest mortality and is the third most common invasive cancer diagnosed among both men and women in Australia.[2] In the United States, it is estimated that 70230 new cases of melanoma will be diagnosed in 2011, with 8790 deaths resulting from this diagnosis.[3] Melanoma is also the most common cancer in young people aged 15 to 44 years.[4]

In response to the high incidence of skin cancer, public health campaigns have aimed to encourage reduced sun exposure and increased sun protection.[5] Evaluation of these campaigns show that while knowledge of the dangers of sun exposure is high, young people in particular engage in relatively few sun protection practices.[2] For example, in Queensland, Australia, 72% of individuals aged 20-30 years report having been sunburnt in the past 12 months compared to 43% of those over the age of 30 years.[6] In adition, younger people are more likely to believe that a tan looks healthy and are also more likely to desire a tan.[7]

Previous public health campaigns have to a large extent relied on media such as television and print-based advertisements, and have been designed based on social-cognitive theories of health behaviour change.[5] More recently, research has investigated ways to better bridge the gap between knowledge, intentions and actual behaviour. For example, implementation intentions which instigate if-then plans for situations in which the desired behaviour should be displayed (for example, if I am at the beach with a group of friends, I will use a hat), have been shown to aid behaviour even in the presence of contextual threats.[8] In addition, and lending themselves for application in such situations where behaviours may easily be threatened, research has been focussing on new modes of communication such as via mobile (cell) phones, email or web-based interactions. These have the added advantage of allowing health promotion messages to be perfectly timed and individualised towards the user, fitting with intentions they may have formed, and can be delivered flexibly and on demand. Access to a mobile phone is almost ubiquitous,[9,10] with Australia having one of the highest rates of

mobile phone ownership in the world. Here, mobile phone connections now exceed land line connections.[11] Similarly, mobile phone ownership is estimated to be 85% among American adults.[12] Ownership is particularly high among young people[13] and the socioeconomically disadvantaged,[14] both key target groups for skin cancer prevention efforts.

Mobile messaging and self-management phone applications have already been successful in delivering health interventions. Specifically related to skin cancer, Armstrong *et al*.[15] used SMS messaging to remind people about sunscreen. From baseline values of 3% and 5%, respectively, daily adherence to sunscreen increased to 56% in the intervention group (daily SMS reminders for six weeks) compared to 30% in the control group.[15] Given these positive results, SMS message prompts alone or in conjunction with other smart phone applications such as the Cancer Council Australia's UV alert 'widget'[16] may be beneficial to improve sun protection behaviours more general. However it is unknown if, and how, young people would be willing to receive such messages.

The present study aimed to assess the willingness of young adults to receive electronic messages to improve their sun protection behaviours, and socio-demographic, skin cancer risk, and attitudinal factors associated with interest in receiving such messages.

Methods

The study was approved by the appropriate ethics committee. Using a pre-established panel of volunteers, an online survey was conducted in the Australian summer (December 2009/January 2010) by a professional survey company accredited to the International Market and Social Research Standard, ISO 20252. The survey company contacted Queensland panel members who were aged 18-40 years. Pre-specified quota to be filled with regards to participants' gender, age group, geographical location (metropolitan/other) and education level ($<$ versus $\geq$ 12 years) were set to ascertain adequate representation of these demographic groups in the sample. Once a certain quota was filled [50/50% gender, 60/40% metropolitan/other area, at least 40% with less than 12 years of schooling and 40% younger than 30 years)] no new panel members with these characteristics could complete the survey.

Online survey

The survey assessed participant's demographic characteristics and common skin cancer risk factors such as hair, eye and skin colour, propensity to burn and ability to tan using questions previously assessed for their reliability within the melanoma screening trial.[17] Participants were asked questions including whether "in the past twelve months have you attempted to get a tan?" and "how many times in the past year have you experienced a sunburn?"

Recall of sun protection guidelines and UV index

Participants were asked to recall without prompt what they could remember about current public health advice about protecting themselves from the sun. Responses were categorised depending on the number of sun protection methods recalled. Participants were also asked if they had ever heard of the UV index and if so, to briefly describe what the UV index was.

Sun protection habits index

Sun protection practices were assessed using the sun protection habits index,[18] which summarises how frequently participants use one of six sun protection methods (clothing, hat, sunglasses, sunscreen, staying in the shade, staying indoors (1=rarely/ never to 4=always)). Test-retest reliability of the sun protection habits index has been reported previously (r=.73).[19]

Attitudes and behavioural intentions
Participants were asked how strongly they agreed or disagreed on a 5-point scale with several attitudinal items, such as whether: a suntanned person looks more healthy; they were concerned about not getting enough vitamin D if they used sun protection; sun exposure ages the skin; and sun protection can help to avoid skin cancer. Participants were also asked whether they intended to apply and reapply sunscreen, as well as stay in the shade when outdoors in the sun or whether they intend to tan.

Acceptability and feasibility of delivery of electronic sun protection messages
Participants were asked whether they had access to, and how often they used mobile phones for voice calls or SMS messages, computer email accounts, and whether they would prefer health promotion through email or text messaging.

In addition, participants were asked if over the past 12 months they had received any information or materials advising them about sun protection, and the effect this information had on their sun protection behaviour. Participants were also asked what information or advice they would find helpful in relation to increasing sun protection practices, such as daily UV index updates. They were also asked about the preferred method, format, frequency and timing of such information and advice.

Data analyses
Using bivariate logistic regression analyses, we compared the characteristics of those who indicated that they would like to be alerted to the UV index, with those who would not. Characteristics found to be associated with desire to receive such advice were entered into a multivariable logistic regression analysis using the 'purposeful selection of covariates' modelling approach.[20]

Following this approach, we included variables which in bivariate analyses were associated with the dependent variable at $p < 0.05$ in an initial model. Those variables no longer significant in the initial model were removed, then returned one by one to assess whether they either gained significance or confounded other variables; if so, they were retained in the model. This process was then repeated with variables which were non-significant at the bivariate level. Finally, we tested plausible interaction terms, but found none to be significant.

Results
A total of 141 participants completed the survey until all quotas were filled (approximately equal numbers by gender, geographical location (metropolitan/other), age and education level (< or > year 12). An additional 101 people who would have agreed to participate were ineligible, as their quotas were already filled.

The median age of participants was 34 years and there were slightly more women (75, 53%) than men. About half of the participants (79, 56%) lived in a metropolitan area. Most participants (87, 62%) had completed high school or further education. Around 40% (56) of participants were employed full-time, and 21% (29) were in part-time or casual employment. Approximately two-thirds of participants (90, 64%) reported that their main job or activity was indoors (Table 1). Five participants (3.5%) had been previously diagnosed with a skin cancer.

Use of technology

Almost all participants (134/141, 95%) owned a mobile phone, with 69% (92) using it for voice calls, and 79% (106) using it for SMS messaging at least several times a week or more. All but two participants had access to a computer at either home or work, and all but four participants had access to personal email. Of the 137 participants with email access, 97% (133) corresponded by email at least several times a week or more frequently.

Skin cancer risk factors

Most participants had fair or light hair colour (83, 59%), blue or green eye colour (99, 70%), light skin colour (82, 58%), and were prone to burning and not tanning (41, 30%), or burning before tanning (61, 45%). Almost half of participants (59/133, 44%) reported that they would never or only slightly tan if exposed to the sun over several days. While only one fifth of participants had attempted to get a tan over the past 12 months (28/141, 20%), most had been sunburned at least once (107, 76%) in the past 12 months (Table 2).

Recall of the UV index and sun protection guidelines

Overall, 130 (92%) participants had heard about the UV index, but few participants could describe clearly what information the UV index summarises. Almost all (138, 98%) participants were able to recall at least one sun protection practice without prompt; most commonly recalled methods were using sunscreen (99, 70%), or wearing a hat (82, 58%).

Sun protection behaviour, intentions and attitudes

Participants reported a mean overall sun protection habits index score of 2.36 (SD= 0.64), when asked to describe their overall frequency of use of six sun protection methods. Wearing sunglasses was the most practised sun protection behaviour (62, 44% always used sunglasses) followed by seeking shade (72, 51% most of the time). Approximately half of the participants (74/141, 52%) intended to apply sunscreen, and 43% (60) intended to re-apply sunscreen when outdoors over the next week. Just over a third of participants agreed with the statement that a suntanned person looks more healthy (47/141, 33%), or that they would be at risk of producing too little vitamin D if they used sun protection (55/141, 39%) (Table 2).

Information preferences and information received

Overall, 80% (113) of participants indicated that they would like to receive some form of sun protection advice. Of these, 42% (59) preferred to receive it via email, 20% (28) preferred the use of SMS and 27% (38) preferred some other method such as through television, radio or other media. The most popular form of advice was weather forecast (106, 75%). Around two-thirds agreed that advice about the sunscreen sun protection factor (89, 63%), best times to stay indoors (94, 67%) and appropriate clothing for outdoor activities (89, 63%) would be helpful. Half of participants wished to be alerted to the UV Index (71, 50%) via electronic messaging.

Desire to be alerted to the UV index via SMS
At the bivariate level, participants demographic characteristics and frequency of use of technology were not associated with the desire to be alerted to the UV index (Table 1). However, compared to those with fair skin, participants with olive or brown skin were more likely to want to be alerted to the UV index (P=0.03), as well as those participants with a higher sun protection behaviour index score (P<0.001). Participants who were unsure (P=0.04) or disagreed (P<0.001) that they intended to reapply sunscreen when outdoors over the next week, as well as those who were unsure (P=0.04) whether a suntanned person looks better were less likely to desire information about the UV Index. In contrast, participants who disagreed that a suntanned person looks more healthy had higher odds of desiring information via SMS messaging (P=0.01) (Table 2).

Multivariable analysis results
After adjustment for age and gender, those participants who were unsure whether or not they agreed with the statement that a suntanned person looks better were less likely to desire UV index information (OR=0.24, 95%CI=0.07-0.90), however the number of participants in this category was relatively small (n=23). In addition, with each increase of one of the sun protection habits index score, the odds of desiring information about the UV index by SMS increased by 2.79 (95%CI=1.45-5.50) (Table 3).

Discussion
While sun protection knowledge and positive sun protection intentions are high in the Australian population, delivery methods using personalised mobile messages may assist in bridging the intention-behaviour gap by providing cues to action,[21] or by reminding people about ways to act on their intentions[8] at times and locations relevant to behaviour. We found that the desire to receive electronic messages about the UV Index was largely independent of participants' demographic or phenotypic characteristics. However, previous sun protection behaviour as measured by the sun protection habits index was predictive of desire to receive such messages. As previously discussed by Weinstein,[22] displaying a behaviour will increase the self-efficacy for repeatedly performing the behaviour. People may also infer from their sun protection behaviour that they are concerned about, and perceive themselves at risk of developing skin cancer.

We found that those participants who were uncertain about whether a suntanned person looked more healthy were less likely to desire information to be sent via SMS. The conflict between appearance and health outcomes of sun exposure especially among young people has been described in a number of studies and has led to the development and implementation of appearance-based interventions. These interventions have been tested mainly with young women with promising results.[23,24] The present study indicates that integration of appearance-based intervention components may be beneficial for sun protection advice. This could include multimedia components (e.g. pictures of sun spots or other sun related skin outcomes) or digital UV photos that may particularly appeal to appearance concerned people. The UV photos display underlying skin damage by highlighting areas with increased pigmentation, and have been effective in changing sun protection intentions and behaviours.[25]

The effect of framing SMS messages relating either to short- or long-term outcomes has been examined by Sirriyeh *et al*. in the context of a physical activity intervention.[26] People received SMS messages relating either to short or long-term outcomes of physical activity, such as mood elevation and weight maintenance. Results showed a significant increase in physical activity only for those participants inactive at baseline who received messages relating to short-term outcomes.[26] This suggests that SMS messages focusing on short-term outcomes of sun exposure such as sunburn and skin ageing could be more effective, compared to those focussing on more distal outcomes such as skin cancer development.

The present study found that 40% of participants used SMS several times a day and a further 40% used SMS once a day to several times a week. The frequent use and wide acceptability of short messages are in accordance with the findings of other studies[14] and present a promising avenue for health promotion purposes. For example, one study used online communication strategies to prevent the spread of chlamydia.[27] Overall, the participants in that trial agreed that SMS was a good or very good tool for communicating with young people as they can be shared with friends and can lead to candid discussion about health issues.[27] More specifically related to sun protection, one study found that using short messages as a reminder tool improved adherence to sunscreen application.[15]

As there was no clear preference for receiving messages by either electronic medium, combinations of message delivery should be considered. Obermayer *et al*.[28] explored the acceptability of using a website in conjunction with SMS messages to help college students quit smoking. Participants rated the website lower than the SMS component of the programme in terms of acceptability and satisfaction; this was mainly due to the easier accessibility of SMS messages. Some of the barriers preventing people from engaging in web-based interventions include having limited access to the Internet, which may be more frequent for those from disadvantaged areas.[28] However, the increasing popularity of smartphones which can provide access to email and the Internet may overcome these barriers, and enhance future opportunities for the delivery of health promotion material using a combination of these modes.[29] Future intervention studies should consider inclusion of measures of cost and cost-effectiveness of electronic health communication.

Limitations

The limitations of the present study include its Internet panel-based recruitment strategy and small sample size, potentially limiting the generalisability of the result. However, participants were young, Internet- and telephone-engaged adults. Almost 40% (54) had less than 12 years of education, and 60% (82) reported fair skin, thus represented well the proposed target group for a mobile skin cancer prevention intervention. Data were collected by self-report thus prone to social desirability bias.

Conclusions

A large proportion of participants appear to be receptive to receiving sun protection advice via electronic messages. The results indicate that emphasis of messages should be on the short- rather than long-term outcomes of sun exposure, such as sunburn and skin ageing.

Acknowledgements

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Table 1. Characteristics of those wishing to receive mobile messages about the UV index

Characteristic	**No. %**		**Odds ratio (95% CI)**	***P*-value**
Gender				
Male	66 (46.8)		1.00	
Female	75 (53.2)		1.45 (0.74-2.81)	0.28
Age, years				
18-30	45 (31.9)		1.00	
31-40	96 (68.1)		0.84 (0.41-1.71)	0.63
Education				
Completed less than 12 years of schooling	54 (38.3)		1.00	
Completed high school (year 12)	25 (17.7)		0.62 (0.24-1.62)	0.33
Trade or technical certificate or diploma	26 (18.4)		1.27 (0.49-3.25)	0.62
University or college degree	36 (25.6)		0.93 (0.39-2.16)	0.86
Current work situation				
Employed full-time	56 (39.7)		1.00	
Employed part-time or casual	29 (20.6)		1.76 (0.71-4.35)	0.22
Full time home duties/home carer	30 (21.3)		1.62 (0.66-3.96)	0.29
Other	26 (18.4)		1.06 (0.42-2.70)	0.89
Location of main job or activity				
Mainly indoors	90 (63.8)		1.00	
Mainly outdoors	16 (11.3)		1.00 (0.34-2.89)	0.98
About equal amounts indoors and outdoors	35 (24.8)		1.05 (0.48-2.31)	0.88
Current living situation				
alone	16 (11.3)		1.00	
with parents	18 (12.8)		1.00 (0.26-3.84)	0.99
with other family members/friends	107 (75.9)		1.02 (0.36-2.91)	0.97
Private health insurance				
No/Don't know/unsure	85 (60.3)		1.00	
Yes	56 (39.7)		0.77 (0.39-1.52)	0.45
Area of residence				
Brisbane	79 (56.0)		1.00	
Other area of Queensland	62 (44.0)		1.09 (0.56-2.13)	0.79
Country of birth				
Other	19 (13.5)		1.00	
Australia/New Zealand	122 (86.5)		0.90 (0.34-2.97)	0.83
How often uses mobile for phone calls [a]				
Several times a week or more frequent	92 (68.6)		1.03 (0.53-2.01)	0.92
How often uses mobile for SMS [a]				
Several times a week or more frequent	106 (79.1)		1.29 (0.67-2.53)	0.44
How often accesses personal e-mails [b]				
Several times a week or more frequent	133 (97.1)		0.49 (0.22-1.01)	0.08

[a]For respondents who owned a mobile phone (n=134)

[b]For respondents with access to a personal email (n=137)

Table 2. Phenotypic characteristics and sun protection practices associated with wishing to receive mobile messages about the UV index

		No. (%)		**Odds ratio (95% CI)**	***P*-value**
Natural hair colour					
	Red, fair or blonde	40 (28.3)		1.00	
	light or mouse brown	43 (30.5)		0.72(0.30-1.71)	0.46
	dark brown or black	56 (41.2)		1.32 (0.58-2.96)	0.50
Eye colour					
	Blue or grey	55 (39.0)		1.00	
	Green or hazel	44 (31.2)		1.70 (0.76-3.78)	0.19
	Brown or black	42 (29.8)		1.67 (0.73-3.82)	0.22
Skin colour before tanning on areas never exposed to the sun					
	Fair	82 (58.2)		1.00	
	Medium	40 (28.4)		0.78 (0.36-1.66)	0.51
	Olive or brown	19 (13.5)		3.67 (1.15-12.1)	0.03
Skin reaction following exposure to strong sun for at least 30 min					
	Burn and not tan afterwards	41 (30.1)		1.00	
	Burn then tan	61 (44.9)		0.84 (0.38-1.85)	0.51
	Tan without burning	34 (25.0)		0.93 (0.35-2.46)	0.88
Depth of tan after being exposed to the sun over several days					
	Never tan, only burn or freckle	22 (16.5)		1.00	
	Slight tan	37 (27.8)		0.35 (0.12-1.04)	0.06
	Moderate tan	48 (36.1)		0.87 (0.31-2.48)	0.80
	Deep tan	26 (19.5)		0.57 (0.18-1.82)	0.34
Attempted to get a suntan in the past 12 months					
	No/don't know	113 (80.1)		1.00	
	Yes	28 (19.9)		1.69 (0.73-3.92)	0.22
How many times got sunburnt in the past 12 months					
	Never/not sure	33 (24.1)		1.00	
	Once	52 (36.9)		0.96 (0.40-2.29)	0.93
	2-5 times	41 (29.1)		1.44 (0.58-3.58)	0.44
	6 or more times	14 (9.9)		1.50 (0.43-5.26)	0.53
Number of sun protection practices mentioned					
	0-2	52 (36.8)		1.00	
	3-4	52 (36.8)		1.47 (0.68-3.18)	0.33
	5 or more	37 (26.2)		1.48 (0.64-3.46)	0.36
Sun Protection Behaviour Index[a]; Mean (SD)		2.36 (0.64)		2.97 (1.63-5.42)	0.001
In the coming week, I intend to apply sunscreen before going outdoors					
	Agree/Strongly Agree	74 (52.5)		1.00	

	Unsure	31 (22.0)		0.45 (0.19-1.07)	0.72
	Disagree/Strongly Disagree	36 (25.5)		0.58 (0.6-1.29)	0.18
While outdoors over the next week, I intend to re-apply sunscreen often enough to ensure adequate protection					
	Agree/Strongly Agree	60 (42.6)		1.00	
	Unsure	39 (27.7)		0.42 (0.18-0.97)	0.04
	Disagree/Strongly Disagree	42 (29.8)		0.29 (0.13-0.68)	0.004
A suntanned person looks more healthy					
	Agree/Strongly Agree	47 (33.3)		1.00	
	Unsure	23 (16.3)		0.28 (0.08-0.96)	0.04
	Disagree/strongly disagree	71 (50.4)		2.64 (1.24-5.65)	0.01
If I regularly protect my skin from the sun, I am at risk of having low vitamin D					
	Agree/Strongly Agree	34 (24.1)		1.00	
	Unsure	52 (36.9)		0.45 (0.18-1.09)	0.08
	Disagree/Strongly Disagree	55 (39.0)		1.18 (0.49-2.81)	0.70

[a] Sun protection factor

[a] Composite sun protection behaviour index, which summarises how frequently participate engage in each of the following: wearing protective clothing, wearing sunglasses, staying in shade, using sunscreen, staying indoors during midday, wearing a hat) [17]

Table 3. Multivariable logistic regression analyses of factors associated with wishing to receive mobile messages

		OR (95%CI)		**Wald χ2; P-value**	
Sex					
	Men	1.00			
	Women	1.14 (0.54-2.41)		0.11; 0.74	
Age group (years)					
	≤30	1.00			
	31-40	1.99 (0.85-4.66)		2.54; 0.11	
A suntanned person looks more healthy					
	Agree/Strongly Agree	1.00			
	Unsure	0.24 (0.07-0.90)		4.47; 0.03	
	Disagree/Strongly Disagree	2.06 (0.89-4.72)		2.91; 0.08	
Sun Protection Behaviour Index		2.79 (1.45-5.40)		9.36; 0.002	

All variables are mutually adjusted in this model