How Can Skin Check Reminders be Personalised to Patient Conscientiousness?

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Abstract. This paper explores the potential of personalising health reminders to melanoma patients based on their personality (high vs low conscientiousness). We describe a study where we presented participants with a scenario with a fictional patient who has not performed a skin check for recurrent melanoma. The patient was described as either very conscientious, or very unconscientious. We asked participants to rate reminders inspired by Cialdini's 6 principles of persuasion for their suitability for the patient. Participants then chose their favourite reminder and an alternative reminder to send if that one failed. We found that conscientiousness had an effect on both the ratings of reminder types and the most preferred reminders selected by participants.

Keywords: Personalised reminders, personality, persuasion, eHealth

1 Introduction

Melanoma (skin cancer) is one of the most common cancers in 15-34 year olds. More than 1/3 of cases occur in people under 55 and, in the UK, it kills over 2,000 people every year [1]. The risk of malignant melanoma is between 8-15 times greater in people who have been diagnosed with a previous melanoma [2] and early detection of these recurrences is a critical goal of follow-up programmes [28]. For this reason it has been proposed that patients treated for cutaneous melanoma perform Total Skin Self-examinations (TSSEs) at frequent intervals [4]. Patients treated for cutaneous melanoma who detected their own recurrences have up to a 63% reduction in mortality [9, 20]. However, even if patients are taught to self-check often, it is likely that their self-checking will decrease over time without an intervention to sustain their behaviour [16, 19]. There is extensive evidence to suggest that mobile telephone and internet interventions can help promote health behaviour change (e.g. [13, 34, 30]), and evidence to suggest that apps (i.e. mobile or tablet applications) can be used to support a sustained health self-management strategy [35].

With this in mind, the ASICA (Achieving Self-directed Integrated Cancer Aftercare) Skin-Checker app was developed at the University of Aberdeen in 2013. The app is part of an intervention that aims to remove barriers between patients treated for melanoma and specialists in dermatology by enabling remote

screening and diagnosis of skin changes. One goal was to ensure that patients complete TSSEs regularly (at least once per month). In a six month pilot study, patients were provided with a tablet with the skin checker app. The same reminder was sent by a member of the team monthly to all patients. We found that the reminders were generally effective, but not for all 20 patients. Accordingly, we decided to investigate how reminders could be personalised. It is likely that personality plays a role in a patient's response to a reminder (along with other relevant factors such as their affective state, daily schedules, etc.), and as personality is relatively stable in adults, it seems a relevant characteristic to consider for the personalization of reminders.

Personality can be measured using many methods, however, the Five-Factor model [14] from trait theory is one of the most popular and reliably validated constructs in use by psychologists. This model describes five personality dimensions: Agreeableness (I), Extraversion (II), Conscientiousness (III), Neuroticism (IV) and Openness to Experience (V). In this paper, we focus on Conscientiousness which describes how meticulous and hard-working an individual is, because this might affect their motivation to perform skin checks. We describe a study where we asked participants to rate twelve different types of reminder for their suitability, based on the conscientiousness of the patient. The results from this study will provide an indication of how reminders could be personalised by the ASICA skin checker app in the future.

2 Related Work

Experts in persuasion have proposed many different sets of strategies (from 6 up to over 100 persuasive strategies per set) that can be used to motivate certain behaviours [22]. In this paper we make use of Cialdini's 6 principles of persuasion [8] (shown in Table 1), as they have been used in multiple contexts including reminders [22]. Cialdini's persuasive principles [8] have been used in reminders for clinic appointments [33] and interaction with an activity monitor app [22].

An effective way to persuade people to interact with a system is to provide reminders [12]. Arguably, in the health domain, reminders should be even more potent, as patients are already motivated by the possible threat to their well-being. Health reminders have been researched for several decades. In 1991, [29] found that computer-generated reminders effectively improve adherence to preventative health services. This has been found in multiple domains - for example, using text message reminders in HIV patients [11]; for malaria management [36]; attending healthcare appointments [17] and using mobile notifications to increase well-being logging on an app [3].

Personalisation in reminders is however a relatively new field. [26] identified the need for the personalisation of reminder systems, beyond adaptation to scheduling preferences. Some research has been done on personalising reminders, e.g. adapting to the user's location and movement when providing medication reminders [23]; adapting affect in hand washing reminders for pa-

Table 1. Cialdini's six principles of persuasion [7]. The alternative terminology in brackets is used in this paper and is taken from [22].

Principle	Description
Liking	"People like those who like them." If a request is made by someone we like, we are more likely to say yes.
Reciprocity	"People repay in kind." People are more likely to do something for someone they feel they owe a favour.
Social Proof (Consensus [22])	"People follow the lead of similar others." People will do the same as other people who are similar to them.
Commitment (and Consistency [22])	"People align with their clear commitments." People will do something if they have committed to it. Also, they will act consistently with previous behaviour.
Authority	"People defer to experts." If a doctor advises you to take a medication, you are likely to comply.
Scarcity	"People want more of what they can have less of." People will take the opportunity to do something that they can't leave until later.

tients with Alzheimers Disease [24]; and tailoring mammography reminders to personal risk and the patient's personal barriers to having a mammogram [25].

There has also been research into the link between personality and the result of reminders in the healthcare domain, e.g [18] found that conscientious people would likely be the most successful at achieving their health objectives, and persuasive categories with a social aspect were likely to be the most successful for conscientious people. Patients low in conscientiousness typically have lower adherence to treatments [5, 6]. Therefore, it is likely that patients who are low in conscientiousness would require different types of reminders, and perhaps more frequently, than those patients who are normally highly conscientious.

3 Study Design

This study investigates which types of reminder are best for patients with different levels of conscientiousness. There were two parts to the study. The first part asked participants to rate the reminders for their suitability for "John", a fictional patient, who would either be described as having high or low conscientiousness. The second part asked participants to pick the best reminder to send. Subsequently, participants were asked how long they would wait before sending a second reminder if the first one failed, and then asked to pick a second reminder to send.

3.1 Participants

The study was administered as an online questionnaire on Amazon's Mechanical Turk [27]. Mechanical Turk allows the creators of tasks (*requesters*) to approve or

reject completed work before payment. As a further check, we included a Cloze Test [32] for English fluency to ensure that workers possessed enough literacy skills to understand the language based nature of the task. Participants had to have an acceptance rate of 90%, be based in the United States and pass the fluency test in order to be eligible for the study. There were 68 participants (50% female, 50% male; 24% aged 18-25, 50% aged 26-40, 35% aged 41-65, 1% over 65) with a random allocation for conscientiousness (30 low, 38 high).

3.2 Materials

Table 2. Stories used in the study to convey high and low conscientiousness

high	low
John is always prepared. He gets tasks done right away, paying attention to detail. He makes plans and sticks to them and carries them out. He completes tasks successfully, doing things according to a plan. He is exacting in his work; he finishes what he starts. John is quite a nice person, tends to enjoy talking with people, and quite likes exploring new ideas.	John procrastinates and wastes his time. He finds it difficult to get down to work. He does just enough work to get by and often doesnt see things through, leaving them unfinished. He shirks his duties and messes things up. He doesnt put his mind on the task at hand and needs a push to get started. John tends to enjoy talking with people.

This experiment conveys the patient's personality using short stories previously validated for describing low or high conscientiousness [10]. Originally the stories were adapted from the NEO-IPIP 20-item scales [15] by combining the phrases into sentences to form a short story, with the addition of a very common male name, John, shown in Table 2.

12 persuasive reminders were developed depicting Cialdini's six persuasion categories [8], two for each category. These were generated with a panel of experts in eHealth in a brainstorming session, and are shown in Table 3.

3.3 Experimental design

The independent variables are the conscientiousness of the patient "John" (low or high, between-subjects), and the persuasive reminder (12 reminders, within-subjects).

The dependent variables are: Suitability; the most preferred ('best') reminder to send first; the best reminder to send second; and the length of time between the two reminders. Suitability was based on the average rating of each reminder of four measures: effectiveness, helpfulness, appropriateness and sensitivity developed by [21]. These have been found to be internally consistent and to contribute to a single factor in a Principal Component Analysis [31].

Table 3. Reminder types and examples used in this study.

Reminder Type	Reminder Text
Liking (LIK)	Your friends would feel better knowing that you are OK. Please check your skin now.
	Dear John, I would appreciate it if you performed your monthly skin check so I don't need to worry about you as much. Love, your daughter, Mary.
Reciprocity (REC)	The Skin Checker iPad was provided to you to help you check your skin. Please check your skin now.
	We would love to receive confirmation that you have checked your skin. Please check your skin now.
Consensus & Social Proof (CON)	90% of people with the Skin Checker iPad have already performed their skin check this month. Please check your skin now.
	Thousands of people are actively checking their skin each month. Join them - please check your skin now.
Commitment & Consistency (COM)	You have checked your skin frequently in the past. Please check your skin now.
	When you decided to participate, you agreed that checking your skin monthly is a good idea. Please check your skin now.
Authority (AUT)	Doctors recommend that you check your skin at least once a month as health outcomes are better if you do. Please check your skin now.
	According to experts, checking your skin regularly is an effective way of identifying recurrent skin cancer. Please check your skin now.
Scarcity (SCA)	This is your last opportunity for your monthly skin check. Do not miss out - please check your skin now.
	If a recurrent skin cancer gets detected quickly, health outcomes are much better. Please check your skin now.

3.4 Procedure

The study began by asking participants to complete the English fluency test. If they passed, participants were asked to select their gender and age from a range (both fields were optional). On the next screen, the participants were shown a short explanation of why skin checking is important, and the story about "John", conveying high or low conscientiousness (see Figure 1). Participants were told that John had not performed his skin check yet this month, and that the app needed to send an automated reminder. Next, they rated each of the 12 reminders in turn for their suitability for 'John' using the 4 scales (see Figure 1).

Subsequently, participants were asked to select the reminder that they felt was best for John. The information about the importance of skin checking and John's personality were repeated to remind the participants (shown in Figure 2). They were then asked how long they would wait before sending a second reminder if the first one failed to provoke John to perform his skin check (from 1-30 days, or 'longer'). Finally, they were asked to pick the reminder that they would send as the second reminder. Participants could choose to send the same reminder again if they wished.

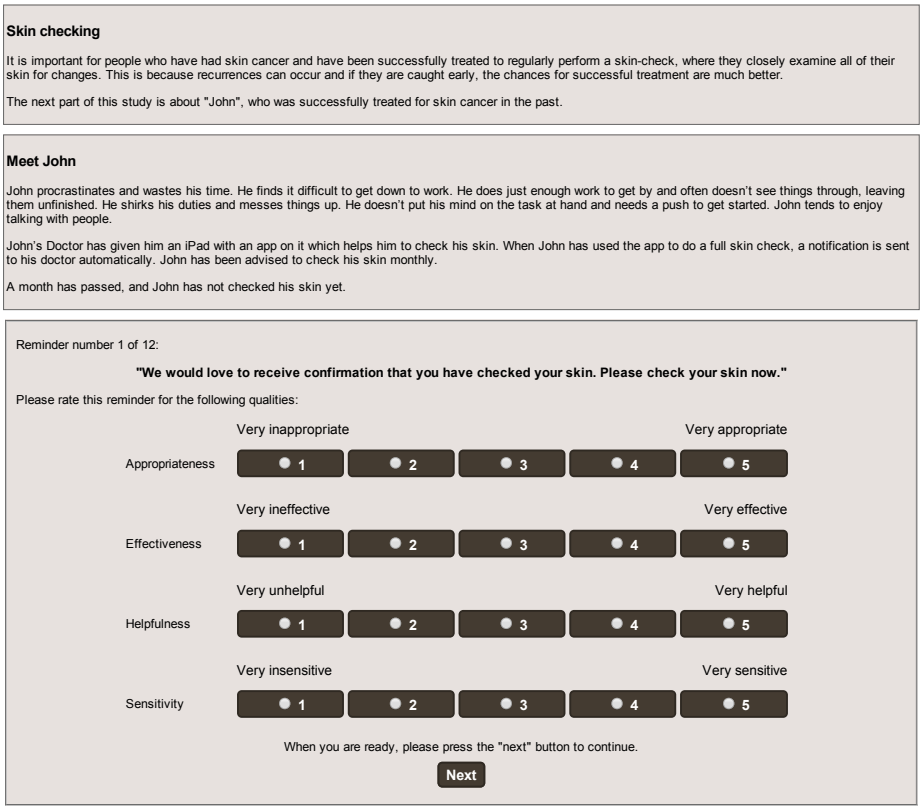

Fig. 1. Screenshot of the rating part of the study

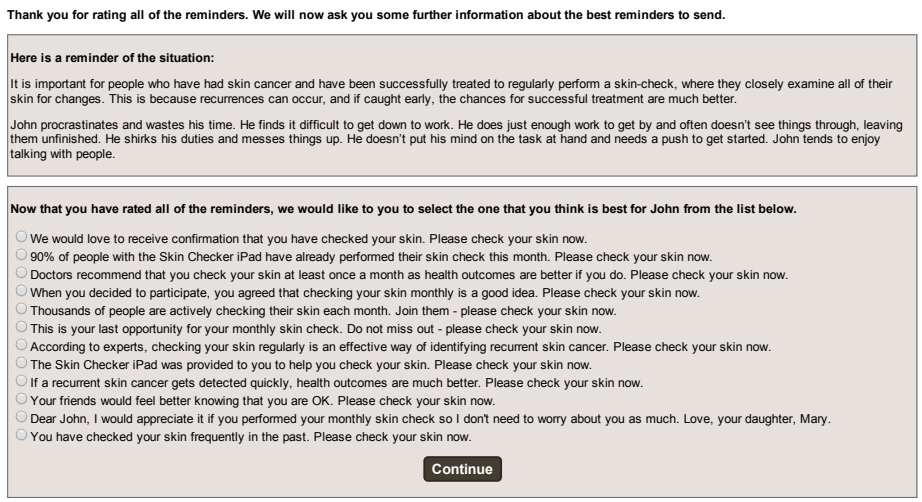

Fig. 2. Screenshot of the best reminder selection part of the study

3.5 Hypotheses

Given the exploratory nature of this study, the hypotheses are open-ended with two-sided comparisons between levels of concientiousness.

H1: People will rate different reminder types differently overall (some may be better than others).
  H1a: People will rate the reminder types differently between levels of conscientiousness.
H2: There will be a difference in the best first reminder type between levels of conscientiousness.
H3: The second reminder type will differ from the first reminder type.
  H3a: The second reminder type will differ between levels of conscientiousness.
H4: The length of time between reminders will vary between levels of conscientiousness.

4 Results

4.1 Analysis of Ratings

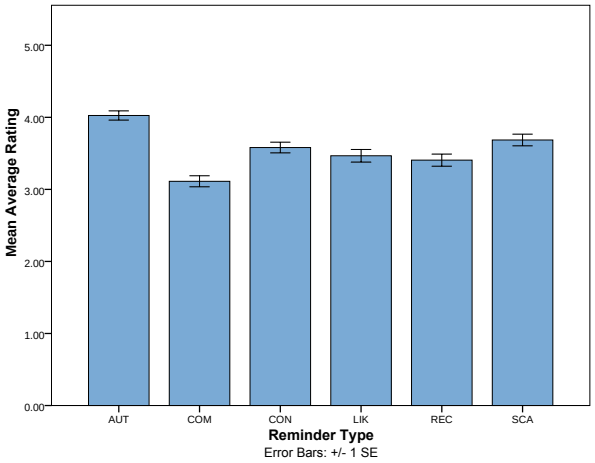

Fig. 3. Graph of Overall Reminder Type Average Rating

Figure 3 shows the overall average rating for each of the reminder types. To investigate if these differences were significant, and to explore the differences for conscientiousness trait level, we performed a 6×2 2-way ANOVA of reminder type × trait level on average rating. Confirming hypothesis H1, there was a significant overall effect of reminder type ($F(5, 804) = 14.50$, $p < 0.01$), and the interaction of reminder type × trait level ($F(5, 804) = 2.54$, $p < 0.05$), supporting

H1a. Pairwise comparisons of Reminder Type revealed 3 homogeneous subsets. Authority was the best, followed by the subset containing Scarcity, Consensus, Likability & Reciprocity. The final subset of Reciprocity and Commitment and Consistency. These can be seen in Table 4.

To investigate the interaction effect, pairwise comparisons (Bonferonni corrected) were performed on Reminder Type × Trait Level. There was a significant effect for Liking - this was rated significantly higher for the low trait level. There were also significant differences in the highest rated reminders for each trait level (m=4.10 vs 3.74) - shown in Table 4 and Figure 4.

Table 4. Homogeneous Subsets for the post-hoc tests of Reminder Type alone and Reminder Type × Trait Level on Average Rating.

Effect of Reminder Type		Effect of trait level x Reminder Type			
		High		Low	
Rem Types in Subset	mean	Rem Types in subset	mean	Rem Types in subset	mean
AUT	4.03	AUT	4.10	AUT, LIK, SCA, CON	3.74
SCA, CON, LIK, REC	3.53	CON, SCA, REC, LIK	3.47	CON, REC, COM	3.38
REC, COM	3.26	REC, LIK, COM	3.22		

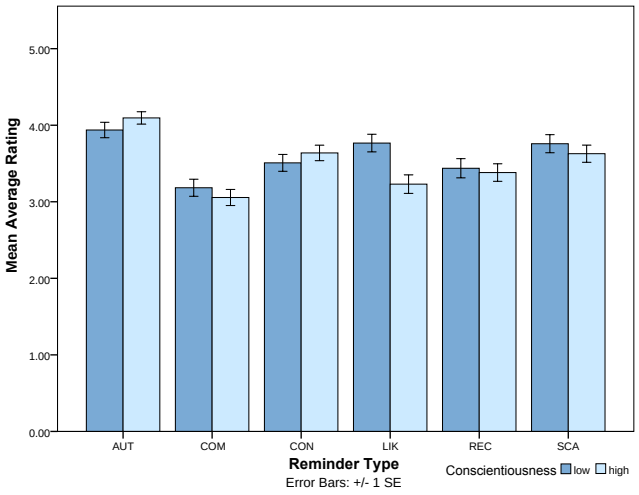

Fig. 4. Graph of Average Rating for each Reminder Type for High and Low Conscientiousness

Table 5. Chi Squared frequencies for Best Reminder Type.

	Reminder Type						
Trait Level	AUT	COM	CON	LIK	REC	SCA	Total
Low	10	1	3	11	2	3	30
High	11	4	0	5	7	11	38
Total	21	5	3	16	9	14	68

4.2 Analysis of Best Reminder

In the second part of the experiment, we asked participants to pick the best reminder to send to John out of all twelve reminders. To analyse this, we performed a Chi-squared test of trait level × Best Reminder Type. This was significant at $\chi^2(5) = 13.70, p < 0.05$, supporting hypothesis H2. Table 5 shows the frequency of each Reminder Type selected for each trait level. For low conscientiousness, participants most commonly selected the AUT and LIK reminders, while for high conscientiousness, participants selected AUT and SCA.

After selecting their best reminder, participants were asked to choose a second reminder to send if their first reminder failed. A Chi-squared test of trait level × Second Reminder Type was not significant at $\chi^2(5) = 3.01, p > 0.5$, meaning H3a is not supported. We explored this further by counting how many participants chose different Reminder Types for their first and second reminders (*changed reminder*). We performed a binomial test of *changed reminder* with Test Proposition of 0.50. This was significant at $p < 0.01$ – 56 of 68 participants changed their reminder type, supporting H3. This shows that participants preferred a different reminder type for the second reminder if the first failed. We did not identify a predictable pattern for the second choice, in terms of direction or level of conscientiousness.

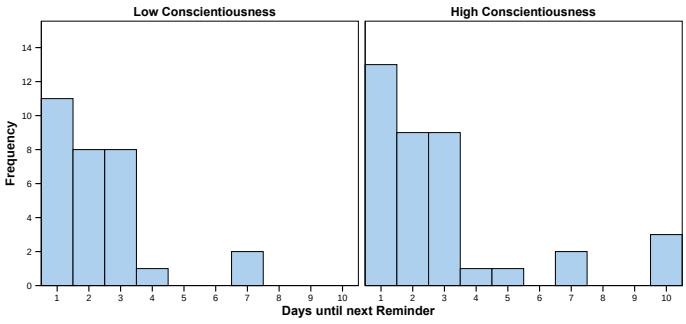

Fig. 5. Frequency Histogram of Number of days to wait before issuing a second reminder for high and low conscientiousness

We also asked participants how long they would wait to send the second reminder (1-30 days or longer). As shown in Figure 5, most participants would wait for 1-3 days (Low trait mean $= 2.30 \pm 1.56$, High trait mean $= 2.92 \pm 2.57$), with a maximum of 10 days in between reminders. A Mann-Whitney test showed no difference for conscientiousness, giving no support for H4.

5 Conclusion

In this paper, we described a study where participants were asked to rate the suitability of different reminders for a fictional patient (with either high or low conscientiousness) to check their skin. We found that the level of conscientiousness of the described patient had a significant effect on both the ratings of the reminders, and the most preferred reminder.

For low conscientiousness, reminders of the 'liking' type (where the reminders appear to come from someone they like) were the most popular, followed closely by reminders of the 'authority' type (where the reminder informs the patient of what doctors recommend). For high conscientiousness, reminders of the authority type were tied with reminders of the 'scarcity' type (reminders that inform the patient that they cannot leave the skin check until later) were the most popular. We found that participants chose a reminder of a different type for a second reminder, but not in a predictable way. Surprisingly, we found no effect of conscientiousness on the time between reminders, with most waiting 1-3 days.

This leads to several interesting questions and directions for future work. Although we found significant differences, reminders of the 'authority' type were universally popular. It is possible that this would be a useful default if the personality of the patient is not identified. Further, the 'liking' type reminders were only marginally more popular than 'authority' for low conscientiousness, and equally as popular as 'scarcity' reminders for high conscientiousness. We still need to establish which type would be best to send. Additionally, we have not found a trend to establish the type of the second reminder if the first fails.

A limitation of our approach is that we only investigated what people think the best reminder would be, and we do not know the effects of these reminders on real patients. If there is a difference between the method preferred by advice givers and which reminders are most effective for patients, this could have a large impact on how advice giving is adapted. We also did not investigate differences based on what participants perceived the application as representing (doctor, friend, etc.). We will work with clinicians to ensure that reminders are appropriate and safe to send to patients. After this, we can begin investigating their effect on patients, and incorporate them into the skin-checker app.

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