Crowd-Designed Motivation: Combining Personality and the Transtheoretical Model

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Abstract. Current approaches to design motivational technology for behavior change focus on *either* tailoring motivational strategies to individual preferences *or* on implementing strategies from behavior change theory. Our goal is to combine these two approaches and translate behavior change theory to text messages, tailored to personality. To this end, we conducted an online survey with 481 participants exploring the relationship between behavior change theory (the Transtheoretical Model) and personality in the context of physical activity. Our results show that (1) people's personalities correlate with their stage of change and (2) people's personalities and their stages of change correlate to preferences for certain processes of change. We discuss the implications of the results for designing motivational technology.

Keywords: Behavior change · Persuasion strategies · Personality · Processes of change · Stages of change · Transtheoretical model

1 Introduction

Over the past few years, human-computer interaction (HCI) research, in particular persuasive technology research, has focused on designing motivational technology, assisting or encouraging people to change their behavior [1]. To increase the effectiveness of the strategies used in these technologies, researchers aim for personalization [2]. This can be done by, for example, tailoring the strategies to certain user characteristics, like personality [3]. Additionally, authors have been advocating the use of behavior change theory [4] aiming to increase the effectiveness of the strategies used in these technologies. However, using theory or models when designing motivational technology for behavior change comes with a challenge: there is no well-established method to translate theoretical constructs and insights to persuasive or motivational interaction designs to be used in practice.

We aim to combine these two approaches to increase the effectiveness of persuasive and motivational strategies. For our long-term goal, the objective is to design a smartphone application that motivates users through text messages

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to become regular runners by implementing strategies from behavior change theory or models and tailoring these text messages to personality.

The strategies that we aim to translate and personalize come from the Transtheoretical Model (TTM) of behavior change [5]. According to the TTM, behavioral change consists of five stages of change. When moving through these stages, people encounter processes of change, i.e., experiences and actions that influence the progression through the stages [6]. Different processes are associated with different stages of change [7]. For example, rewarding desirable behavior (i.e., Reinforcement Management) is expected to be most useful in stages where desirable behavior is performed (i.e., in the Action or Maintenance stage), whereas making someone aware of the risks of undesirable behavior (i.e., Consciousness Raising) is expected to be most useful in stages where the undesirable behavior is still performed (i.e., in the Precontemplation, Contemplation or Preparation stage). We expect that when designing messages that capture a process of change that fits with the stage of change a person is in, the effectiveness of the messages will increase. To increase the effectiveness even further, we could account for the individual preferences people have for persuasive strategies [8,9], for example based on their personality [10], which is similar to a persuasion profile [11].

In this paper we report on the first step in a novel approach to translate and personalize strategies from behavior change theory to inform the design of motivational technology. Using a crowdsourcing platform, we measured the participants' stage of change, personalities and preference for a certain process of change. We show that (1) personality is correlated to the stage of change a person is in, and (2) personality and stage of change are related to the preference for a certain process of change.

In the following sections we report on theoretical background, related work, our expectations, the design and results of the crowdsourcing study with questionnaires, and we end with a discussion and conclusion.

2 Theoretical Background: TTM and Personality

The Transtheoretical Model (TTM) from Prochaska et al. [5] is a dynamic, integrative behavior change model focused on the individual. The stages of change associated with the TTM can be practically applied [12] and classify people into (not necessarily linearly) progressing stages for changing behaviors, i.e., Precontemplation, Contemplation, Preparation, Action, and Maintenance. While the stages of change are useful in explaining when changes in cognition, emotion, and behavior take place, the processes of change help to explain how and why the progression through these stages occur. Ten covert and overt processes will usually be experienced when successfully progressing through the stages of change and attaining the desired behavioral change. The ten processes can be divided into two groups: Experiential processes and Behavioral processes. Experiential processes are focused on changing people's ideas and Behavioral processes are focused on changing people's actions, see Table 1 for an overview. The effectiveness of the processes of change depends on their associated stages of change.

Table 1. The processes of change divided in experiential and behavioral processes with a short description.

Experiential processes
Consciousness raising (CR): The individual seeks increased knowledge about the causes, consequences and cures for their problem behavior
Dramatic relief (DR): The individual's emotions about the problem behavior and possible solutions are evoked
Environmental reeval. (ER): The impact that the individual's problem behavior has on their environment is reevaluated
Social liberation (SOL): Attempts are made to increase alternatives for the individual's former problem behavior
Self-reevaluation (SR): Cognitions and emotions regarding the individual with respect to their problem behavior are reevaluated
Behavioral processes
Self-liberation (SEL): The individual has the belief that he can change and commits to it by choosing a course of action
Helping relationships (HR): The individual seeks trust and open discussion about the problem behavior as well as support for the healthy behavior change
Counterconditioning (CC): The individual substitutes positive behaviors for the individual's problem behavior
Reinforcement manag. (RM): Steps or changes made by the individual are rewarded when in a positive direction or punished when in a negative direction
Stimulus control (SC): Stimuli that may cue a lapse back to the problem behavior are avoided and prompts for more healthier alternatives are inserted

If we could also account for individual preferences, for example those caused by differences in personality [10], we could increase the effectiveness even further.

Personality is a way to describe long-lasting individual characteristics (similarities and differences) between people. In the psychology literature, a lot of different personality classifications can be found. The most important one is the Big Five [13] model, also known by its acronym for the personality traits; OCEAN. This framework classifies people in five dimensions: Openness to experience, (**O**), Conscientiousness (**C**), Extraversion (**E**), Agreeableness (**A**) and Neuroticism (**N**). A well-known measure for this five-factor model is the NEO-PI-R [14]. Although there are other personality theories, we chose to work with this model: it is practical in use, it is temporally stable [15], and measurement tools (i.e., questionnaires) for the model are widely available and well validated [16].

3 Related Work

The use of theory or models, such as the TTM, has been advocated in designing strategies to change behavior (e.g., [17,18]) because this will help evaluate

this theory or model and the use of this theory or model then offers an explanation when the designed intervention strategy does or does not work. Hence, a theoretical foundation will help in understanding and targeting determinants of behavior, like the stages of change or personality. However, there is little guidance on how to apply theory to the design of intervention strategies [18].

In the context of changing or determining physical activity behavior, some direct relations have been found between physical activity and certain personality traits. Overall, Extraversion and Conscientiousness seem to be positively correlated with physical activity and exercise behavior [19–21] while Neuroticism appears to be negatively correlated to physical activity [21].

Research on personality as a factor for tailoring messages to encourage physical activity has been rather limited. The most closely related works can be found in [22,23]. In a study by Courneya et al. [22], exercise behavior, motives, barriers, and preferences were correlated to the Big Five. Among other things, it was found that: the personality trait Openness was related to the motive of fun and enjoyment; Conscientiousness was related to the motive of fitness and health; Extraversion was related to the motive of socializing and meeting people, Agreeableness was negatively related to preference for competitive exercises; and Neuroticism was related to the barriers of lack of energy, lack of motivation and embarrassment. From these correlations, one could derive guidelines on how (not) to tailor motivational messages to each personality type. Another study [24] also addressed the relation between personality and motives in exercise participation. It was found that different personalities have different motives for change in exercise participation, indicating that people with different personalities should be motivated in different ways to participate in exercise. Halko et al. [23] explores the relationship between personality (Big Five) and persuasion in the context of health-promotion with mobile applications. Their results showed that all personality types had different preferences for (mobile) persuasive messages (for healthy living). Finally, there have been some studies that suggest that the stages of change can benefit from personalization [25], that future research should tailor messages that promote physical activity to people's personalities [26], and that "Individuals with certain personality traits are more likely to be perceptive toward the idea of physical activities" [3, p. 8]. All these studies indicate that personality is a decisive factor in explaining the individual nature of people and their motivations and barriers for physical activity participation.

There has been some recent research into the role of personality when designing tailored persuasive strategies [9,27,28]. For example, Kaptein et al. [9] developed six persuasive strategies and a questionnaire to measure the user's susceptibility to those six persuasive strategies. They tested a setup where they tailored to the user's susceptibility versus a contra-tailored setup in the context of snacking and found a greater decrease in the tailored version. In a study about tailored persuasive messages for advertisement (advertising mobile phones), Hirsh et al. [27] let participants rate the level of persuasiveness of the messages that were tailored to each personality type. For example, people with the Extraversion personality type would receive messages like "With XPhone,

you'll always be where the excitement is" [27, p. 579] because extraverts are especially sensitive to rewards and social attention. The results show a clear benefit in tailoring messages to personality type features. Similar results were obtained in a study [28] where an application was developed to persuade users to study more using persuasion strategies that were tailored to users' personalities: different personalities indeed preferred different (persuasive) study behaviors. All these studies show promising results and are good examples of how persuasive strategies and personality targeted design can influence participants and increase their participation in a HCI context.

4 Expectations

Our long-term goal is to develop technology that motivates people to exercise and adhere to exercising for a longer period of time such that long-term behavior change can be accomplished. We argue that motivational text messages tailored to personality, as a stable, distinctive factor, and framed in behavior change theory, will contribute to longer-term exercise adherence.

In the current work, we explored the relation between personality and the stages, and between personality and the stages, and the processes of change. For the first relation, we expected to find that personality correlates to the stages of change. More specifically, given that Extraversion and Conscientiousness have been found to correlate positively to fitness and health [19–22], and Neuroticism was found to correlate negatively to physical activity [21], we expected to find a positive correlation for Conscientiousness and Extraversion and a negative correlation for Neuroticism in relation to stage of change. For the second relation, we expected to find that different personality traits together with the stages of change related to different processes of change, but we had no expectation specifically, about how traits, stages and processes related.

5 Study

Our study was framed as an online crowdsourcing (language-elicitation) task with questionnaires. The same study was also described in [29] but reports on different results. In the current paper, we focused on the results of the questionnaires. The participants were gathered through Amazon Mechanical Turk (AMT), with a link to SurveyMonkey where the study was hosted. In the questionnaires, we measured the participants' personalities, their self-assessed stage of change and the processes of change.

5.1 Sample

The sample size consisted of 500 people. The data of 19 respondents was excluded because their questionnaires were incomplete. The final sample included 481 respondents (250 male and 231 female). The minimum age was 18 and the maximum was 68. The average age was 31.09 (SD = 9.22) and the median 29.

With respect to education, 201 respondents received some college education, 183 obtained a college degree, 46 obtained a masters degree, 42 completed their high school, 5 obtained a PhD and 4 received other types of education.

The AMT requirements for the respondents were that they had already completed >1000 tasks on AMT, >98 % of them were approved successfully and the respondents were located in the United States. These requirements ensured that respondents were already familiar with surveys, that they were serious about filling in the survey (only 19 were not, which is low for online anonymous surveys) and that they had some proficiency in English.

5.2 Questionnaire Measures

To measure participants' personality we used the 50-item IPIP representation of the revised version of Costa and McCrae's [14] NEO Personality Inventory[1] which posed 50 statements (for example, "Make plans and stick to them."). Participants were asked to answer how self-descriptive they found these statements (on a 5-point Likert scale, 1 being "very inaccurate" and 5 being "very accurate"). We used a 1-item stage of change measure for exercise [30] where participants were given a description of regular exercise and of the five stages and rated their stage based on that description. Additionally, we used a 30-item processes of change measure[2] for exercise [31] which asked how often certain experiences or habits (for example, "I feel more confident when I exercise regularly.") occurred in the last month (each measured by three items, ratings from 1 (never) to 5 (always)).

The reliability of the measures was overall very good (see Table 2 for personality and Table 3 for processes). The only disputable measure was that of Social liberation, with a Cronbach's alpha of .63 which we found still acceptable (and also comparable to other relevant work [7]). Otherwise the reliability scores were between .75 and .90.

5.3 Procedure

Participants were recruited through AMT. They were informed of their compensation, the goal of the survey experiment and the estimated completion time. On SurveyMonkey, the goal of this survey was summarized and participants were asked to complete a consent form. Our study was framed as an online crowdsourcing (language-elicitation) task with questionnaires. First, the participants were given a crowdsourcing language-elicitation task: the description and analysis of this task fall outside the scope of this paper. Second, participants were asked to fill out questionnaires for personality, stage of change and processes of change. We address the results of these questionnaires in the current paper.

[1] adopted from http://ipip.ori.org/.
[2] adopted from http://www.uri.edu/research/cprc/measures.htm.

Table 2. Averages (M), standard deviations (SD), and Cronbach's alpha's (α) for all the construed scales. Scales are added, instead of averaged to keep origin clear. Personality scales are 10 items with scoring from 1 to 5 added up (possible scores from 10 to 50). Ordinal regression with stage of change as dependent variable and the personality traits (OCEAN) as independent variables. (N = 481)

Trait	M	SD	α	$ratio$	sig	CI
Openness to exp.	38.94	6.65	.77	1.015	.252	[0.989 – 1.042]
Conscientiousness	37.75	7.43	.89	1.025	.074	[0.998 – 1.055]
Extraversion	31.02	8.91	.90	1.050	**.000**	[1.028 – 1.075]
Agreeableness	38.24	6.14	.80	0.969	.057	[0.939 – 1.001]
Neuroticism	24.61	8.91	.90	0.971	**.024**	[0.946 – 0.996]

The participants were debriefed about the detailed goals of this survey and given a completion code to fill in on AMT to receive payment. The survey took about 45 min to complete. Participants were compensated 3 US dollars for their participation.

6 Results

Data from 481 participants was analyzed. Important to note is that the self-assessed stages of change measure was not equally distributed: 175 participants rated themselves to be in the *Maintenance stage* (M), 114 in the *Preparation stage* (P), 91 in the *Action stage* (A), 68 in the *Contemplation stage* (C), and 33 participants rated themselves in the *Precontemplation stage* (PC).

6.1 Relation Between Personality and Stages of Change

Based on literature we expected that certain personality traits scores significantly relate to self-assessed stage of change. An ordinal logistic regression was run to determine the effect of the traits (OCEAN) on the self-assessed (ordinal) stages of change. The general model (OCEAN) statistically significantly predicted the stages of change over and above the intercept-only model, $\chi^2(5) = 66.526$, $p < .001$. Concerning the contributing factors, an increase in Extraversion was associated with an increase in stage of change, with an odds ratio of 1.051 (95 % CI, 1.028 to 1.075), $\chi^2(1) = 18.578$, $p < .001$. However, a decrease in Neuroticism was associated with an increase in stage of change, with an odds ratio of 0.971 (95 % CI, 0.946 to 0.996), $\chi^2(1) = 5.091$, $p < .024$. The other personality traits were not significantly ($p < 0.05$) related to stage of change (see Table 2). Overall, the influence of the relations (as expressed in the odds ratio) is small.

Table 3. Averages (M), standard deviations (SD), and Cronbach's alpha's (α) for all the construed scales. Scales are added, instead of averaged to keep origin clear. processes of change are 3 items with scoring from 1 to 5 added up (possible scores from 3 to 15). Standardized regression coefficients of personality traits, stages of change and the processes of change are reported. (N = 481) $^1p < 0.05$, $^2p < 0.01$, $^3p < 0.001$.

PoC	*M*	*SD*	α	R^2	SoC β	O β	C β	E β	A β	N β
CR	8.81	3.38	.89	.246	**0.398**^{3}	**0.102**^{1}	0.014	**0.151**^{2}	0.005	0.018
DR	9.10	3.10	.75	.112	**0.278**^{3}	0.080	**0.127**^{1}	0.072	-0.068	0.115
ER	10.65	2.88	.75	.071	0.087	**0.160**^{2}	**0.114**^{1}	0.072	0.011	0.047
SOL	10.64	2.57	.63	.121	0.087	0.064	**0.147**^{2}	**0.171**^{2}	**0.171**^{2}	**0.143**^{1}
SR	12.34	2.75	.86	.260	**0.389**^{3}	**0.225**^{3}	0.014	-0.010	**0.119**^{1}	0.007
SEL	10.98	3.07	.82	.476	**0.619**^{3}	**0.083**^{1}	**0.112**^{2}	0.045	0.006	-0.001
HR	7.81	3.75	.90	.194	**0.297**^{3}	-0.077	0.035	**0.203**^{3}	0.027	-0.046
CC	8.08	3.29	.85	.462	**0.578**^{3}	-0.005	**0.146**^{2}	**0.111**^{2}	0.008	-0.011
RM	11.21	3.11	.84	.310	**0.441**^{3}	**0.164**^{3}	0.062	0.058	0.074	0.001
SC	8.30	3.45	.77	.335	**0.471**^{3}	0.053	**0.115**^{1}	**0.126**^{2}	-0.033	-0.015

6.2 Relation Between Personality and Stages and Processes

We expected that the stages of change and different personalities would relate to different self-assessed processes of change in relation to exercise, but we had no expectation specifically, about how traits, stages and processes related. We were interested in understanding the relations between the continuous personality trait variables (O, C, E, A and N) of the compound variable personality and the continuous variables of the processes of change, which we can assess with regression coefficients. Hence we carried out multiple regression analyses. In Table 3 the standardized regression coefficient (β) scores are reported for the predictor variables stages of change and personality traits (OCEAN) and the outcome variables of the processes of change (10 times). The regression coefficient results suggest that different personality traits scores relate differently to processes of change. All processes are significantly correlated to at least one personality trait, and all personality traits are significantly related to at least one process. It should be noted that although there are significant personality-trait-to-process relations, the stages of change are usually a much larger predictor (this can be seen from the standardized β reported in Table 3). The personality trait results could be considered 'nuances' to the already existing relation between stages and processes.

7 Discussion

Using theory in practice is not always easy and effective. Although there is a general consensus on the value of most behavior change theories and more specifically the Transtheoretical Model, there is also still plenty of room to increase

the effectiveness and salience of such theories by identifying more determinants (e.g., personality) for specific situations (e.g., the exercise domain) and by revealing new dependencies between them. As a first step towards combining personality and behavior change theory to motivate people to exercise, we assessed the possibility of personality-based tailoring of the processes of change through crowdsourcing and self-assessment measures. We conclude that (1) personality traits (E and N) relate to the stages of change and (2) personality traits and the stages of change relate to preferences for certain processes of change. In this section we discuss the implications of the results separately for each expectation.

7.1 Relation Between Personality and Stages of Change

The results of the study show that people's personalities are related to their progression through the different stages of change for exercise behavior, specifically that the Extraversion trait was positively correlated with people progressing through the stages, while the Neuroticism trait was negatively correlated with progressing through the stages. In other words, people scoring higher on Extraversion are more likely to be in higher stages of change, while people scoring higher on Neuroticism are more likely to be in the lower stages of change. No significant relation was found between Conscientiousness and the stages of change. Although the correlations of personality traits to the stages of change are relatively small, this is similar to other research on personality and physical activity [21] and considered still important for the health context. For Extraversion and Neuroticism, which are significantly correlated to the stages, one tentative explanation could be that people change their personality when changing their behavior. But, because it is believed that personality is temporally stable [15], a more likely explanation is that people with low Extraversion and high Neuroticism scores need different motivations and see different barriers when trying to change their behavior (compared to high Extraversion, low Neuroticism scoring people) then those addressed in current motivational technology and programs and therefore these people have more difficulties in changing their behavior.

7.2 Relation Between Personality and Stages and Processes

Our study also shows that there are relations between different personality traits and different processes of change they find important in relation to exercise. Conscientiousness is related to six processes, Openness to Experience and Extraversion are related to five, Agreeableness to two, and Neuroticism to one. Interesting to see is that Neuroticism, which correlated negatively to the stages of change, does not (significantly) relate to many processes. This could support our previous interpretation that the processes believed to help people through the stages are not very appealing to people scoring high on Neuroticism and therefore they also do not progress through the stages. Similar results with health-promoting strategies for people scoring high on Neuroticism were found in previous work [23]. Conscientiousness, which we expected to relate to the stages of change did not, but in turn correlated to the most processes. Previous work also suggested

a relation between Conscientiousness and the stages of change, but found that this was fully mediated by the relation between Conscientiousness and certain processes [32]. In any case, the results show a relation between different processes of change and personality traits, which serves as an indication that the tailoring of processes to personality trait preferences could be very helpful in making the messages more salient for behavior change.

7.3 Limitations of the Current Study

There were some limitations to the present study. Firstly, we used a cross-sectional design which does not provide strong evidence for causation, only correlation. A second limitation is that we ran our study on AMT. This could misrepresent the 'general' population, although some studies have reported that AMT can give very good representation of general society, especially for online survey standards [33]. A third limitation is the self-assessment nature of the measures, which asks people to *think* about what strategies influence them. This does not necessarily mean these strategies *will* influence them, or that they will be influenced by textual representations of these strategies.

8 Conclusion

As part of a larger study, we sought to leverage certain HCI practices, like crowdsourcing, to explore theory on behavior change from psychological research to come to useful and practical insights about how to further adapt the processes of change to (robust) user characteristics (e.g., personality traits). We identified new dependencies between the different processes, stages and personality traits in the context of the exercise domain. And we made a first step in translating theoretical constructs and principles of behavior change theories to information structures and interaction designs. These findings can help inform developers of motivational and persuasive technology who want to use the TTM as a foundation for long-term behavior change and who want to use personality to tailor to individuals. Concretely, we argue that: (1) when designing for behavior change, one should take into account the relation between someone's personality and the stages of behavior change; (2) when designing for more than one-size-fits-all, one should take into account the relation between someone's personality and the preference for different processes of change.

In future research, we will address the limitations of the current study (see Sect. 7.3), and carry out a long-term in-the-wild study to look into the effectiveness of personality-tailored behavior change messages.

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