The Effects of Online Social Supports on Exercise Behavior

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Abstract. Exercise is demonstrated to be beneficial to both physical and mental wellbeing. The challenge of how to persuade individuals to maintain regular exercise has received attention from multiple disciplines. With the rise of online social networks, a number of studies found positive correlations between online social support and active lifestyle. In this paper, we report findings from a 52 weeks study under the methods of phynomenography to analyze the roles played by friends in social networks and the support in exercise behavior changes related to these relationships. The results show that besides the individual effect from message tailoring and intervention strategies, the interaction ecosystem based on appropriate role playing by leaders, peers and followers can enhance persuasion power. Effective social support for encouraging physical activities should consider the roles played by the target individuals in the environment and provide comfortable role support.

Keywords: Physical active · Persuasion · Transtheoretical model · Online social support · Role playing

1 Introduction

Exercise is demonstrated to be beneficial and necessary to both physical and mental wellbeing [1]. Though the benefits of exercise are well known, physical inactivity is still a worldwide problem [2]. The research problem of how to persuade individuals to maintain regular exercise has attracted attention from multiple disciplines. With the rise of social networks, a number of studies found positive correlations between online social support and more active lifestyles [3–7]. However, there is a lack of study focusing on the role played by social network followers or friends during this kind of interactions. Without understanding the effect of this kind of relationships, we cannot

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fully exploit online social support in effecting exercise behavior changes to guide persuasive designs.

Based on the review of 71 previous studies, Marshall and Biddle identified three widely accepted categories for "regular exercise or Physical Active (PA)" [8]: (a) unspecified intensity level of exercise for 15 to 30 min each time, three times per week, (b) moderate-to-vigorous level of exercise for 15 to 20 min each time, three times per week, and (c) moderate-to-vigorous level of exercise for 30 min each time, four to seven times per week. In this paper, we followed this standard with considerations for differences in age, gender, and exercise purposes by participants, and define a participant as "performing actively" or "taking regular exercise" by taking "moderate-to-vigorous level of exercise for at least 30 min each time, at least three times per week".

We report findings from a 52 weeks study under the methods of phynomenography to analyze the roles played by friends in social networks and the support in exercise behavior changes related to these relationships. The results show that besides the individual effect from message tailoring and intervention strategies, the interaction ecosystem based on appropriate role playing by leaders, peers and followers can enhance persuasion power. Effective social support for encouraging physical activities should consider the roles played by the target individuals in the environment and provide comfortable role support.

2 Related Work

A number of studies around the world in all age groups have demonstrated the positive effects of intervention in persuading the individuals to adopt and maintain a physically active lifestyle. Researchers have summarized several effective intervention methods. According to Kahn [9], interventions in encouraging PA can be accomplished by providing knowledge and information, teaching behavioral management technologies, building social support and policies. Furthermore, previous studies found that tailored interventions based on the targeted subjects' behavioral change strategies to be effective.

TTM provides a dynamic perspective for understanding the processes of change rather than regarding it as an "all or nothing" phenomenon. As an intervention strategy, it provides a framework for understanding the stages of changes (SOC) in behaviors for each individual. TTM defined five main stages of change to adopt a healthy behavior pattern including: pre-contemplation, contemplation, preparation, action, and maintenance.

Stage 1: Pre-contemplation: people at this stage are not ready to adopt a healthier lifestyle. They do not have the awareness to gather knowledge or think about changes. They will not start to change in the near future (within 6 months). To persuade them, we need to wake their mind by encouraging him/her to think with more conscious about the multiple benefits of changing behaviors.

Stage 2: Contemplation: people at this stage tend to change their behavior by reevaluating the cons and pros of changing their behaviors. They may take action

within 6 months. We encourage the subject in the stage of contemplation by helping them to reduce the potential cons of behavior changing.

Stage 3: Preparation: people at this stage are ready to change their behaviors in both beliefs and abilities. They take small steps as gathering information or making a plan. They always start to take actions within 1 month. To persuade them to move on, we can provide knowledge, strategies and help them to make plans.

Stage 4: Action: at this stage, people finally start to act. They adopt new behaviors and work hard to maintain it. When people start to take actions, they need supports like techniques or incentives. We can also persuade them to maintain the behavior by help them to avoid tempts.

Stage 5: Maintenance: at this stage, people have kept the healthy behavior for at least 6 months. In the maintain stage, people tend to spend time with people with similar beliefs. They need to seek support from those who believe and take healthy lifestyle. We need to maintain their habit of relying healthy activities to cope stress.

The first 3 stages are categorized as the inactive stage, while action and maintenance are grouped with the name of active stages. During the stages of change, people use both covert and overt strategies and techniques to influence cognitive, emotional and behavioral activities to process through the stages [10, 11]. Prochaska defined 10 distinct processes of change (POCs) to interpret how the behavior changes happen through the stages moves:

1. Consciousness Raising: showing increasing awareness in gathering facts, information and knowledge about healthy behaviors.
2. Dramatic Relief: feeling fear or worry about the unhealthy behaviors. Feel inspiration to others' experiences of behavior change.
3. Environmental Re-evaluation: noticing that he/she can affect others through his/her behaviors; realizing the positive social impact of healthy behaviors and vice versa.
4. Social Liberation: realizing that the society including both the public and the close social relations is supportive of the healthy behaviors.
5. Self-reevaluation: creating a new self-image with the healthy behaviors as one important signature and be ready to act following this new self-image.
6. Self-liberation: believing that he/she has the ability to conquer the temptations and change the behaviors positively and make commitments to act in this way.
7. Counter Conditioning: learning and adopting healthy behaviors instead of continuing with the old ways.
8. Helping Relationship: seeking support for their change; finding building and maintaining this kind of supportive social relationship proactively.
9. Stimulus Control: managing the environment to support the behavior change like setting goals, and planning to encourage exercise or using check-in APPs to stimulate healthy behavior maintenance.
10. Reinforcement Management: setting reward mechanism to encourage healthy behaviors while punish the negative ones.

The relationship between SOC and POCs is displayed in Fig. 1.

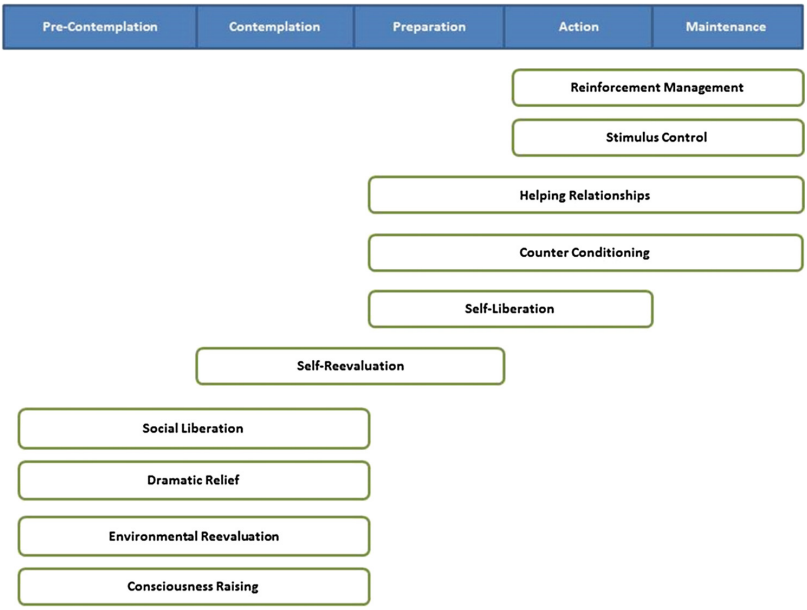

Fig. 1. The distribution of POCs along SOC

The description of the POCs has been demonstrated to be effective in guiding the design and implementation of interventions.

Some of the discriminations between the stages are vague. For example, people in the preparation and maintenance stages all tend to seek support, but the support must be different in practice. Can we go further to supplement these persuasive strategies? Furthermore, both the POCs and the persuasive strategies mentioned social support but there is little studies talk about the sources of the social support. When the same support is provided by different social relations, will the effectiveness be influenced?

To address these questions, we proposed the following study.

3 Methods

We use phenomenography, a qualitative method, to analyze the participants' exercise behavior changes. Phenomenography is "a research method for mapping the qualitatively different ways in which people experience, conceptualize, perceive, and understand various aspects of, and phenomena in, the world around them" [12]. It is a methodology with the aim of seeking and describing the variation in ways people experience. It groups the participants by their performance. Then the researcher will

observe and analyze the experiential differences between the active group and the inactive one. Based on the coding of the qualitative data collected during the observation, the research will categorize and define the different experiential and behavioral patterns. The descriptions as results are called phenomenographic essence which is assumed to be the key reason leading the experiential differences between the two groups. To test this hypothesis, the researcher will do iterative comparisons by training the inactive group by the phenomenongraphic essence. If the performance of the inactive group improves after adopting the new methods, the phenomenongraphic essence is demonstrated to be effective.

In this study, we would like to understand how online social support affects the individuals' physical actives. Therefore, we choose a chatting group with the tag of fitness randomly as the target of this study. It is supported by the QQ application provided by Tencent, China. This group has 309 members. The participants are all Chinese females aging from 18 to 42 (mean = 26.0, SD = 6.5) in acceptable health conditions for regular exercising. We designed a 52 weeks long study to analyze online social support behaviors among the members in a chatting group as a social support platform. Since the participants joined the chatting group aiming to keep fitness initiatively before the experiment, we assume that they have all passed the first stage of pre-contemplation. Therefore, this study will focus on the last four SOCs: contemplation, preparation, action, and maintenance.

3.1 Experiment 1

In the first 4 weeks, we observed and recorded each group member's self-reported exercise session every day. The communication context among the members is also recorded automatically by the application. At the end of the 4th week, we grouped the participants according to their performances for further analysis: Group A covers all the participants who took regular exercises during this period, while Group B contains the subjects who failed to maintain regular exercises. Based on this grouping, we compared the communication pattern differences between the active Group A and the inactive Group B. Following the process of Phenomenography method, we analyzed the daily chatting contexts by members of Group A on each SOC using Axial coding.

The results show that:

1. The persuasive argumentations in Group A always show a signature of "completion". The right person appears at the right time. We found 2 argumentations with similar beginning but leading to different consequences as an example to show the differences between effective persuasion and ineffective ones. In this scenario, when the individual describes temptation, a "leader" provides her practical solutions to conquer the temptation, while in the other case a "follower" appears to comfort her with excuses. The feedback from the online social support directs the subject's follow-up behaviors. The logistic analysis is shown in Table 1:

Table 1. Example of effective argumentation vs ineffective argumentation

An effective argumentation example		An ineffective argumentation example	
Communication function	Dialogue	Communication function	Dialogue
Describe temptation	*A. I fall in love with a TV show. It occupies all my leisure time*	Describe temptation	*A. I was not a sofa potato, but when I think about exercise, I cannot lift myself*
Propose solutions	*B. Try to stand to watch TV instead of sitting and lift dumbbell during your watching*	Comfort others	*B. Why do you torture yourself? Just do what you want. At least that makes you happy*
Make excuses	*A. That's a good idea! But my room is too small to do this*	Make commitment	*A. I made a promise to take exercise every evening*
Provide knowledge and share experience	*C. See the link below and copy the postures. I've tried this in my Harry Potter's room*	Make excuses	*B. It doesn't matter to miss one day. You can always find a time to offset*
Agree	*A. Wow! You saved me!*	Agree	*A. That makes sense… …*

2. The decisive argumentations look like a mini theatrical with the members supporting by playing their own roles. We can borrow the definition of Role to assist this study. Role is a symbol for individuals in a society to communicate with each other [13]. Role playing contains a set of expected behavior patterns from one individual to another [14]. In this study, the concept of role is defined by its functions.

   In addition to the processes of individual behavior changes, the participants showed diversity and complexity in their interaction actions. They undertook different functions in the system. By Axial coding, we category their chatting record as following (Table 2):

Table 2. Coding Results

Axial Coding	Open Coding	Examples
Follower demands	Ask questions	*"How can I break up with my soft belly?"* *"I am not good at any sport, what should I do to keep active?"*
	Require supervision	*"I am not sure how long I can persevere. Is there anyone who would like to inspect me?"*
Follower supports	Join in active groups	*"I like your training plan, may I copy it? We can encourage each other."*
	Worship	*"Hope I could keep active as long time as you did."*

(*continued*)

Table 2. (*continued*)

Axial Coding	Open Coding	Examples
Leader demands	Call for participation	*"I'm going to take fitness courses, is there anyone like to join me?"* *"It's Spring! Let's fight for hot pants in the coming summer!"*
Leader supports	Provide knowledge	*"If you want to build lines on your stomach, you can try the following actions…"* *"Exercise is not only about keeping fit. It contributes to a healthier, happier and balanced life."*
	Propose solutions	*"If you cannot find time to exercise, try to tighten your belly for 5 min every hour when you are sitting in a chair."*
	Dispel negative feelings	*"Of course you can say goodbye to the fat. You've just started. Let's see the results after one month."*
	Correct wrong behaviors	*"Having KFC after exercise is not a good idea."*
	Supervise commitments	*"Have you finished your daily training plan?"*
	Introduce a role model	*"I have to show you these compare photos, girls. My friend lost 12 kilos by physical exercise in one semester!"*
	Rewards	*"Wow, that's really something! I'll put a sticker on your avatar as a reward."*
Peer demands	Set up a goal	*"I bought a pair of jeans in the size of 25. I will stuff myself into it by July"*
	Make a plan to achieve the goal	*"I will jog for 30 min every day."*
	Describe temptations	*"There are so many interesting things to do beside PA in my limited after work time."*
	Make excuses	*"It is too cold to work out today."* *"I do not want to take an extra shower after the exercise."*
	Conquer temptation	*"I was too tired to work out today but I crawled to the gym."*
	Display achievement	*"Check-in! Finished 1 h training today!"* *"Now, I can run 10 km without a stop."*
Peer states	Describe feelings	*"I took the elevator even when I just need to go up one floor. I'm afraid I will lose the ability to go upstairs by my feet forever."*
	Make self-reevaluation	*"I was too lazy."* *"I hate to look like this."*
	Share beliefs	*"I won't take running since it will make my muscles look like stones."*
	Share experience	*"I used to take exercise every week, but lost 0 kilo."*
	Refute or doubt others	*"Are you serious? I've never heard about this exercise program."*

(*continued*)

Table 2. (*continued*)

Axial Coding	Open Coding	Examples
Peer supports	Encourage	*"Come on! You can make it! You are doing so well till now."*
	Agree to others' opinion	*"That's true. You cannot keep fitness by discarding breakfast."*
	Comfort others	*"That's all right. You've already tried."*

3. Based on the categories generated from coding, we define the roles in this study as leaders, peers, and followers in the online social support system. These roles communicate with each other with the purpose of changing behaviors. They are taking different functions in different SOCs. A Leader always acts initiatively and takes responsibility to others. They usually have more related knowledge and would like to share with others. In this small online society, they are taking the roles as PA coaches or supervisors. They feel satisfaction from the others' following. A follower behaves in the opposite way. They tend to ask questions or request help from the environment. They contribute to the online society by providing feedbacks as praise or behavioral changes. Besides these two classic roles, peers are more complex to define. They need social support as the followers but with more initiative. They share knowledge as the leaders but without much purpose to affect others. They also "state" something which is more personal with less sociality. This category is not stable in practice. A group member may play different roles in different scenarios. However, from a long-term perception, the role playing of a member can be defined by others' expectation towards him/her and his/her self-awareness of his/her social functions. Table 3 lists down the appropriate role interactions we observed during this experiment at each SOC.
4. The effectiveness of specific persuasive strategy changes not only along the stages of change of the individual but also the role she is playing in the group. The most powerful strategy in this case is playing the appropriate role in the communications. Role playing is a two-way process. The feedback from the other party affects the subject's behavior. For example, a Leader cannot play her role if there is no Follower appreciating her shared information or exercise plan. This phenomenon leads to relapse of the Leaders. When a Leader in the maintenance stage affecting others by persuasion, she is also be persuaded to maintain this behavior pattern because of the cognition of responsibility and the enjoyment of leading.
5. When the individual's SOC moves, her role playing switches with it gradually. For example, after a period of preparation, a Peer may make a committee to take actions. During her preparation, she gathered a lot of knowledge and techniques to support her further actions. When she enters the action stage, she may be eager to share her knowledge and experiences to help others. This behavior change makes her a new leader.

Based on the coding results, we can hardly make a conclusion about which category of the social support works most effectively in persuading the members to take more exercise. The phenomena showed that the persuasive effectiveness of one strategy depends on both the stage of change of the individual and also her role playing during the interactions.

Table 3. Overview of the role playing strategies

Role	Interaction behaviors	SOC				The proposed appropriate following actions	The possible actions lead to this feedback
		C	P	A	M		
Follower	Ask questions	√	√			Provide knowledge and propose solutions	
	Require supervision			√	√	Supervise commitments and rewards	
	Join in active groups			√		Supervise commitments	Call for participation
	Worship	√	√	√	√	Agree to others' opinion	Introduce a role model, display achievement
Leader	Call for participation		√	√	√	Join in active groups, set up a goal, make a plan	
	Provide knowledge	√	√	√	√	Agree to others' opinion, state self-belief and Share experience	Ask questions
	Propose solutions			√	√	Set up a goal, and agree to others' opinion	Make excuses
	Dispel negative feelings	√	√	√	√		Describe feelings
	Correct wrong behaviors			√	√	(behavior changes)	Make a plan to achieve the goal and share experience
	Supervise commitments			√	√	(behavior changes)	Require supervision, set up a goal, make a plan and conquer temptation
	Introduce a role model	√	√			Worship, set up a goal	Share experience
	Rewards			√	√	(behavior changes)	Require supervision, display achievement

(*continued*)

Table 3. (*continued*)

Role	Interaction behaviors	SOC				The proposed appropriate following actions	The possible actions lead to this feedback
		C	P	A	M		
Peer	Set up a goal		√			Propose solutions and supervise commitments	Call for participation
	Make a plan to achieve the goal		√			Supervise commitments	Call for participation
	Describe temptations	√	√	√	√	Propose solutions	
	Make excuses	√	√	√	√	Propose solutions	
	Conquer temptation			√	√	Worship, rewards	
	Display achievement			√	√	Worship, rewards	
	Describe feelings	√	√	√	√	Share beliefs…	
	Make self-reevaluation	√				Share beliefs, encourage, comfort others	
	Share beliefs	√	√	√	√	Encourage and comfort others	
	Share experience			√	√	Share belief, worship, and correct wrong behaviors	
	Refute or doubt others		√			Provide knowledge, share experience	Provide knowledge, share belief, share experience
	Encourage	√	√	√	√		Share experience, set up a goal, make a plan
	Agree to others' opinion	√	√	√	√	(share more)	Provide knowledge, share experience, set up a goal, make a plan
	Comfort others						Share experience, share belief, describe feelings

3.2 Experiment 2

To demonstrate our findings, we designed an intervention experiment and recruited participants in Group B. 185 of the group members joined the experiment. We use several controlled IDs to join Group B (n = 185) as persuasive agents. We separated Group B into Group B Experiment1 (n = 62), Group B Experiment2 (n = 62) and

Group B Control (n = 61) almost equally in SOCs. In Group B Experiment1 (BE1), the agents played the roles following the pattern we observed in Group A. For example, the controlled IDs played the roles of L to communicate with the Fs in the preparation stage by helping them to make a work out plan or proposing solutions to solve their practical problems.

In Group B Experiment2 (BE2), the agents are playing opposite roles compared with Group BE1. We go continue to use the example in BE1, when a Follower in the preparation stage is demanding a plan, we send a follower instead of a leader to help. We do not reject the traditional strategies demonstrated to be effective by the previous researchers, but we deliver the same messages by a different "role" comparing with Group BE1. From the subject's perception, this "person" is less expertise on the related area based on their previous communications. The experiment results will show us whether the role of the members is a critical factor in affecting the persuasion.

In Group B Control (BC), there is no agent. But it does not mean there is no social support in this group. The participants in this group are also doing interventions to others and themselves. They also tend to change their behaviors towards a healthier way.

The agents speak in the groups every day in the following 48 weeks. The communication context and self-reported exercise sessions per week are recorded. We also recorded the weekly physical active frequency of each participant before the experiment as Week 0 to be a benchmark. The results are analyzed after each 12 week period. An ANOVA test at the end of 48 weeks after the intervention, demonstrated significant differences between Group BE1, BE2, and BC ($F = 9.59$, $P < 0.005$). The Table 4 shows the results in each group. The members in Group BE1 take average 3.6 exercise session per week at the end of this study. This number rises from 1.4 at week 0. Comparing with the little numerical fluctuation in the other two groups, we can see a significant ascent in physical active.

Table 4. Mean exercise session per week based on self-report

	Week 0	Week 12	Week 24	Week 36	Week 48
BE1	1.4	3.9	3.2	3.3	3.6
BE2	1	2.1	1.7	2.3	1.4
BC	1.1	0.8	1.8	1.6	1

Figure 2 visualized the differences between the experimental groups (BE1 and BE2) and the control group (BC). Participants supported by the appropriate role playing were more active comparing with the other two groups. Though the drop in Week 24 shows a classic problem of short term effectiveness in persuasion intervention, the participants' performance got better after the valley. The mean exercise session reported by treatment group BE1 increased in the last 12 weeks which significantly differs from the other 2 groups. This trend shows a positive potentiality of our proposed role playing theory in long term online social support.

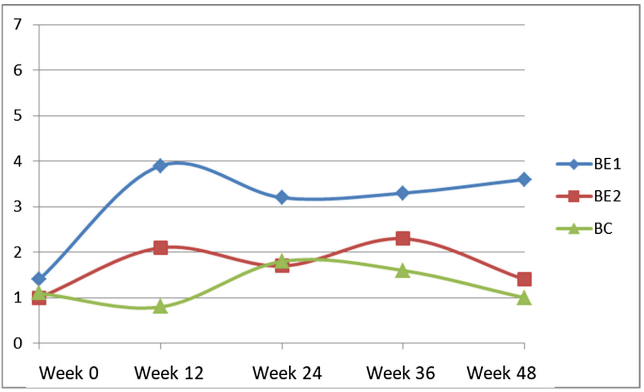

Fig. 2. Mean self-reported exercise sessions of the 3 groups along the 48 weeks

To analyze the long term relationships of role playing and behavior changes, we calculated the percentages of the participants who take behavior changes in each experimental group. In Group BE1, 30% of the participants (n = 62) changed their behavior positively from inactive (contemplation and preparation) to active stages (action and maintenance) and maintain the active behavior for at least 1 month. 45% of the participants processed from inactive stages to active ones for a short term but relapse within 1 month. 25% of the participants in this group did not change their behaviors. Table 4 displayed the results of Group BE2 and Group BC.

Table 5. Percentages of participants in SOC

	Percentage of participant process from IA to A for at least 4 weeks	Percentage of participants process from IA to A for a short term	Percentage of participants adopt no behavior change
Group BE1	30%	45%	25%
Group BE2	15.1%	39.4%	45.5%
Group BC	21%	37%	42%

At the end of Week 48, 7 of the participants from Group BE1 were still maintaining regular exercises. At the same time, none of the participants from the other two groups were able to keep up.

4 Discussion

- In the maintenance stage, the consideration of "who" is more critical. Our proposed theory shows significant effectiveness in the last three months by comparing the per capita weekly active days between Group BE1 and BE2. At the same time, the

participants who maintain the physical active lifestyles at the end of the study were all under the intervention of our proposed theory in Group BE1. People who are trying to maintain a habit consider more about feelings and social relations than practical issues.

- Based on our proposed theory and experiment results, we conclude that appropriate role playing is an important component of online social support in persuading the individuals to adopt a physical active lifestyle. These roles can be played by not only human beings but also artificially intelligent agents. Our proposed theory can inspire AI designs.
- What factors lead to the role adapted by each group member? From this study, we found in the stages of change of a specific individual affect the role he/she is playing in the online group because of his/her cognition and ability. However, we can also see that people at the same stage choose multiple roles naturally. Some of the role adoptions come from the first impression, for example, if a member answered a question by coincidence at the first time when he/she enters the group and gets broad support, he/she will face a great chance to be followed. What follows is a subtle leader role adoption. In addition to this, the personality of each individual may also affect the role adoption during their interaction though this kind of role playing may not be successful for other members' unpredictable reactions.

5 Conclusions

How does social support persuade the individuals to adopt a physical activate life style? In additional to the separated personalized message tailoring and intervention strategies, the interaction among the social members can empower the persuasive strength at the same time. This ecosystem runs in a healthy way based on the appropriate role playing of the leaders, peers and followers. An effective social support in encouraging physical actives should consider the role playing by the targeted individual and provide the comfortable role support.

Developing persuasion techniques to support behavior changes for users is a critical challenge in human computer interaction study. This study can help us to understand the appropriate roles an intervention agent needs to play. It will provide useful guidelines to support the designs of persuasive artificial intelligence agents and applications to support the adoption of healthy styles.

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