Cognitive Chrono-Ethnography (CCE) to Reveal Personal Walking Motivations and Nudging Habit Formation in Reaction

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***Abstract*—Cognitive Chrono-Ethnography (CCE) explores the qualitative nature of people's decision-making process through ethnographical field observation to identify human behaviors related to a daily activity. This paper shows how the results of previous CCE studies on habitual walking behavior possibly nudged people along the stages of the transtheoretical model. The interview results of 29 participants from past CCE studies showed that participants became more consciously aware of their appreciation for certain walking elements through either the one-on-one interview or the experience on an unfamiliar route. Moreover, the revealed walking motivations were matched to the six different stages of the transtheoretical model, assuming that people in the precontemplation and contemplation stages are motivated by exploration and a route plan, people in the preparation and action stages are motivated by the surrounding and social aspects, and people in the maintenance and termination stages are motivated by mental thinking, physical exercise, and a route plan.**

Keywords*—Cognitive Chrono-Ethnography; Habit Formation; Walking Preferences; Nudges.

I. INTRODUCTION

Making a permanent change in behavior is rarely a simple process. It often involves a considerable commitment of effort, time, and emotion. In this regard, many researchers have studied the process of behavior change. Prochaska introduced the transtheoretical model of behavior change, which assess an individual's readiness to act on a new healthier behavior, and provides strategies, or processes of change to guide the individual [1]. In the transtheoretical model, change involves progress through the following six stages [1][2]:

1) Precontemplation: People have no intention to take action in the foreseeable future and are unaware of their behaviour.
2) Contemplation: People are aware of their behaviour, and intend to take action in the foreseeable future.
3) Preparation: People are intending to take action in the immediate future, and may begin taking small steps of behaviour change.
4) Action: People have made overt modifications in their behaviour or in acquiring new healthy behaviours.
5) Maintenance: People have been able to sustain their change for at least six months and are working to prevent relapse.
6) Termination: People have zero temptation and they are sure they will not return to their old behavior.

Past research mentioned various motivating factors for progression along the transtheoretical model stages. Accordingly, it is recognized that people at different stages are motivated by different messages. A smoker in precontemplation likely needs different information to move to contemplation than a smoker in the action stage who needs to move to the maintenance stage. Hence, it is important to develop persuasive interventions that match an individual's stage. Hereof, O'Keefe [3] noted that decisional balance and self-efficacy are important to create stage-matched persuasive messages.

This research considers the capability of the nudge theory to push people along the different stages of the transtheoretical model. Nudge theory is based on the concept that by shaping the environment, one can influence the likelihood that one option is chosen over another by individuals [4]. In other words, nudge theory proposes adaptive designs of the decision environment as ways to influence the behavior and decision-making of groups or individuals [4]. Therefore, a nudge makes it more likely for a person to make a particular choice, by altering the environment so that automatic cognitive processes are triggered to favour the desired outcome.

On this matter, Cognitive Chrono-Ethnography (CCE) as defined by Kitajima [5][6] could possibly be a nudge to promote habit formation in participants. CCE explores the qualitative nature of people's decision-making process through ethnographical field observation to identify human behaviors related to a daily activity. Afterwards, study parameters are identified through model-based simulation, which are used to find participants who suit the criteria. Consequently, a CCE study is conducted where participant's activity is recorded without interfering their usual behavior. For example, Kitajima, Nakajima, and Toyota [7] clarified visiting behaviors of 9 loyal baseball fans via CCE. They selected loyal fans based on web questionnaires and interviews, and asked them to watch three baseball games while their view, heart rate, and utterances were recorded. One week after each game, interviews were conducted. Each participant did 4 interviews, which created a fan history from 5 years ago until the present, showing what triggered them to stage-up and become a loyal fan. Among the participants, there was one fan who mentioned that looking back on his past made him a stronger fan [8]. Therefore, reflecting on one's own experience via CCE unconsciously nudged them on the transtheoretical model.

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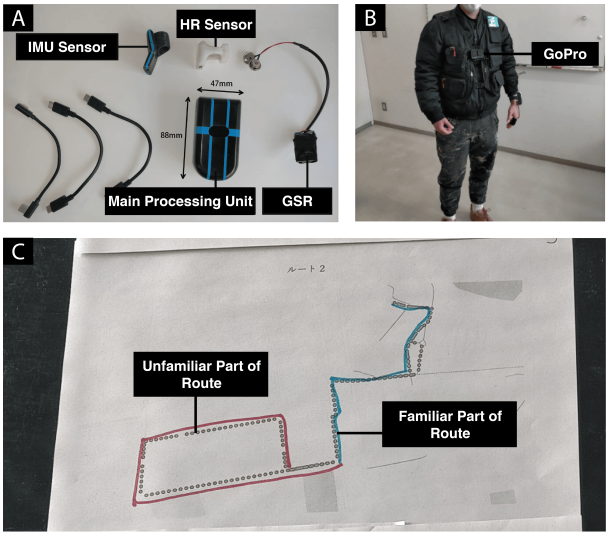

Figure 1. Walking experiences were recorded via (A) biometric data captured with a wearable device, (B) video footage captured with a GoPro camera, and (C) a map showing the familiar and unfamiliar parts of the route.

Similarly, past studies have used CCE to study individual walking experiences and identify individuals' walking motivations to promote healthy habitual behaviors [9][10][11]. During the studies, participants became aware of their appreciation for certain elements of a walk because of the experimental setting of CCE. Therefore, we hypothesized that participants of this study also unconsciously progressed on the transtheoretical model, because the personal walking motivations became apparent through the CCE study. However, research has not yet confirmed whether the past CCE studies also nudged participants to forming a walking habit. Therefore, the purpose of this study is to clarify how CCE revealed individuals' walking motivations, and consider how participation to the CCE study could nudge participants to make a permanent change in behavior.

This paper is organized as follows. In Section II, the methodology of this study is described. In Section III, the results of the 29 participants are shown regarding personal walking motivations. In Section IV, the relation between CCE, walking motivations, and nudge theory are discussed. Finally, Section V concludes the paper and shows how future works concerns CCE to promote healthy habit formation.

II. Methodology

In order to understand how CCE helps participants becoming aware of the walking elements that personally motivate them to take a walk, this study examined the experience of 29 participants from past CCE studies [9][10][11]. All participants walked two routes: firstly, a familiar route (A), and afterward, an unfamiliar route (B). Routes were discussed and decided together with participants beforehand to confirm participants' familiarity with the routes. As shown by Degen and Rose [12], taking repetitive walking routes makes people less sensitive to their surroundings. As a consequence, individuals,

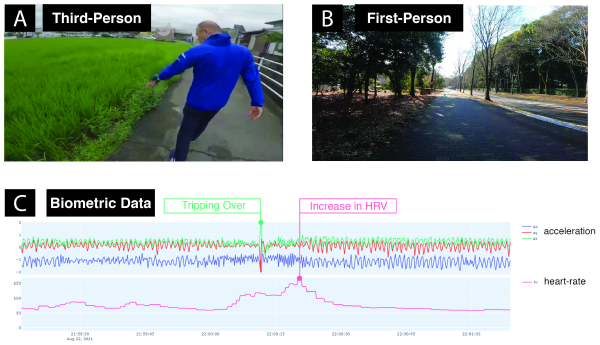

Figure 2. Activities of participants 1 to 5 were recorded via (A) third-person view, while participants 6 to 29's (B) first-person view was recorded, and (C) biometric data of all participant was visualized.

who enjoy the benefits of walking, might not be aware of all the elements that contribute to their good walk. This is further supported by the fact that walking is an automatic process performed unconsciously [13]. Hence, walking an unfamiliar route after a familiar route possibly helped to reveal underlying personal factors that are unconsciously valued by participants. Moreover, their activity was recorded via a wearable device to capture biometric data (Figure 1 (A)), an attachable GoPro camera to capture video footage (Figure 1 (B)), and a map where participants filled in their familiar and unfamiliar parts of the route (Figure 1 (C)).

Consequently, after route A and after route B, 10-minute one-on-one interviews were conducted. Following the CCE approach, participants' walking experience was reproduced in chronological order by showcasing the captured video footage, biometric data, and route to make participants remember their experience to the best extent possible. During the interview, participants were asked about their activity by focusing on the decision-making process and satisfaction of their walks. Additional questions were asked about the walk's interesting moments, participants' walking preferences, and the good and bad parts of the walk.

Past research [9][11] transcribed and analyzed the interview answers using Thematic Analysis (TA) to relate participants' walking habit with the walking elements that they valued, and to clarify the events that triggered the feeling of value or satisfaction. TA is a method for identifying, and analyzing patterns of a dataset [14]. Hanssen et al. [9][11] first familiarized themselves with the interview answers, and marked interesting answers. Then, similar interesting answers were grouped into themes and further reviewed. Finally, each theme was named, and results were summarized.

III. Results

A. Activity Recording

As a result of the wearable device (Figure 1(A)) and the attached GoPro video camera (Figure 1(B)), camera footage and biometric data were recorded for all participants. Participants 1 to 5 participated in a separate CCE study [9] from participants 6 to 29 [11]. The video footage was recorded from

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TABLE I. THE VALUES MENTIONED BY EACH PARTICIPANT DURING THE ONE-ON-ONE INTERVIEWS AFTER EACH WALK

Participant	Value 1	Value 2	Value 3	Value 4	Value 5	Value 6	Value 7
1	Safety	Unknown Scenery	Rhythm				
2	Safety	Daylight					
3	Conversation	Flora	Company	Surrounding	Nature		
4	Flora	Insects	Talking	Scenery	Nostalgic	Benefits	
5	Seeing Firework	Night	Nostalgic	Conversation	Relax	Scenery	
6	Sunny	Seeing pigeon	Seeing statue	Seeing playground	Seeing School	Seeing lake	Seeing trees
7	New Things						
8	New Things	Weather	Feelin Environment				
9	Safety	Air Quality	Scent	Weather			
10	Peaceful Atmosphere	Safety					
11	Less People	Scenery	Tempo and Music	Adventure			
12	Mental Thinking	Scenery					
13	Scenery	Sunny	Time	Less People			
14	Natural View	New Shops	Less People	Explore	Season	Flowers	
15	Physical	Oxygen	Thinking while Exercising	Road Condition			
16	Landmarks	Familiarity	Purpose	Fun Shops			
17	Sunny	Greenery	Peceful and Silent				
18	Safety	Scenery	No Cars				
19	Mentality	Weather					
20	Pedestrian Road	Plants	Season				
21	Relaxing						
22	Others	Nature	Scenery	No Noise	Explore		
23	Purpose	Solitude	Nature	Silence	See Others	Continuity	
24	Time	Freedom	With Someone	Purpose	Plan		
25	With Someone	Walkability	Scenery				
26	Scenery Changes	Newness	Nature	Walkability			
27	Physical Benefits	Purpose					
28	Familiarty	Adventure	Time				
29	Weather	New Things					

different perspectives for the two CCE studies. Therefore, the captured video footage was recorded from a third-person view for participants 1 to 5 (Figure 2(A)), and a first-person view for participants 6 to 29 (Figure 2(B)). Moreover, Figure 2(C) shows an example of the biometric data that was recorded with the wearable device shown in Figure 1(B). As part of a CCE study, these recordings were shown to participants during the one-on-one interviews to improve the memory of participants related to their experience.

B. One-on-one Interviews

During the interview participants discussed parts of the walk that impacted them and identified enjoyable walking elements that potentially motivated them to walk again. Table I summarizes all values that were mentioned by the 29 participants in the past research [9][11].

Many participants became aware of their appreciation for certain values through the interview itself. The review of the captured video footage, biometric data, and map of the route made participants remember their walking experience, enabling them to answer the questions asked by the researcher. Hereof, participants mentioned directly that they were unaware of their appreciation for certain elements that walking has to offer, but the experiment made them realize their appreciation for these walking elements. For example, participant 4 mentioned the values "Nostalgic" and "Benefits" during the interview. In this regard, he mentioned:

> *I felt nostalgic while walking because I used to take recreational walks in the past but not any more. My father used to walk with me everyday because I had many personal troubles after we moved to a different house. Now I realize that walking everyday gave me many benefits that helped me to overcome that situation.*

Other participants realized their appreciation for certain walking elements after they were introduced to an unfamiliar route after the usual familiar walk that they took. In this regard, participants 1 and 2 realized their appreciation for "Safety" after the unfamiliar route. For example, after walking a route with a narrower pedestrian road than usual, participant 1 told the interviewer:

> *The narrow pedestrian road was too close to the cars passing-by and made the route not enjoyable. Therefore, I think safety is the most important factor for a good walk.*

Similarly, participant 15 mentioned her appreciation for certain specific walking elements related to safety, such as "Road Condition" and "Thinking while Exercising." These became apparent to her after walking an unfamiliar route, which had a poorer road condition than she was used to with her familiar walks. She mentioned:

> *The poor condition of the pedestrian road made me focus on where I put my feet while walking. Because of this, I could not think about the things I want to think about while walking.*

However, many participants' experience were also positively influenced by the unfamiliarity of the second route, making their appreciation for "Newness" and "Exploration" apparent. For example, participant 26 mentioned the importance of

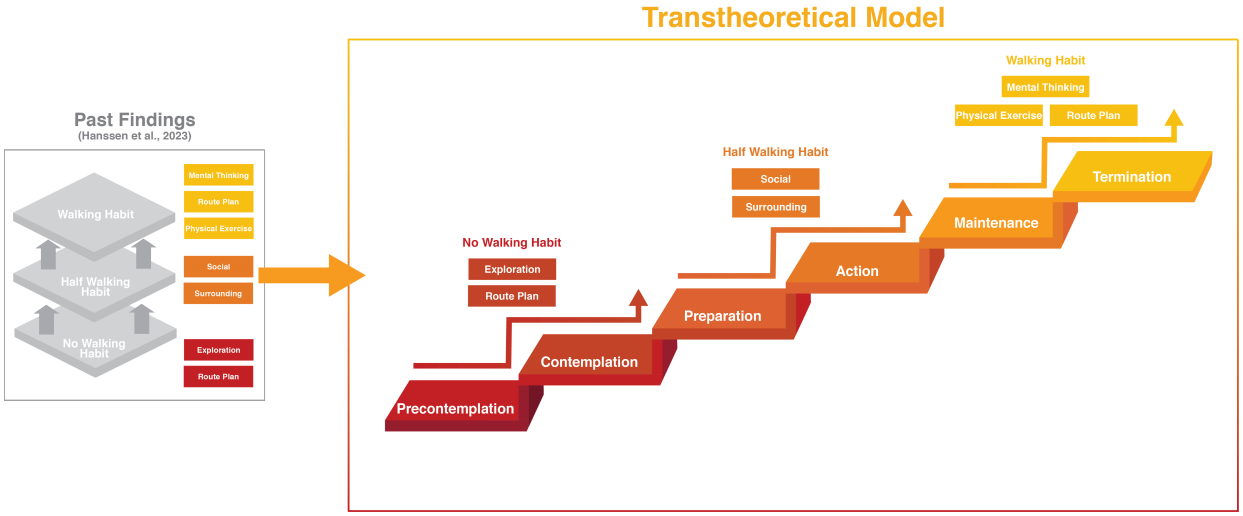

Figure 3. Walking motivations related to different stages of the Transtheoretical Model were found based on previous findings [9].

"Scenery Changes" and "Newness" after walking an unfamiliar route. Also, participants 7 and 8 mentioned "New Things" as important motivations for them to take a walk. Similarly, participant 14 mentioned the importance to explore during a walk. After having walked her unfamiliar route, she mentioned during the interview:

> *I like to explore during a walk. I saw new shops that looked interesting. It is nice to find new shops that I can maybe visit later in the future.*

The familiarity of the experience was not only determined by the route that participants walked, but also by the time of the day. Participant 2 usually takes a walk in the daylight. However, he walked the second unfamiliar route during the night. As a result, the familiarity of the overall walking experience further decreased. Moreover, participant 2 noticed the importance of daylight in order to have a satisfying walk. In this regard, he mentioned:

> *I needed to watch out where I walked because of the lack of light. Therefore, the walking experience felt less safe.*

C. Emerged Themes for Walking Motivations

The Thematic Analysis of the previous CCE studies showed that people with different walking habits valued different walking elements. As a result, Hanssen et al. [11] classified the values into the following six emerging themes to relate the values to walking habit stages:

- **Surrounding:** Elements related to natural features of our surroundings, considered in terms of their appearance, smell, and sound.
- **Social:** People's need for interactions with other people or need for solitude during the walk.
- **Exploration:** Wanting to explore "newness" during a walk by encountering unfamiliar events or objects.
- **Route Plan:** People with a walking habit benefited from the "safety" and "road condition" of the Route Plan, while people with no habit valued the "purpose" or "destination" of the Route Plan.
- **Physical Exercise:** Walking motivations that stem from wanting to move the body for healthy exercise.
- **Mental Thinking:** Walking helped to stimulate the people to think about desired things in their mind.

IV. Discussion

A. CCE to Identify Walking Motivations

Past studies took various approaches to study habit formation that improve physical health [15][16]. Lally et al. [15] documented experiences of habit development in participants who enrolled on a weight loss intervention. Tobias [16] developed a social psychological model of habit development by studying the effect of memory aid in habit development and analyzing time-series data from a behavior-change campaigns. Both studies found insights regarding behavior change. Lally et al. [15] revealed that behavior change is initially experienced as effortful but automaticity increased, as the performance becomes easier. Moreover, Tobias [16] provided a new understanding on the role of memory to support the performance of repeated behaviors. However, related works have not yet shown methods to reveal the valued walking elements of people that have different walking habits [1][2].

Nevertheless, the past CCE studies' results on people's walking experience raised awareness on personally valued walking elements [9][11]. In particular, some participants' one-on-one interview responses revealed that they were unaware of personal walking motivations beforehand, but the walks during the experiment and review of the captured activity recordings raised their awareness on the elements that motivated or satisfied them. These were summarized in Table I, and it could be argued that these stimulated them to walk regularly. In this manner, CCE contributed to healthy behavior change as it was able to identify the walking elements that motivate people to walk again.

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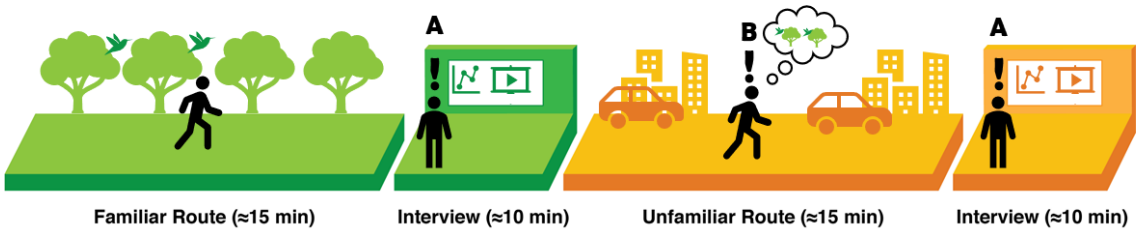

Figure 4. Personal walking motivations of participants were found during the CCE study by either (A) the review of the captured data during the interview or (B) the presence or lack of certain walking elements during the unfamiliar route.

Moreover, Hanssen et al. [11] further classified the valued walking elements into themes via Thematic Analysis. Six themes emerged, which were further related to people of different walking habit stages, identifying how people with a walking habit value different elements than people without a walking habit. This study built upon the previous findings by examining how the themes possibly relate to the different stages of the transtheoretical model, as shown in Figure 3.

In past research, three different walking habit stages were identified based on how often participants mentioned that they walked in their daily life. The three stages were the "No Walking Habit", "Half Walking Habit", and "Walking Habit" stages. Since previous research identified three habit stages and there are six stages in the transtheoretical model, this research matched the "No Walking Habit" stage to the "Precontemplation" and "Contemplation" stages, the "Half Walking Habit" stage to the "Preparation" and "Action" stages, and the "Walking Habit" stage to the "Maintenance" and "Termination" stages of the transtheoretical model. Therefore, this study assumes that people in each stage are motivated by the following values, as shown in Figure 3:

- **Precontemplation – Contemplation:** People at this stage are motivated to stage-up by values related to "Exploration" and "Route Plan" of walking. Specifically, the "Route Plan" needs a purpose and destination.
- **Preparation – Action:** People at this stage are motivated to stage-up by values related to "Social" and the "Surrounding" of walking.
- **Maintenance – Termination:** People at this stage are motivated to stage-up by values related to "Mental Thinking", "Physical Exercise" and "Route Plan" of walking. Specifically, the "Route Plan" needs to be have good road conditions and safety.

However, future works should concern how participants can be categorized to one of the six stages of the transtheoretical model. Currently, this research assumed relations between the three walking habit stages and the transtheoretical model, but these are only based upon the frequency that participants mentioned to walk in their daily life. Hence, more in-depth questions should be asked in future works to confirm the stage of the participant, and to reveal what walking elements motivated people in each of the six stages.

B. CCE as a Nudge for Walking Habit Formation

Not only researchers, but also the participants themselves became aware of the elements that motivated them. Therefore, participation to the CCE study enabled the participants to better understand their reasons and benefits for walking. It can be argued that better understanding the reasons and benefits of healthy activities motivates people to perform this activity regularly [17] . Therefore, past CCE studies were not only able to identify walking motivations, but also nudged participants to form a walking habit by letting them understand their personal walking motivations.

Hereof, CCE nudged people in two different manners. First, with the review of the video footage, map, and biometric data, as it helped participants to remember and understand their own experience better. Accordingly, when they were questioned about their walking motivations, they discovered that they had an appreciation for certain walking elements that they previously did not know (Figure 4(A)). An example can be seen in the response of participant 4. The interview and review of the captured data together with a researcher forced participant 4 to reflect on walking in general. Because of this, the participant realized the importance and benefits that he got from past walking experiences. In other words, it can be argued that the participant became more aware of the effect of daily walking, which possibly motivated him to walk more frequently.

Second, participants discovered their appreciation for walking elements during the unfamiliar route (Figure 4(B)). In this regard, participants either realized their personal walking motivations because the usual elements that they encounter in their familiar walk were not present during the unfamiliar walk, or because the unfamiliar walk introduced them to new elements that they immediately appreciated. For example, participants 1 and 15 noticed the lack of safety while walking the unfamiliar route compared to their familiar walking route. Participant 1 mentioned the pedestrian road being narrower than usual, and participant 15 mentioned the bad influence of the poor road condition on her experience. Therefore, they became more aware of the importance of safety to have their good walk. On the other hand, participant 14 noticed many new shops during the unfamiliar route that she had not seen before. Because of this, she became aware of her appreciation to explore and find new things during a walk.

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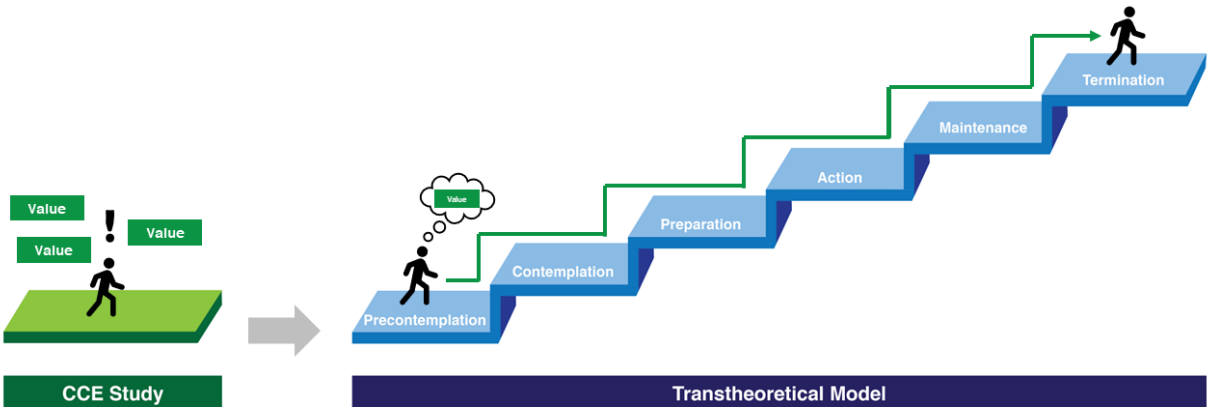

Figure 5. The influence of CCE to push people along the six stages of the transtheoretical model via the increased awareness on personal values was found

C. The Effect of CCE on the Transtheoretical Model

CCE's contribution to the transtheoretical model is shown in Figure 5. Participants become aware of an activity's benefits through CCE, which can motivate them to develop a habit. In this regard, it is assumed that participants in the precontemplation and contemplation stages are impacted to the greatest extent, as the results showed that participants in the higher stages were already more aware of their walking motivations.

V. Conclusions

This paper presents a new approach to understanding the personal motivations that people have to walk. The interview results from past CCE studies showed that participants became more aware of their appreciation for walking elements, possibly nudging them towards the next stage in the transtheoretical model. In this regard, CCE mainly identified motivations for habitual walking experiences in two different manners. First, the interviews helped participants to reflect on their experience. Second, participants realized what important walking elements were missing in the unfamiliar route.

Even though this paper explains CCE's ability to identify motivations for walking, it can be applied to any activity that requires progression through the transtheoretical model, such as psychological rehabilitation. By uncovering personal motivations and facilitating progression through the transtheoretical model, CCE can help individuals in psychological rehabilitation become more aware of the elements that contribute to their well-being and address any missing components in their therapeutic journey. CCE's ability to identify motivations extends its potential beyond walking, making it a valuable tool for promoting positive change and psychological recovery.

In conclusion, CCE can reveal what factors push people to advance to the following transtheoretical model stage. The revealed factors can be introduced to other people who are in the precontemplation or contemplation stage, but have the potential to fully develop a habit, so that they are successfully guided through the transtheoretical model stages. By participating in a CCE experiment about a healthy activity, participants can become aware of the activity's benefits, which potentially nudges them to the next stage in the transtheoretical model.

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