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Walk Your City: Using Nudging to Promote Walking

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1 ABSTRACT

In recent decades, a stagnation or even a decline in pedestrian traffic has been observed in many cities, despite the ambitious efforts of national and international action plans, strategies and initiatives. Our project, which is named “Walk Your City”, addresses this problem by designing, developing and evaluating an innovative behavioural-based pedestrian initiative, with a focus on “nudging” as the applied method. The overall aim is to decisively raise awareness of walking as an active and health-enhancing activity through behavioural approaches such as nudging. The core of our approach is represented by “nudges”, which are triggered via an app as well as offline campaigns. The story refers to a not-so-distant dystopian future where the pilot city of Graz in Austria suffers from pollution and traffic chaos, as well as climate change. Through regular walking, as well as visiting places such as parks or viewpoints, users of the app are rewarded with tokens. Following the idea of crowdsourcing, these tokens can be invested into desired improvements such as parking benches or zebra crossings. Through this unique combination of technological innovation, a fun approach, behavioural concepts and a creative campaign, participants are motivated to explore and experience the city on foot. Walking should be perceived as a genuine and healthy alternative for short distances (<3 km), and the first choice when covering small distances (<1 km). The nudging approach will be iteratively optimized in terms of acceptance, functionality and usability, using focus groups, internal lab tests and expert workshops. This strategy will ensure a practice-oriented project implementation that is tailored to the needs of the different target groups, such as students, commuters and tourists. The mobility and health data obtained during the pilot test will be used to evaluate the suitability and impact of the nudging approach in an academic paper. As the empirical data show, a behavioural change in terms of a larger share of walking in the modal split, as well a positive impact on the interest and awareness regarding the effects of walking, can be observed.

Keywords: Walking, City, Urban Planning, Nudging, Gamification

2 INTRODUCTION

2.1 Pedestrian Traffic

Many cities have experienced a stagnation or even a decline in foot traffic (cf. BMVIT, 2016), which contradicts the ambitious efforts of national and international action plans, strategies and initiatives. Exact statements on the development of pedestrian traffic are difficult to make, however, because short distances on foot are insufficiently recorded in mobility surveys or – with the exception of Switzerland – no stages of the trip are recorded (see KOMOD, 2014; bmlfuw & bmvit, 2015). Statistics on the modal split from 1982 to 2013 show that the share for pedestrians fell from 31% to 19% (Mobility Agency Vienna, 2014; ZIS+P, 2014). A similar picture emerges at the urban level. For example, from the modal split, pedestrian traffic in Vienna in Austria decreased from 33% to 25% between 1995 and 2014, and in other Austrian cities from 27% to 17% on average (bmvit 2016). This negative trend can be observed to a similar extent throughout Europe (cities of Ljubljana and Copenhagen, 2014) and has not been stopped by numerous infrastructural measures (e.g. wider and separate sidewalks, more promenades, meeting zones, seating, floor-level adjustments, crossing aids), which are mostly located at the city district level. This is due to the high degree of motorization, the car-oriented spatial structures and the resulting longer distances (bmlfuw & bmvit, 2015). This makes supportive behaviour-based approaches at the municipal level appear all the more important.

It has been shown that younger people, up to 14 years of age in particular, walk 28% of their distance travelled, and that older people over 65 years of age walk 25% of their distance travelled. In the age group of 20 to 25 years, this proportion amounts to only 9% of all trips. In all age groups, women have a larger share of walking than men (see bmvit 2016).

For urban and densely populated areas in particular, and for short distances, there is still considerable development potential, as distances of less than 1 km account for about 65% of all journeys on foot and 30% of all car journeys (bmlfuw & bmvit, 2015). Pedestrian traffic, with all its advantages, is currently given too little priority within modern transport systems. In addition, the perception of walking as an independent "means of transport" is still not pronounced. However, promising initiatives (e.g. the 2015 Year of Walking in Vienna, the redesign of "Sonnenfelsplatz" in Graz, the Vienna based ZEUS project for analysing the needs of pedestrians, and the annual Walk-Space Conference in Austria) are taking place, and they are helping to deepen the understanding of the needs of people when walking, to identify barriers and obstacles and to promote the development of a "walking lifestyle".

2.2 Health-Related Effects of Walking

Internationally and nationally, efforts to promote active, health-promoting and sufficient mobility are increasingly becoming the focus of attention. This is being triggered by, amongst other things, a growing lack of exercise, intensified climate protection efforts and the increasing burden of motorized private transport (e.g. the increase in pollutant emissions, land sealing, noise and traffic jams). Walking, as the most natural form of active mobility, conserves resources, is socially just, promotes health, is rarely associated with injuries and is self-sufficient. According to the latest physical activity guidelines (U.S. Department of Health and Human Services (2018), individuals should undertake at least 150 minutes of exercise per week.

Walking is affordable for everyone, no additional sports equipment is required, no special movement skills are needed and walking can be practised by the majority of the population at any time. In a systematic review article, including a meta-analysis (Oja et al., 2018), the authors showed that inactive adults who participated in walking interventions achieved increased fitness and decreased body weight, BMI, and systolic and diastolic blood pressure. Based on the scientifically well-documented health effects of regular physical activity, the Austrian Health Promotion Strategy's Framework Health Goal 8 is: "To promote healthy and safe physical activity in everyday life by appropriately shaping the living environment." (Federal Ministry of Health and Women, 2016.)

3 THEORETICAL FRAMEWORK

3.1 Transtheoretical Model

Mobility management deals with the question of how the behaviour of people can be changed through measures or interventions. In general, individuals should organize their daily activities (e.g. work, education, shopping) in an efficient manner, in terms of cost, energy saving and environmental protection. To achieve these objectives, a wide range of different interventions have been used. Some studies have investigated interventions which have had a positive effect on mobility behaviour by sharing information and practical knowledge (Staats, Harland & Wilke 2004); by the specifications of goals (Locke & Latham, 2002); by comparison and competition with other players; or by rewards and punishments via feedback (Fujii et al., 2009; Taniguchi & Fujii, 2007; Cairns et al., 2008; Froehlich, 2011). However, many of these "soft" interventions are insufficiently embedded in a comprehensive behavioural theoretical concept for us to be able to evaluate their effectiveness.

In order to change human behaviour, it is necessary to understand the underlying behavioural processes. Many theories of motivational psychology and behavioural science have attempted to describe and explain mobility behaviour, including the theory of planned behaviour (Ajzen & Fishbein, 1975 & 1980), the norm-activation theory (Schwartz, 1977) and the self-regulation theory (Bamberg, 2012). In line with Prochaska and DiClemente (1982), the self-regulation model of Bamberg (2012) claims that behaviour changes through a time-ordered sequence of stages. Each stage involves various cognitive and motivational difficulties occurring throughout the process of behaviour change. Bamberg (2010) described the following qualitatively different stages:

- Precontemplation: In the first stage, individuals are not yet aware of their own behaviour. By self-focusing their behaviour, they still have to choose an overall goal amongst competing wishes (i.e. goal setting), and they still have to consider the feasibility and desirability of the relevant outcomes. Before choosing a goal (i.e. goal intention), the subjective probability of achieving it is evaluated.
- Contemplation: In this stage, individuals consider the pros and cons of the different options and choose the most suitable means for reaching their goal.
- Preparation/testing: Individuals form a concrete plan of when, where and how they can implement the new behaviour. The first practical steps are taken.
- Maintenance: In the final stage, individuals have a new behavioural pattern. Since the new habit has substantial benefits, relapse into the old behaviour can likely be avoided.

3.2 Nudging

The term “nudge” or “nudging” originally derives from the field of behavioural economics and describes a soft type of influence, with the goal to elicit a certain behaviour. Thaler and Sunstein (1975) defined nudging as a positive intervention that stimulates a voluntary change in behaviour without including external (negative) consequences. The idea of nudging has been booming in the USA in recent years, whereas very few initiatives are known in Europe, where the focus is generally on the creation of politically motivated interventions, and is particularly anchored in the field of health prevention (Quigley, 2013). Nudging, in itself, is based on motivational psychological models and shows parallels to the principle of gamification. However, in contrast to gamification, stimulus-response chains in the sense of incentives and penalties fade into the background, and subtle strategies and positive interventions for decision optimization come to the fore. Nudging strategies make behavioural alternatives more visible, in the area of physical activity; for example, by making stairs more attractive than a lift (Hollands et al., 2013).

Nudging has also been successfully used in the context of active mobility; for example, to promote cycling in cities (Wunsch et al., 2015). The methods used here are similar to the “persuasive technology” principle. In both cases, the aim is to promote certain behaviours or options through targeted measures in terms of the design of places, processes and graphic interfaces (Fogg, 2009). Nudges can further be seen in a similar way to gamification, or as a relevant part of gamification, in the form of the game mechanics of achievements. (Pfeiffer, 2018).

3.3 Research Questions

The primary aim of the “Walk your City” research project is to increase the awareness of the positive effects of walking, the acceptance of walking as a means of mobility and the implementation of walking as a habit, which will primarily support the subsequent ambitious transport and health policy strategies.

The research questions are as follows:

(1) Can changes in walking behaviour be determined after the field test compared to before?

(2) Is the applied nudging framework able to alter the attitude towards walking, the knowledge of the positive effects, as well as the behaviour, in terms of the implementation of walking as a habit?

(3) Are participants progressing through the stages of the transtheoretical model in terms of a “level-up”?

(4) Do participants report increased fitness levels after participating in the field test?

(5) How is the app rated in terms of usability and fun of play?

4 METHOD

4.1 Nudging Framework

Numerous innovative features were used, which were intended to intrinsically motivate players to walk more, in an enjoyable and behaviour-oriented way. The applied nudging framework was a central component in this context, and was used both virtually and at local events. The framework integrates four different types of behavioural interventions or nudges:

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- Informative and awareness-raising nudges: Push notifications via smartphone for educating users about the positive health- and traffic-related effects of walking, and a web dashboard with tracking statistics.
- Social nudges: Activities such as guided walking tours in the course of local campaigns.
- Rewarding and enjoyable nudges: Token-based reward system, street games.
- Stabilizing and preventive nudges: Daily walking targets, statistics/visualizations of the positive effects of walking.

4.2 Mobile App

The native "Time2Walk" app was developed as a central hub for conveying the nudges and for raising the players' awareness of the benefits of pedestrian mobility. Through the game mechanics, players are motivated to discover beautiful places and the hidden corners of Graz on foot, and to experience activities on site. Figures 1 to 5 show a few screenshots from the app.

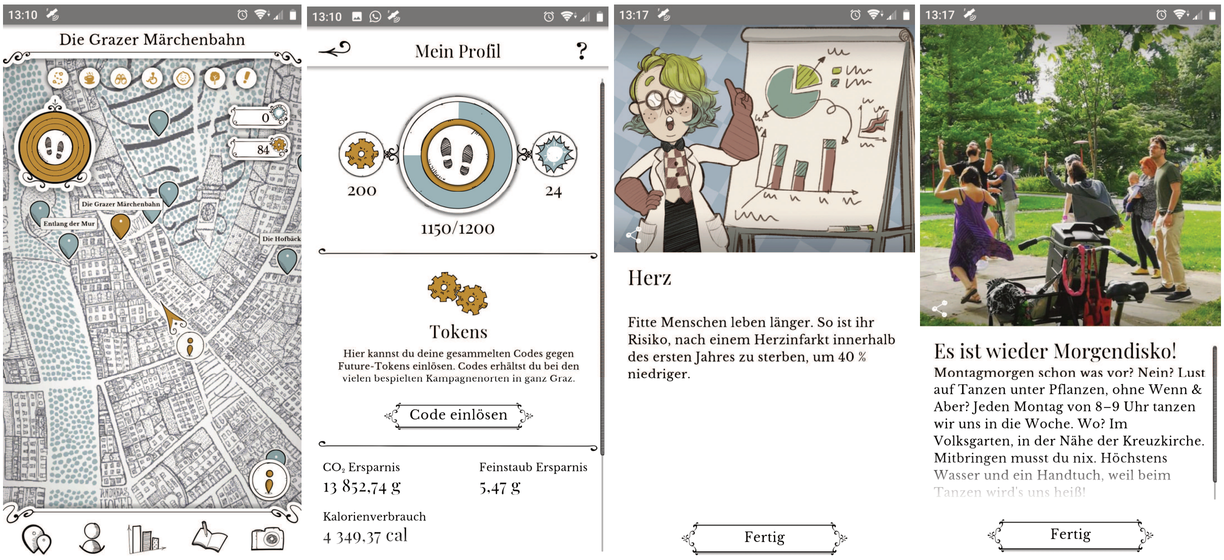

Fig. 1: Start scree, Fig. 2: Personal profile, Fig. 3: Push notification as an informative and awareness-raising nudge, Fig. 4: Push notification as a call to attend an event

The landing page of the app is shown in Figure 1. All event locations (points of interest) are located there as an icon on a hand-drawn city map. The pedometer is prominently placed in the upper-left area. The navigation bar is located in the lower area, from which players can get an overview of:

- all the venues that the player has already visited;
- the personal profile, in which the steps and savings achieved can be checked (see Figure 2);
- statistics, where a comparison with other players is possible;
- the journal, in which the game history and all push notifications can be read;
- and the augmented reality mode.

Figure 3 gives an example of a push notification designed to increase awareness of a healthy lifestyle through physical fitness. Figure 4 shows how a push notification is used to notify the player of an upcoming event.

4.3 Field Test

As a preparatory measure for the field test, players were recruited via social media, press releases, advertising material and personal contacts (see Figure 5).

The field test ran from 16th of September to 16th of October 2019 in the city of Graz in Austria. During this period, it was possible for individuals to download and to play the Time2Walk app via the Google Play Store and to take part in the accompanying events in the city of Graz. Local campaigns took place at several different locations that could be visited on foot. In addition to the app, there was also a printed map of the playing area with the event locations, so that individuals who did not want to use the app or who were less tech-savvy could also take part in the campaign. By applying both digital (via app) and real nudges (via local campaigns), it was ensured that a wide variety of target groups could be addressed.

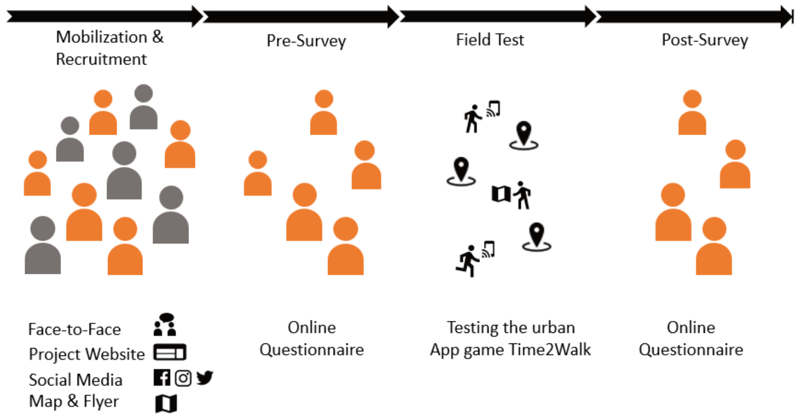

Fig. 5: Overview of the research design

4.4 Data Collection

The data were collected using online surveys and the tracking system integrated in the app. The two standardized online surveys (pre-/post-survey) were implemented with a survey tool. When defining the question types, special attention was paid to ensuring that the different question types were easy to read and could be displayed on both a PC and smaller smartphone displays, thus enabling a responsive experience. The survey was conducted anonymously, in accordance with data protection regulations.

The personal data collected (e.g. age, education) did not allow for a clear identification of the person. Since GPS tracking of the footpaths (e.g. for determining the number of steps) was dispensed with, it was not possible to draw conclusions about the exact whereabouts (e.g. place of residence/work) of the participants. After the evaluation of the field data was finished, all personal data, such as addresses, were deleted. In addition, the participants could at any time arrange for their data to be changed or deleted during the field test, in compliance with the EU General Data Protection Regulation (GDPR).

4.4.1 Examined Variables

A pre-post single-group design was used to demonstrate the behavioural changes. Identical questions regarding mobility settings and mobility behaviour – especially walking behaviour – were asked before and after the field test using the same sample (a within-subject design). Thus, the achieved effects of the nudging framework could be analyzed at an individual level. In addition to questions about the impact, other aspects such as usability and gameplay were also surveyed.

The study design of the first questionnaire included questions on sociodemography, environmental attitudes and playing behaviour. In addition, the motives for increased walking, as well as questions about personal health and lifestyle, were also assessed. The second questionnaire raised questions about the gameplay, the usability of the app, as well as questions referring to the local campaigns.

4.4.2 Sample

In the course of the field test, 238 people used the Time2Walk app. For the detailed analysis, only survey data in the tracking system for the 120 players with a walking time of at least 5 minutes (corresponding to approximately 500 steps) were considered.

After processing the data, 145 persons from the pre survey and 48 persons from the post survey could be analyzed in detail. This corresponded to a response rate of 33%. Since the testing of the app and its evaluation could be considered as a considerable effort in the everyday life of an individual, the response rate can be deemed satisfactory. Above all, a representative survey was not central to the research project. A variety of strategies were pursued, with the aim of keeping the dropout rate as low as possible. For example, the two surveys and the competition were announced several times via newsletters and push notifications triggered by the app. The joint progress within the game, as well as an individual comparison with other

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players, could be called up in real time, while motivating campaign activities were advertised at an early stage via social media. The majority of the participants in the field test were female (pre-test: 66%; post-test: 71%). The age range was from 11 to 72 years. Most players were between 21 and 40 years old (pre-test: 76%; post-test: 74%). Overall, few players were under 21 years of age (pre-test: 8%; post-test: 3%) or over 60 years of age (pre-test: 3%; post-test: 0%). The sample included an above-average number of persons who had attended a university, college or university of applied sciences (pre-test: 57%; post-test: 65%).

5 RESULTS

The analysis of the results involved a comprehensive mix of methods, and the samples were described by means of descriptive statistics. In order to investigate the statistical relationships between variables, bivariate correlations, linear regressions and analyses of variance were applied. By means of t-tests for dependent samples, changes in attitude and behaviour were investigated.

5.1 Usability

For the usability analysis, the standardized "System Usability Scale" (SUS) questionnaire, established in the field of usability research (Brooke 2013 & Bangor et al. 2008), was used for calculating a SUS score. With regard to the gameplay and usability, positive ratings could be observed. A differentiated view of the SUS score suggests that the Time2Walk app is particularly quick and easy to learn (SUS=73/100).

The vast majority (85%) enjoyed playing Time2Walk. The pedometer scored particularly well (M=1,6[1]), through which the daily progress could be followed directly. The illustrated positive effects of walking were also very popular (M=1,9), as was the possibility of discovering new places (M=2,0). Local campaigns were visited by 26% of players. Almost 40% of all the players that used the Time2Walk app never normally used their smartphone for gaming applications.

The subjective level of fitness of the participants was rated as good (pre-test: 36%; post-test: 39%). In total, 9% described their state of health as "not good" or "bad" in the first survey, while this was only 6% in the second survey. This suggests that the fitness level of the participants increased as a result of the field test.

5.2 Impact

To analyze the impact of the nudging framework, the collected quantitative tracking data were compared with the subjective self-assessment of the players. By comparing the statements before and after the field test, changes could be identified on an individual level.

	Sum	**Mean**
Global step count	10.635.000	88.625
App starts	1810	15
POI check-ins	312	2,6
Check-ins at points of interest	218	-
Check-ins at local campaigns	94	-
Positive effects		
Reduction of CO_2	1.016.157 g	8.467,98 g
Reduction of fine particulate matter	400,90 g	3,3408 g
Calories burned	319.046 kcal	2658,72 kcal

Table 2: Tracking data

5.2.1 Tracking Data

On average, each day, each player walked 1,437 steps (or 14 minutes) more than indicated at the beginning of the field test. This is because the self-estimated average walking time per player was 54 minutes, while the actual recorded walking time at the end of the field test was 68 minutes. This corresponds to an increase of about 26%. In order to illustrate the effects of such an increase, the difference is shown in terms of CO_2, fine particulate matter reduction and calories burned in Table 2. The CO_2 and particulate matter savings are based on the assumption that car journeys were saved during the walking time. The effects were calculated by

[1] Measured with a 5-point Likert scale, ranging from 1 = very good to 5 = deficient

taking the basic assumption of “no active movement” as a starting point, as is the case with car journeys. In total, players completed 10 million steps and visited 218 points of interest.

On an average day, a player took 6,837 steps, which roughly corresponds to a walking time of about 68 minutes. If this empirically determined value is compared with the self-estimated average walking time of 54 minutes, which was requested when the app was first opened, an increase of 14 minutes per day and player can be observed. Compared to the self-estimated initial duration, an increase of about 26% can be observed over the course of the field test.

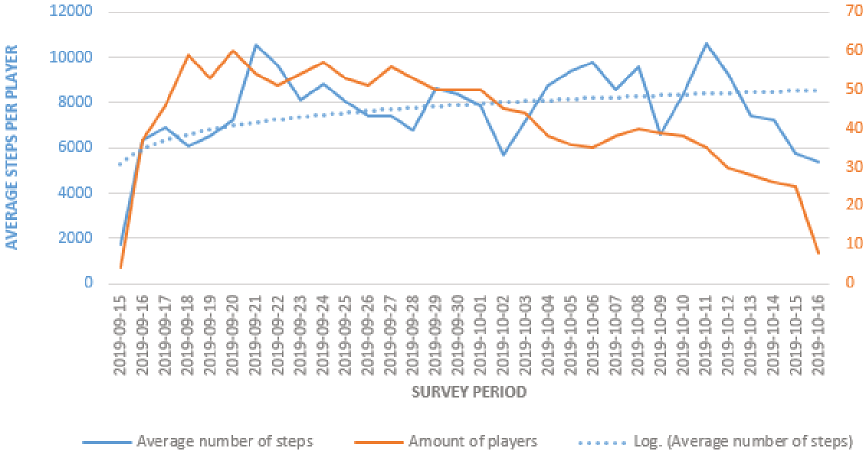

Fig. 6: Number of steps and players during the field test

5.2.2 Subjective Impact

The subjective impact was evaluated by the determined changes in interest for climate-friendly travel options, the awareness of the positive effects of walking, as well as health-related knowledge and well-being. Regarding the self-assessed changes, no significant results were obtained in a t-test with paired samples ($p>0.05$). Only with regard to the item “I would like to find out (more) how I travel in a more climate-friendly way” was there a statistical significance. Thus, the interest of the players was increased by the interventions in the field test (Mpre-test=2.26, Mpost-test=1.97; $p>0.05$).

On a descriptive level (no statistical significance reached), increased values for all variables (interest, perception, knowledge, participation and behaviour) between the pre- and post-test could be observed. This means that there was more interest, an increased perception, more knowledge, more desire to participate and more willingness to walk.

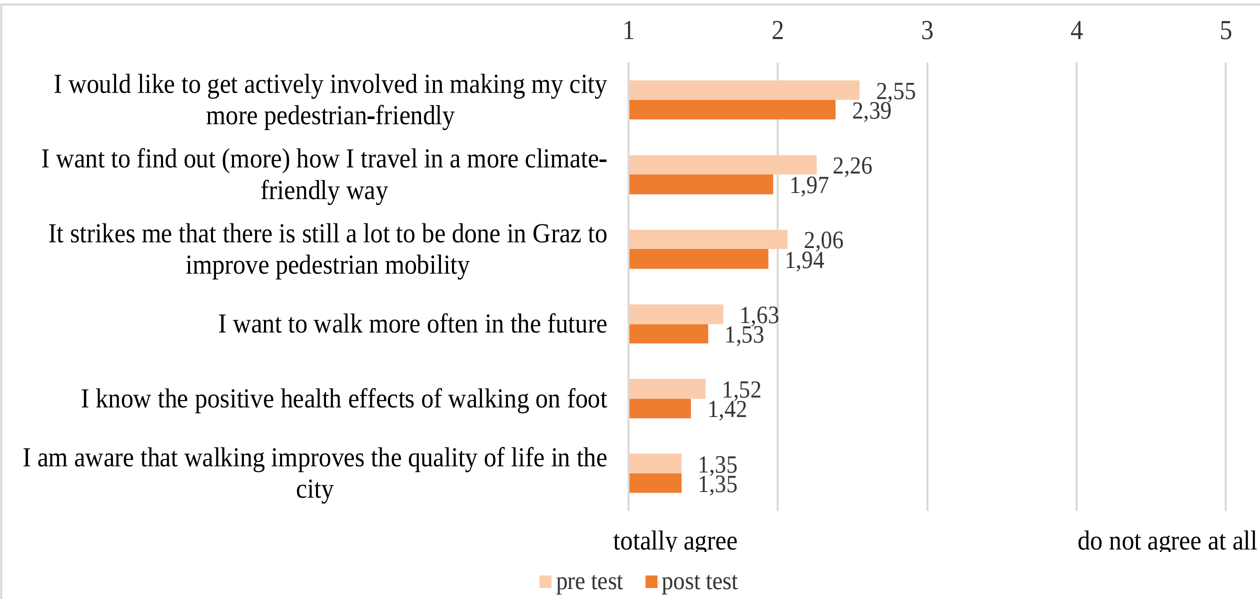

Fig. 7: Impact on interest, awareness and knowledge (pre-test: N=145, post-test: N=48)

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5.2.3 Behavioural Impact

To compare the characteristics of the transtheoretical model between the two test points, cross tables were created in order to calculate the significance using chi-squared tests. The last stage was split up depending on the time frame in which participants stated that they walked for at least 150 minutes per week. In principle, a positive development is evident: after the field test, fewer subjects are assigned to the first stage, in which there is no intention to walk more. In the last stage, however, in which a disposition for action can be spoken of, i.e., in which the behaviour is consolidated, an increase can be observed. Based on the expected and observed frequencies, as well as the standardized residuals, statistically significant differences arise at the third stage, in the form of behavioural intention. This means that after the field test (17%), plans for regular walking are more likely to be made than before (6%). According to this finding, the volatile third stage shows a particularly positive influence, leading to a "level-up" (see Figure 8).

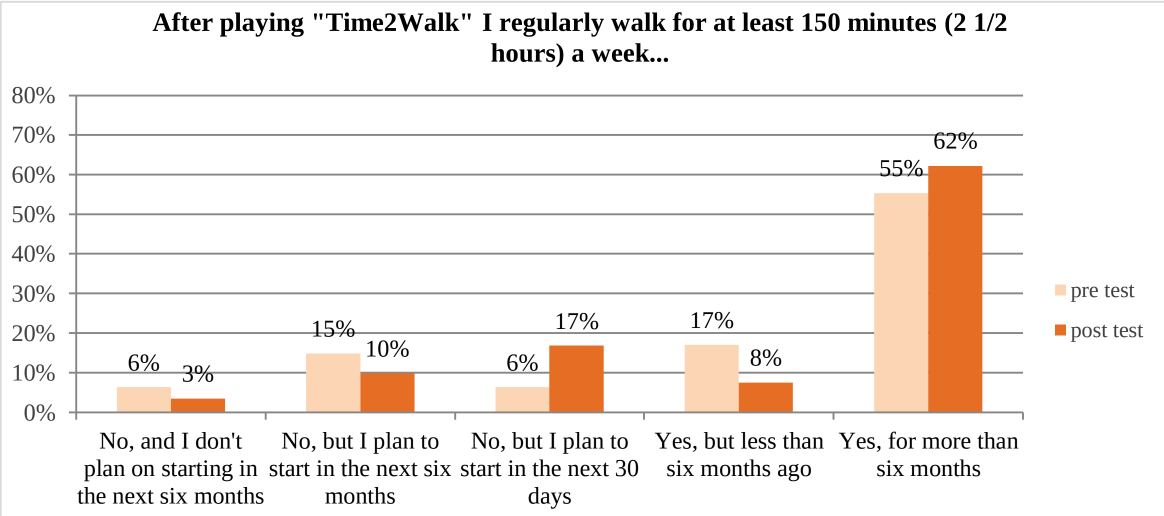

Fig. 8: Impact on the stages of the transtheoretical model (pre-test: N = 145, post-test: N = 48)

With regard to the choice of means of transport, a comparison between the pre-test and the post-test shows a shift away from motorized individual transport. While 54% stated that they walked daily before the field test, the percentage rises to 66% after the field test. This difference is statistically significant (F=2.91; p<0.001). An increase was also achieved for the 5–6 days per week group. For cars, there is a reduction in daily usage, which is no longer present in the second survey. The use of bicycles is identical, apart from a slight deviation, and there is a slight decrease in the use of public transport (see Figure 9).

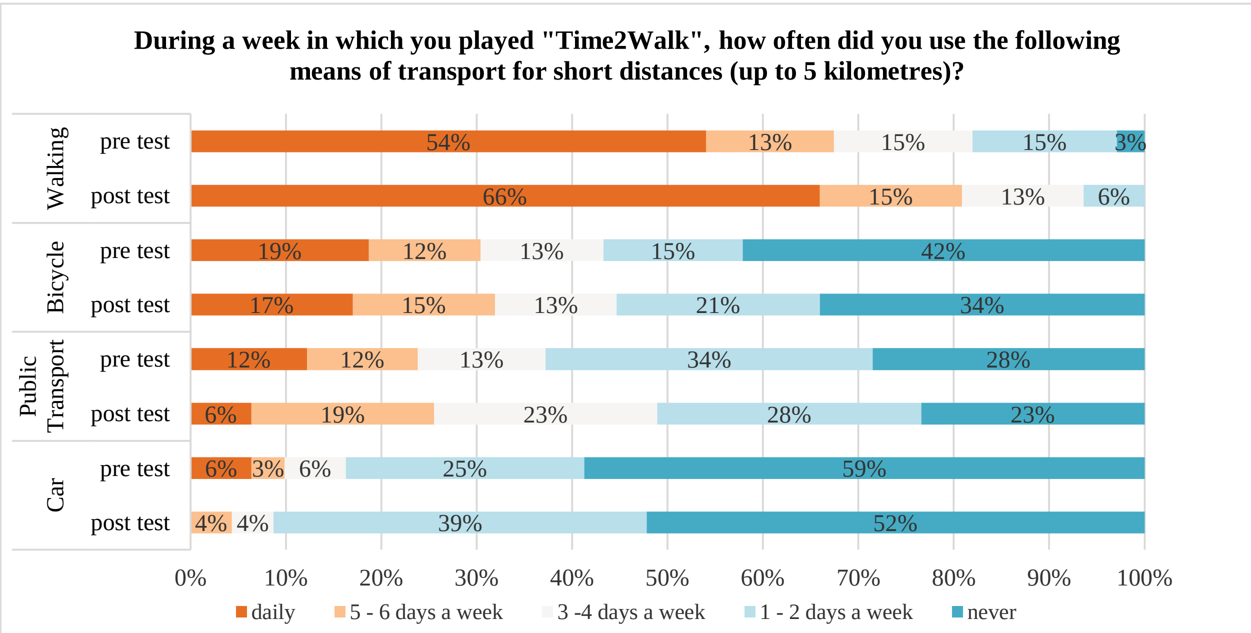

Fig. 9: Modal split (pre-test: N=145, post-test: N=48)

6 DISCUSSION

Over the course of the field test, established behavioural patterns (e.g. regular car journeys) were partially reversed, while attitudes towards climate-friendly mobility were demonstrably strengthened. This means that participants now pay more attention to environmentally friendly travel, especially travel on foot, and would like to find out how they can travel in a more climate-friendly way. Furthermore, the participants now have a better understanding of the positive effects of walking on their personal health. In the post-test, the effects on individual mobility behaviour were also significant. When looking at the individual level, a positive trend could be observed, i.e., the average of 54 walking minutes per day which the players stated at the beginning was increased by 26% to 68 walking minutes per day. According to the observed modal split, cars were no longer used daily by any of the players on short distances of less than 5 km, while, at the same time, the share of pedestrian traffic was demonstrably increased. In reference to the transtheoretical model, the most volatile stage 3 showed a positive influence, leading to more participants planning to walk more in the future.

The limitations of this study include the small sample size for the post-test, as well as the elaborate test design, which would be difficult to reproduce. Through a variety of different measures, an attempt was made to keep the dropout rate as low as possible. Despite these measures, the local campaigns were only visited by a quarter of the participants, mainly because of time constraints. This was despite the fact that an attempt was made to locate the venues in such a way that they could be easily visited during a workday routine – both in terms of time and location.

Future concepts could further emphasize the modular approach and highlight key features such as the step counter, the daily targets, as well as information on the positive effects of walking.

7 CONCLUSION

In the Walk Your City project, a behavioural and game-based pedestrian initiative with a focus on the nudging method was designed, developed and evaluated. Through the unique combination of online nudges triggered via the Time2Walk app and offline nudges provided through local campaigns in lively places, participants were motivated to explore and experience the city Graz on foot. Walking was to be perceived as a healthy means to cover short distances, with the ultimate goal being to anchor walking as a stable habit. The applied nudging framework was able to influence attitudes towards walking, as well as increase knowledge about the positive effects of walking, and to change the existing mobility behaviour patterns.

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