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RESEARCH

Nudges Can Both Raise and Lower Physical Activity Levels: The Effects of Role Models on Stair and Escalator Use – A Pilot Study

Mathias Krisam[1,2], Ruben Korenke[3], Mona Maier[2] and Jakob Korenke[4]

[1] Charité – Universitätsmedizin Berlin, DE

[2] läuft GmbH, DE

[3] Technische Universität Berlin, DE

[4] Independent, DE

Corresponding author: Mathias Krisam (mathias.krisam@charite.de)

Introduction: The majority of people worldwide do not engage in enough physical activity which can have hazardous effects on both individual and public health. Increasing physical activity levels in our daily lives is therefore a key concern within public health initiatives. Making an active choice to take the stairs over alternatives is an effective and freely accessible way to increase daily physical activity. Research has shown that alongside prompts, role models can be influential in increasing stair use among pedestrians. Presently, no research has been conducted comparing the role model effect towards passive and active behaviour. We conducted a pilot study, seeking to confirm the effect of role-models on stair use and also investigating the effect of role-models on escalator use.

Method: In the railway station "Zoologischer Garten" in Berlin, a role model either climbed the stairs or took the escalator in front of unknown pedestrians to reach the platform in sequences of 3 minutes. Two researchers counted per intervention-sequence the number of people taking the stairs or the escalator respectively against a control measurement with no intervention. In total pedestrian behaviour was observed over a period of 108 minutes and the choices of a total of 1778 people were recorded. A chi-squared test was used to measure the intervention effects. The effects of role-models on active and passive behaviour were compared.

Results: Stair use increased from 29% to 33% in the presence of a stair role model (net increase 14%). Escalator use increased from 71% to 74% in the presence of an escalator role model (net increase 4%). A chi-squared test shows that participants' decisions on whether to take the stairs or the escalator were significantly different depending on the intervention type (Stair-, Escalator-Model, no model) participants were exposed to. Neither of these differences was found to be statistically significant when estimating logistic regression models. Traffic volume was weakly significantly ($p < 0.1$) linked with an increased likelihood of participants using the stairs when traffic volume increases.

Discussion: Role models can impact physical activity levels among citizens on an unconscious and often anonymous level. For public health experts it is important to recognise that people can be nudged by role models both towards passive and active behaviour. This pilot study provides the first evidence of the concept that everyone in society can and should be an effective role model for increasing physical activity levels in our daily lives and should be aware of negative role model effects when demonstrating passive behaviours. This information can be relevant when creating public health messages. Future studies should observe a larger sample size and distinguish between a number of different factors (such as weather, time of day, weekday vs, weekend) that might influence the role model effect on stair or escalator use.

Keywords: Nudging; Health Promotion; Physical Exercise; Role Model; Stair use; Behavioural Science

Introduction

3.2 million deaths per year are linked with physical inactivity (World Health Organization 2010a). In the UK 70,000 deaths are caused by sedentary lifestyles alone (Heron et al. 2019). The WHO recommends at least 150 minutes of moderate walking per week but many people fail to reach this goal (World Health Organization 2010a). People do not necessarily need to go to the gym or other exercise facilities but can easily include daily activities into their routines to increase and attain the recommended level of physical activity (Smith et al. 2014). Aside from this, significant improvements would be possible if people integrated more physical activity in their daily routines, such as at home, on the way to work/school, or at work and in school where a sedentary lifestyle is often supported by daily routines and societal norms (Owen et al. 2010).

Excluding workplaces as an important setting for promoting health and particularly physical activity, cities and their architecture are a crucial environment for promoting health in public as they can facilitate an improvement in opportunities to be more physically active. Stairs in particular can be utilised as one of the most efficient and easily accessible opportunities for boosting physical activity. Multiple different studies show that stair climbing has positive effects on health outcomes (Tan et al. 2002; Boreham et al. 2005; Meyer et al. 2010). Stair climbing can be classed as a physical activity that can significantly improve cardiorespiratory fitness in untrained individuals (Tan et al. 2002). Boreham et al. (2005) found that stair climbing favourably alters important cardiovascular risk factors. Furthermore, a 12-week promotional campaign for stair use in a workplace connected increased levels of stair use with significant increases in participants' estimated maximal aerobic capacity, and decreases in participants' waist circumference, weight, fat mass, diastolic blood pressure, and low density lipoprotein cholesterol (Meyer et al. 2010).

Despite the numerous positive effects on health alongside the free and easy accessibility of stairs evidence shows that only around 10 % percent of people do actually take the stairs on a regular basis if an escalator is located next to them (Adams et al. 2006). Therefore, the vast majority of people remain passive even if they are presented with easy opportunities to be active that could improve their health significantly.

Research to this point has focused its effort on stair prompts and nudges motivating people to take the stairs as an alternative to taking a nearby escalator or lift. Most of the interventions that have been tested used signs and graphs with varying messages and communication styles. A systematic review showed that stair prompts significantly increase stair usage (Soler et al. 2010). As such there are efficient and known ways to increase physical activity levels by using the stairs more often.

Aside from prominent signs and motivating messages, another important factor in influencing people's behaviour is the application and display of role models and societal norms. In simple words: how does the behaviour of other people affect my own behaviour? Within the field of behavioural insights, messages which point out the behaviour of the majority or the behaviour of people someone feels close to are very effective (Ayres et al. 2013). Simply providing people with information about how the majority of their peer group (same profession, country or region) behaves in a specific situation, has shown to be effective in increasing tax replies (Hallsworth et al. 2017), reducing unnecessary prescribing of antibiotics (Hallsworth et al. 2016; Hiscox et al. June 2018), and reducing energy usage of households (Ayres et al. 2013). Furthermore, social comparison and perceived behaviours of peers are significant predictors of health-promoting behaviours such as nutrition and physical activity (Luszczynska et al. 2004).

Due to the fact most of the studies which aim to increase stair use have focused on stair prompts, we wanted to examine the effect of role models on stair use. To our knowledge, only three studies have examined the effect of role models on the use of stairs. Adams et al. (2006) could show that role models taking the stairs relatively increased stair use amongst men by 102,6% and amongst women by 61,8%. In their study role models waited in front of the stairs at an airport for other passengers to approach and started to ascend and descend the stairs as soon as other pedestrians were in view. They walked ahead of participants to maximise their exposure to them. Another study which investigated behavioural mimicry in the context of stair/escalator choice was conducted in a mall and also found that individuals mimic the stair/escalator choices of fellow pedestrians (Webb et al. 2011). They only focused on people ascending the stairs and further found that the role model effect was more modest between strangers compared to acquaintances. van Calster et al. (2017) evaluated the role model effect by displaying a video with a stair climbing model next to a set of stairs at a worksite and found that displaying the video increased stair climbing by 12.5%.

In our study we wanted to replicate Adams et al.'s (2006) intervention but rather than measuring the effect on people both ascending and descending the stairs, we were only interested in the effect on ascending stairs since this has a higher impact on people's fitness than descending. Furthermore, we wanted to find out whether the effect of role models promoting stair climbing is comparable to the effect of role models using the escalator. Our research question was therefore: can people be nudged both towards a passive action (taking the escalator) as well as towards an action which involves an increase in physical activity (taking the stairs)?

Method

Setting

As the place of intervention we chose a staircase at a train station in Berlin ("S-Bahnhof Berlin Zoologischer Garten"). We made the assumption that most people coming to this location are commuters. This assumption was made given that the particular staircase we observed leads only to two platforms which are frequented exclusively by local urban trains and no long-distance trains. The logic behind choosing a staircase that is used mostly by commuters, rather than people who are on a longer-distance journey was that commuters usually travel with much smaller amounts of luggage in comparison to people travelling longer distances. This could pose large confounder effects on the behaviour we were observing.

At the station and platform we conducted our research at, there were two staircases which led to the platform. We conducted our intervention at the staircase "Hardenbergstraße". Each day, around 140,000 people use this staircase (Ströer 2019). People walk into the station from the street "Hardenbergstraße" and need to make a 180° turn to walk up the stairs or to take the escalator to get to the platform. **Figure 1** shows the architecture of the place and the way people walk. **Figure 2** depicts a photograph of the staircase showing the entrance from Hardenbergstraße (right hand side) and the escalator (left hand side). As can be observed the stairs are closer to the entrance and in order to reach the escalator some extra steps have to be taken. The staircase consists of 46 steps and has two horizontal landings every 15 steps.

We conducted the experiment on Thursday June 13 2019 between 3:00 pm and 4:30 pm. It was a sunny afternoon, averaging 24°C.

Intervention

The performing role models in this study were three young men: 25, 29 and 31 years old. They were wearing comfortable summer clothes; one model was wearing sunglasses.

In the intervention, one of the models was waiting at the bottom of the staircase for other passengers to arrive. As soon as a group of at least two people arrived the model started walking in front of them. In intervention-condition 1 the model took the stairs (S). In intervention-condition 2 they were using the escalator (E). In both cases, as soon as the models reached the top of the stairs or the escalator, they turned

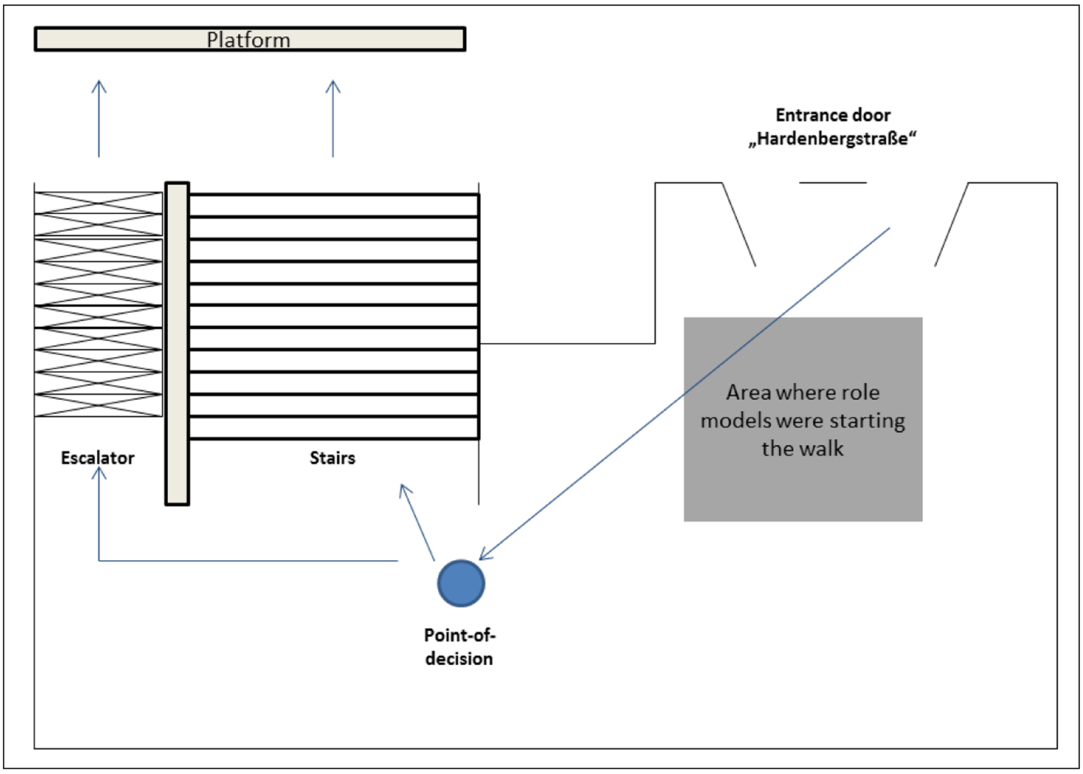

Figure 1: Passenger's path to the staircase.

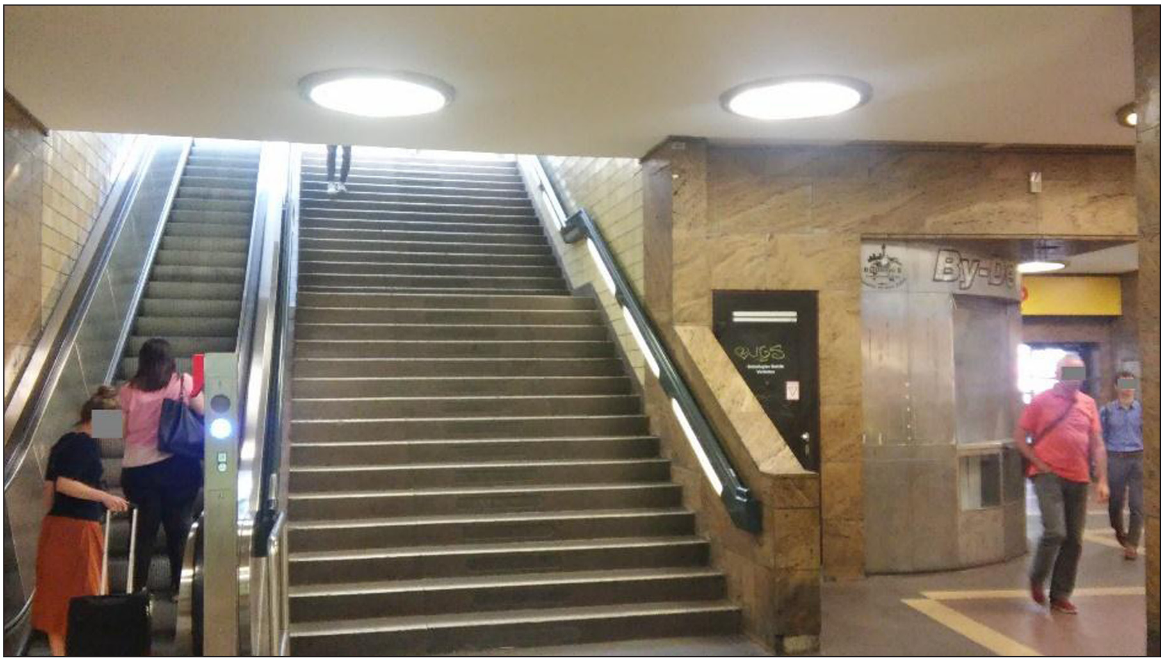

Figure 2: Setting at "S-Bahnhof Zoologischer Garten", Berlin.

around walked down the stairs, repeated waiting for other passengers and took the stairs or rather the escalator (depending on the current intervention-condition) in front of the next arriving passengers.

Each intervention-condition always lasted 3 minutes. This specific time interval was chosen to ensure that the results were not confounded by the timetables of the trains which operate by a different timing schedule. Hence, one complete sequence always consisted of 3 minutes walking the stairs, 3 minutes taking the escalator, 3 minutes no intervention (control measure; baseline). After each sequence of stairs (S), escalator (E) and control (C), the role model changed. We conducted 12 complete sequences of S, E and C; meaning we documented 108 minutes in total. During each intervention-condition of three minutes of taking the escalator or the stairs, the role model on average went up the stairs or escalator 5 times.

Measurement

The two researchers who were not acting as role models during a sequence were counting the people who took the stairs and those who took the escalator. They used analog hand counters and after each 3 minute interval, the number of people taking the stairs and taking the escalator was recorded. The "counters" were standing on the platform observing stairs and escalator with an unobstructed view.

Sample

We analysed all people who walked up to the platform during that time. Although we did not conduct any further analysis, we assume that this sample mainly consisted of local commuters. In total 1778 people were counted.

Statistical analysis

A Chi-square test was conducted for stair vs. escalator decision by intervention type.

Furthermore, two binomial logistic regression analyses were performed to examine the influence of role models on the odds of taking the stairs/escalator. The stair/escalator choice was the dichotomous outcome variable, and the 'role model condition' was the main predictor. The nature of the role model condition was different in the analyses:

Analysis 1 compared a model taking the stairs (S) to the no model condition (C).
Analysis 2 compared a model taking the escalator (E) to the no model condition (C).

These binary levels were dummy coded, with the 'no model condition' (C) serving as the reference category. Although pedestrian traffic volume was not expected to have an impact on the outcome variable, it was included as a second predictor variable to confirm it had no effect. Another predictor was included indicating which one of the three researchers acted as a model at the time of decision. Again, this predictor was not expected to have an impact on the outcome variable, as all models were male, similar in age, and similarly dressed. Odds ratios (ORs) and 95% confidence intervals (CIs) are reported for each factor.

All analyses were performed with STATA/IC version 15.

Results

Figure 3 gives an initial overview of the number of participants counted by the researchers taking the stairs and escalator for each intervention type. This graphical depiction of the data shows that stair use increased during the stair-model condition, and escalator use increased during the escalator-model condition.

The total counts and shares for each intervention type as well as the Chi-square contingency table test results are presented in **Table 1**. Our results support our hypotheses: Stair use increased from 29% to 33% in the presence of a stair-model (net increase 14%). Escalator use increased from 71% to 74% in the presence

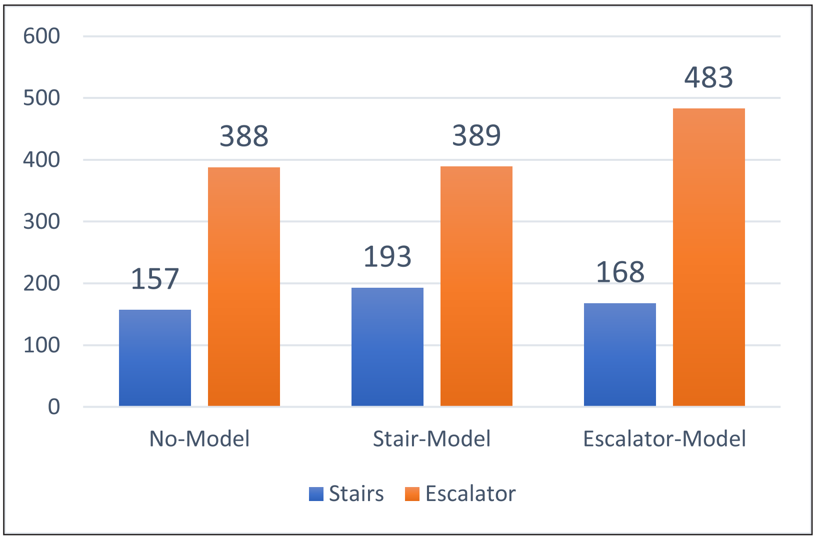

Figure 3: Counts of participants by Intervention Type and Decision.

Table 1: Stair and Escalator Use by Intervention Type.

Intervention Type	**Decision**		
	Stairs	**Escalator**	**Total**
Control (no model)			
total count	157	388	545 (31%)
share	29%	71%	
Stair-Model			
total count	193	389	582 (33%)
share	33%	67%	
Escalator-Model			
total count	168	483	651 (37%)
share	26%	74%	
Total			
total count	518	1260	1778 (100%)
share	29%	71%	

Pearson $chi^2(2) = 8.0921$; Pr = 0.017.

of an escalator-model (net increase 4%). Participants' decisions on whether to take the stairs or the escalator were significantly different depending on what intervention type the participants were exposed to.

Table 2 summarises the binomial logistic regression results for both regressions. Results of both binomial logistic regressions of participants stair use assessing the influence of stair-models (Model A) and elevator-models (Model B) and covariates are presented in **Table 2**.

The presence of a model could not be significantly associated with an increase or decrease in stair use contrasted with the no-model condition. Although no statistical significance could be detected, the effects do indicate the trends that were expected. The odds ratio in Model A is positive, indicating that participants are more likely to take the stairs when a stair-model is present compared to the no-model condition. In similar supporting fashion in Model B the odds ratio is negative, indicating that participants are less likely to take the stairs when an escalator model is present. Traffic volume was weakly significantly linked with an increased likelihood of participants using the stairs when traffic volumes increase. This was only found in Model A, and the effect is very small and should therefore be interpreted with caution.

While directionally consistent with the hypotheses, the results could not further confirm our Hypotheses. A follow up study with higher statistical power (e.g. through a bigger sample size) could potentially alleviate this problem.

Discussion

It is commonly understood that the average citizen does not engage in enough physical activity on a regular basis which has significant negative consequences for both individual and public health. This lifestyle choice is fostered by our surroundings which often support a sedentary lifestyle even though there are plenty of possibilities to increase one's physical activity level, such as stairs in public, at work or at school.

In 2018, 11.6 billion German passengers used public transport systems with 60 % of those taking trains (Statistisches Bundesamt 2018). Therefore, public transport locations pose a good setting to target a large share of the population on a regular basis. Despite the fact that Public Health practitioners must mainly focus on avoiding sedentary lifestyles in general, railway stations can play a crucial role in promoting increased physical activity and therefore improving citizens' health.

Evidence from previous research shows that role models can play an effective role in 'nudging' people towards physical activity by choosing to use the stairs. This study confirms this role model effect by showing

Table 2: Binomial Logistic Regression of Stair Use on Model-Interventions.

Variables	**Stair Use (1) Escalator (0)**	
	Model A **Stair-model vs control**	**Model B** **Escalator-model vs control**
	Odds Ratio **(p-Value)**	**Odds Ratio** **(p-Value)**
Intervention Type		
baseline: no model	1	1
Stair-model	0.165	
	(0.209)	
Escalator-model		–0.117
		(0.394)
Traffic volume	0.00776*	–0.00336
	(0.075)	(0.489)
Model	–0.00812	–0.0306
	(0.92)	(0.704)
Constant	–1.269***	–0.681**
	(0.000)	(0.013)
Observations	1,127	1,196

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

that people's decisions on whether to take the stairs or the escalator were significantly different depending on whether there was a role model operating in front of them. It is interesting that this role-model effect is anonymous, meaning that anyone can act as a role model for people they have never met before, and it seems that this change in behaviour happens unconsciously. Therefore, (subconscious) imitation of active physical behaviour is an effective tool to increase physical activity without a need for conscious plans or intentions.

Furthermore, this is the first study of its kind which investigated the role model effect towards passive behaviour (using the escalator).

We know from empirical evidence that stair prompts and signs are effective tools for increasing stair use. A systematic review quantified the effect of stair prompts with a 54% median increase (Kahn et al. 2002). All the interventions using prompts to increase stair use did not methodologically differentiate between the effect of the prompts themselves, and the resulting imitative behaviour of pedestrians. We know from our research that imitating behaviour alone can have an impact on people's physical activity. It is important to note that this study failed to replicate the strong effects which Adams et al. (2006) found. This can be explained by the fact that pedestrians appear much less inclined to climb stairs in comparison to descending stairs. Our study differed because it only considered people ascending a staircase whereas Adams' sample mainly consisted of participants descending the stairs. Nonetheless, we can conclude that role models alone have a small effect on stair use. If used in combination with other interventions such as prompts, it has the potential to increase the volume of people taking the stairs even further.

The consequences for public health policy are not only a call-for-action to use public stair prompts (which we would also recommend), but additionally an appeal to all of us as citizens to become role models in our daily lives. In practice we could design stair prompts which include our insights of the role-model effect as part of the messaging (for example "Be a role model and take the stairs. Many others will follow!"). One previous study has used similar messaging when prompting health professionals to be activity role models (Andersen et al. 2008). As part of this study, which was conducted during a Sports Medicine conference, the attendants (mostly health professionals) were prompted to use the stairs with the following message: "Be a role model. Use the stairs!". Activity levels increased by 11.8% (Andersen et al. 2008).

Our results show that on average every person who took the stairs and therefore exhibited an active behaviour successfully motivated others to take the stairs as well. On the other hand, every role model deciding to be passive and take the escalator was also followed by other people. It is clear then that the effect towards the passive behaviour also persists.

Limitations

The observation phase might have been too short to produce statistically significant results. Considering the small effect size, a larger number of observations could have proved more conducive in achieving statistical significance. Furthermore, our intervention in terms of climbing the stairs or taking the escalator was constructed in a way that just one person could influence decisions only 5 times per sub-sequence at the bottom of the stairs/escalator. Therefore, many decisions of taking the stairs or the escalator during our observation period were not influenced by our role models, either due to them being too far away or walking down the stairs whilst other passengers were arriving. Additionally, more role models could have been used to influence people's decisions. Also, our study did not measure other variables that might influence people's behaviour like for example the gender, age or dress of the role model or the pedestrian.

Outlook/further studies

Further studies should aim to collect higher numbers of observations and have more diverse role models to influence people's decision of taking the stairs or the escalator and have a stronger effect during the intervention. From anecdotal observation we would also hypothesize that people who are in a rush to catch the next train are more likely to run up the stairs. We also think that time of the day (e.g. early in the morning or late in the afternoon/night) as well as weekday vs weekend can influence people's choices of taking the stairs or the escalator due to it being more busy around certain times or people being under different levels of time pressure. Other studies could also examine if temperature or weather impacts the use of stairs by pedestrians. Hot or rainy weather might push people more towards using the escalator to avoid too much exercise and sweating or slipping on the stairs, respectively. Finally, further studies should explore whether stair prompts such as posters that point out the role-model effect show larger effects than traditional stair prompts that have been used previously.

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Competing Interests

MK & MM work for läuft GmbH, a consulting company for the application of behavioural insights in health. The authors have no competing interests to declare.

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